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NEWS

Shri Manohar Lal assumes charge of Ministry of Power



Shri Manohar Lal, Union Minister of Power

New Delhi, India: Shri Manohar Lal has taken charge as Union Minister of Power in addition to his existing portfolio of Minister of Housing and Urban Affairs at Shram Shakti Bhawan. Shri Pankaj Agarwal, Secretary, Ministry of Power, along with the senior officials of ministry welcomed the Minister. Shri Raj Kumar Singh, former Minister of Power, extended a warm welcome to his successor. Shri Shripad Yesso Naik, Minister of State in the Ministry of Power, was also present at the occasion. The Union Minister was briefed by senior officials of the Minister of Power and after taking the charge, he also took a review meeting regarding the power supply position in the country. *(Source: PIB)*

Shri Hardeep Singh Puri takes charge as Minister of Petroleum and Natural Gas



Shri Hardeep Singh Puri, Minister of Petroleum and Natural Gas

New Delhi, India: Shri Hardeep Singh Puri has officially taken charge as the Minister of Petroleum and Natural Gas. After taking charge as Minister of Petroleum and Natural Gas, Shri Hardeep Singh Puri said that India under the visionary leadership of Prime Minister Shri Narendra Modi successfully navigated the energy trilemma of energy availability, affordability and sustainability.

Speaking about exploration and production, Shri Puri said that oil production from the 98/2 well will increase to 45,000 barrels per day very soon and gas production will also start soon. "For western offshore, ONGC has already floated a tender to get an international technology partner. All international oil and gas majors having an annual revenue above 75 billion USD have been invited to participate in this tender," he added.

Reiterating government's commitment to achieve 20 per cent ethanol blending target by 2025, the Minister said,

Ramesh Babu V takes oath as Member in CERC



Ramesh Babu V. has taken oath of office and secrecy as Member, Central Electricity Regulatory Commission, on May 21, 2024.

Ramesh Babu V. holds M. Tech Degree in Thermal Engineering and B. Tech degree in Mechanical Engineering. He held the post of Director (Operations), NTPC from May 2020 till his retirement, before which he served in various positions in NTPC.

The Central Electricity Regulatory Commission (CERC) is the Central Commission for the purposes of the Electricity Act, 2003 which has repealed the ERC Act, 1998.

"In the month of May only, we were able to cross 15 per cent of ethanol blending."

Highlighting the government's dedication to integrating green hydrogen in the refining process, Shri Puri said that green hydrogen plants at refineries in Panipat (10 KTA), Mathura (5 KTA), and Paradeep (10 KTA) will be installed soon. "First green hydrogen plant (10 MW) was commissioned on 27th May 2024, even as elections were on. Many of our Oil PSUs are in the process of issuance of tender for supply of green hydrogen. Green hydrogen station at Kochi has been commissioned for bus plying from Kochi Airport," he added.

Talking about upcoming projects in refining sector, Shri Puri, said that BPCL is in advanced stage to set up greenfield refineries and GAIL is also planning an ethane cracker unit for petrochemicals. "BPCL's Bina refinery is coming up and Cauvery Basin Refinery is also coming up by IOCL at Chennai," he added. (*Source: PIB*)

Haldia Petrochemicals signs naphtha supply agreement with QatarEnergy

Kolkata, India: Haldia Petrochemicals Limited (HPL) has announced a strategic agreement with QatarEnergy, for long-term naphtha supply. As per the agreement, QatarEnergy will supply a total of up to two million tons of naphtha to HPL (through its 100 per cent subsidiary, HPL Global Pte Limited, Singapore) over the next ten years, starting from the second quarter of 2024.

The long-term agreement was executed by HPL Global Pte Ltd. and QatarEnergy, for and on behalf of Qatar

Petroleum for the Sale of Petroleum Products Company Ltd. (QPSPP) representing the largest commitment undertaken between the two companies.

Commenting on this agreement, His Excellency Saad Sherida Al-Kaabi, the Minister of State for Energy Affairs, the President, and CEO of QatarEnergy, said, "We are pleased to sign this agreement, which reaffirms our continued commitment to be part of India's economic growth trajectory. We take great pride in the longstanding exemplary relationship between our respective entities and between the State of Qatar and the Republic of India."

Speaking about the agreement, Dr. Purnendu Chatterjee, Chairman, HPL, said, "We are pleased to announce this landmark strategic agreement with QatarEnergy. This will further strengthen HPL's long-standing partnership with Qatar Energy, one of our key partners in this journey of growth. This landmark agreement resonates with HPL's continuous efforts towards business development and strategic investment to fulfil the demands of our customers worldwide, maintaining the quality of the products HPL has always been known for."

Cairn Oil & Gas commences commercial ASP injection in Mangala oil field

New Delhi, India: Cairn Oil & Gas, India's largest private oil and gas exploration and production company, part of Vedanta Group, has announced the implementation of Alkaline Surfactant Polymer (ASP) flooding in the Mangala oil field in Barmer, Rajasthan.

Kartikeya Dube takes over as India unit chief of BP



Kartikeya Dube is the new India unit *chief at global energy player, BP* with effect from 01 July 2024.

Dube has been with BP for more than 20 years, serving in finance, commercial and business transformation in India, Singapore and the UK. Last year, he assumed the position of Vice President of Group Investor Relations in the company's London head office.

Previously, he was involved with setting up the BP joint ventures with Reliance in India. He was the Chief Financial Officer for BP's mobility joint venture with Reliance in India from 2020 until 2023.



ASP injection facility inauguration at Cairn Oil and Gas.

ASP is one of the most unique Enhanced Oil Recovery methods where polymer and surfactants are injected into the matured fields to increase recovery. The injection of ASP allows an increase in recovery in matured fields by up to 60 per cent using polymers and surfactants, instead of just 40 per cent using polymers alone.

Cairn implemented this largest commercial injection at the MWP-1 and 19 ASP project site in the Mangala field. The efforts are expected to yield about 20 per cent additional oil recovery in the targeted area. Moving forward, this technology will be expanded to other fields in the Rajasthan block.

Dr. Steve Moore, Deputy Chief Executive Officer, Cairn Oil & Gas, Vedanta, said, "In line with our commitment to boost India's domestic oil and gas production, we are proud to pioneer the implementation of ASP flooding technology in our flagship Mangala oil field."

Saatvik Solar partners with Bhasu Energy System



Team members from Saatvik Solar and Bhasu Energy System during the signing of the agreement.

New Delhi, India: Saatvik Solar, one of the leading solar photovoltaic (PV) module manufacturing brand, in the renewable energy sector, has entered into a strategic alliance with Bhasu Energy System LLP to bolster the promotion and distribution of solar PV modules across Telangana.

Under this collaboration, Bhasu Energy System LLP will serve as a dedicated channel partner for Saatvik Solar, leveraging its extensive network and expertise to enhance the accessibility of solar PV modules throughout Telangana. By joining hands with Bhasu Energy System LLP, Saatvik Solar aims to amplify its market presence and cater to the growing demand for renewable energy solutions in the state.

Commenting on the partnership, Mr. Pushpendra Samadhiya, National Head Sales & Marketing, Saatvik

Saatvik Solar appoints Kuldeep Jain as COO



Saatvik Solar, one of the leading manufacturers of solar modules and providers of solar Engineering Procurement and Construction (EPC) and Independent Power Producer (IPP) services, has appointed **Kuldeep Jain as Chief Operating Officer (COO)** for their Solar EPC & IPP projects.

Kuldeep Jain as COO for EPC projects heralds a new era of expertise and leadership in the renewable energy sector. With an illustrious career spanning over 39 years, Jain's vast experience encompasses a spectrum of verticals such as Solar PV, Solar RESCO, Solar Thermal, Marine and Indian Navy Projects, Fuel/Gas-based Power Plants, Hydro Power, and Piping Projects across India, the Middle East, and African regions. His distinguished track record includes leadership roles with prominent organizations such as Lanco, Astonfield, Vikram Solar, Sangam Renewables Ltd and Azure Power. He has also served in renowned firms such as BST MFG Limited (Raunaq Group), Triveni Engineering Works Limited and Warstila India/Finland. Solar expressed optimism about the collaboration's potential to drive positive change in Telangana's energy landscape. "We are delighted to join forces with Bhasu Energy System LLP in our endeavour to promote sustainable energy practices and expand our market reach in Telangana. By combining our strengths and resources, we are confident in our ability to empower more communities and businesses with reliable solar solutions," added Mr. Samadhiya.

Honeywell Naphtha technology set to boost energy efficiency

New Delhi, India: Honeywell has announced a transformational new naphtha to ethane and propane (NEP) process that will enable regions across the world to improve the efficiency of light olefin production and lower CO₂ emissions per metric ton of olefin produced.

The NEP technology generates a tunable amount of ethane and propane from naphtha and/or LPG feedstocks. In a typical NEP-based olefin production complex, the ethane will be fed to an ethane steam cracking unit and the propane will be fed to a propane dehydrogenation unit. This approach generates more high-value ethylene and propylene with reduced production of lower-value by-products compared to a traditional mixed-feed steam cracking unit directly processing the same quantity and composition of feedstock.

"The petrochemical industry faces strong competition and challenges in obtaining raw materials globally," said Mr. Matt Spalding, Vice President and General Manager of Honeywell Energy and Sustainability Solutions in MENA. "Our technology helps to enable more efficient production of ethylene and propylene, two chemicals which are in high demand, while also helping our customers lower their carbon emissions."

This new solution is a part of Honeywell's Integrated Olefin Suite technology portfolio – a first-of-its-kind in the industry that creates differentiated offerings to enhance the production of light olefins.

Shri Pralhad Joshi assumes charge of Ministry of New and Renewable Energy, Shri Shripad Yesso Naik takes charge as Minister of State



New Delhi, India: Shri Pralhad Joshi took charge as Union Minister of New and Renewable Energy in addition to his portfolio of Minister of Consumer Affairs, Food and Public Distribution, at Atal Akshaya Urja Bhawan. Shri

Waaree Energies appoints Amit Paithankar as CEO



Waaree Energies Ltd has announced the appointment of **Amit Paithankar** as its new **Chief Executive Officer (CEO).** In his new role, Paithankar will strive to utilize his experience and leadership to drive the company to grow in the renewable energy sector. He intends to onboard expertise to drive Waaree Energies Ltd towards sustainable innovation.

Before joining Waaree, he was associated as Managing Director (South Asia) with Emerson Electric Co. (India) Pvt. Ltd., among other roles. His educational background, includes a Ph.D. in Electrical Engineering and a Master of Business Administration. Shripad Yesso Naik also assumed charge as the Minister of State in the Ministry of New and Renewable Energy. Secretary, Ministry of New and Renewable Energy, Shri Bhupinder Singh Bhalla, along with senior officials of the ministry welcomed the ministers.

Speaking to the media, the Union Minister Sh. Pralhad Joshi emphasized the critical importance of the renewable energy sector for ensuring India's energy security and outlined the vast potential for growth in this field. He also underscored the government's commitment in advancing renewable energy initiatives to meet the country's rising energy demands and environmental goals. (*Source: PIB*)

Suresh Gopi takes charge as Minister of State for Ministry of Petroleum and Natural Gas



The Minister of Petroleum & Natural Gas, Shri Hardeep Singh Puri, extending a warm welcome to Shri Suresh Gopi

New Delhi, India: Shri Suresh Gopi, Member of Parliament from Thrissur, Kerala, has officially taken charge as the Minister of State for the Ministry of

Petroleum and Natural Gas. Shri Gopi, who has been an influential figure in various fields, steps into this role following his predecessor, Shri Rameswar Teli. The Minister of Petroleum & Natural Gas, Shri Hardeep Singh Puri, extended a warm welcome to Shri Gopi.

Born on June 26, 1958, in Alappuzha, Kerala, Gopi has had a distinguished career both in the entertainment industry and public service. He holds a Bachelor of Science degree in Zoology and a Master of Arts degree in English Literature from Fatima Mata National College in Kollam. (Source: PIB)

Ministry of New and Renewable Energy organises 'Global Wind Day 2024' event



Minister of State of Power and New & Renewable Energy Shri Shripad Yesso Naik addressing the gathering during Global Wind Day event

New Delhi, India: The Ministry of New and Renewable Energy (MNRE) organised 'Global Wind Day' on the 15th of June 2024, aimed at celebrating the glorious success of Indian Wind Sector so far and also discussing the potential

Grew Energy appoints Hardip Singh as COO



Solar manufacturer and services provider, **Grew Energy Pvt Ltd**, has announced appointment of **Hardip Singh as the Chief Operations Officer (COO) - Modules Business.**

With an extensive career spanning over 37 years, Singh will oversee sales and operations of Grew's module business. His rich experience across domains like manufacturing, sales and marketing, distribution, planning and operations will drive growth and expansion of the modules business.

Sharing his thoughts, Hardip Singh, COO, Grew Energy, said, "I am excited to join Grew when it is aggressively working towards achieving its ambitious plans of completing a total of 6GW of modules manufacturing capacity. Being a part of Grew's growth story will be personally fulfilling for me." way forward for accelerating wind energy adoption in India. With a central theme of 'Pawan–Urja: Powering the Future of India', the event successfully conducted panel discussions around the 'Role of Wind Energy in Meeting the Power Demand', 'Accelerating Onshore Wind Energy Adoption in India' and 'Offshore Wind Development in India: Bolstering India's Energy Security'.

The event discussed the production potential, challenges, and feasible way forward to enhance the wind energy generation capacity which is essential to achieve the Nationally Determined Commitments (NDCs). Wind energy is crucial to India's efforts in achieving 50 per cent of its electric power installed capacity from non-fossil fuel-based energy resources by 2030 and net zero by 2070.

The Minister of State of Power and New & Renewable Energy Shri Shripad Yesso Naik facilitated states of Gujarat, Karnataka, and Tamil Nadu for achieving highest wind capacity addition in the country during FY year 2023-24. In his inaugural address, the Union Minister called for collective action to achieve renewable energy targets, making India a leader in wind energy and creating a greener, brighter future for all.

Coal Ministry takes proactive measures for disposal and repurposing of fly ash



Fly Ash filling at abandoned quarry of Manikpur OC, Korba Area

New Delhi, India: The Ministry of Coal (MoC) is actively working to ensure the proper disposal and repurposing of fly ash generated by Thermal Power Plants (TPPs). Extensive research and development have enabled the effective use of fly ash for filling voids and as a component in construction materials.

A Central level Working Group (CLWG) under the chairmanship of Additional Secretary, Ministry of Coal was formed in 2023 for the same. The interested TPPs applies for the allocation of mine voids to the Central Electricity Authority (CEA), which is eventually discussed in the CLWG meeting. In this proactive move, a total of 19 mines have been allocated to 13 TPPs. This allocation addresses environmental concerns associated with fly ash disposal and promotes sustainable practices within the coal mining sector. Additionally, approximately 20.39 lakh tonnes of fly ash have been repurposed to date at Gorbicoal mine pit-1.

CG Power appoints Amar Kaul as MD and CEO



CG Power and Industrial Solutions has appointed **Amar Kaul** as the next **Managing Director & CEO** for five years with effect from 25 July 2024. He replaces the incumbent Managing director N Srinivasan.

Amar Kaul has over 30 plus years of total work experience, 12 years of which has been overseas. Kaul was in the executive leadership position leading Europe, Middle East, India and Africa (EMEIA) region for compression systems and services in Ingersoll Rand. He also served as the Chairman and Managing Director of Ingersoll Rand. Prior to this, he held senior leadership positions in Bharat Forge and Delphi. Kaul has proven ability to strategize, execute and manage high growth P&L and foster innovation across Engineering, Capital Goods sector, Automotive Industry, sectors that are important to CG Power.

NEWS

As per Ministry of Environment, Forest and Climate Change notification dated 3rd November 2009, the term "fly ash" means and includes, all ash generated such as Electrostatic Precipitator (ESP) ash, dry fly ash, bottom ash, pond ash and mound ash. Its composition, rich in silicon dioxide (SiO₂), calcium oxide (CaO), and aluminum oxide (Al₂O₃), makes it valuable for various applications, transforming potential waste into useful material. Effective management promotes its use in construction activities, thereby minimizing waste, conserving natural resources, and reducing the carbon footprint.

The MoC, in collaboration with the Central Mine Planning and Design Institute (CMPDI), is in the process of creating a centralized portal to manage the application process for the allocation of mine voids to TPPs for fly ash backfilling activities.

Comprehensive feasibility studies are being conducted to explore the optimal methods for mixing fly ash with overburden in operational mines. Standard Operating Procedures (SoPs) have been established to guide the safe and efficient use of fly ash, addressing both safety and administrative considerations. A significant feasibility study is underway at the Nigahi operational mine in collaboration with the Central Institute of Mining and Fuel Research (CIMFR). This study aims to determine the optimal percentage of fly ash to be mixed with overburden, with results expected soon. (Source: PIB)

New & Renewable Energy Secretary addresses World Hydrogen Summit 2024, highlights India's vision and capabilities in RE and Green Hydrogen

New Delhi, India: Secretary, Ministry of New & Renewable Energy, Government of India, Shri Bhupinder Singh Bhalla addressed the World Hydrogen Summit 2024 in Rotterdam, Netherlands on May 15, 2024, highlighting India's strategic vision and capabilities in the domain of Renewable Energy (RE) and green hydrogen production.

Mr. Bhalla underscored the comprehensive nature of the National Green Hydrogen Mission, comprising components such as pilot projects, research and development (R&D) initiatives, and skill development programs.

Mr. Bhalla reiterated India's position as a global leader in renewable energy affordability, emphasizing the nation's



Secretary, Ministry of New & Renewable Energy, Shri Bhupinder Singh Bhalla, addressing the World Hydrogen Summit 2024 in Rotterdam, Netherlands

low cost of renewable energy. He highlighted India's integrated grid infrastructure as a key enabler for the seamless integration of renewable energy sources into the national energy mix. He told the Summit audience that this integrated grid not only enhances grid stability and reliability but also enables the strategic placement of renewable energy plants, optimizing efficiency and minimizing the need for long-distance transportation and storage of hydrogen.

He highlighted India's ambition to emerge as a leading exporter of green hydrogen. Asserting India's clear vision and commitment to sustainable energy practices, he underscored the nation's determination to play a pivotal role in the global hydrogen economy.

He assured the World Hydrogen Summit delegates of India's capability to meet any scale of production demand for green hydrogen, provided there is sufficient market demand and support. This confidence stems from India's robust renewable energy deployment strategy, as outlined in its Nationally Determined Contributions (NDC). Highlighting the rapid scale-up of renewable energy infrastructure in the country, the Secretary informed the audience that approximately 43 per cent of India's current installed electricity capacity is from nonfossil-fuel sources, with projections indicating a rise to 50 per cent by 2030.

The Secretary's keynote address showcased India's leadership, ambition, and capabilities in the domain of renewable energy and green hydrogen production. He pointed out that with a strong emphasis on affordability, infrastructure development, skilled personnel, ambition, and scalability, India is poised to emerge as a key player in shaping the global hydrogen economy and advancing sustainable energy solutions on a global scale. He said that the National Green Hydrogen Mission stands as a testament to India's commitment to fostering innovation and collaboration towards a greener and more sustainable future. (*Source: PIB*)

25th PM-STIAC meeting discusses CCUS and Carbon Credit in India



Dignitaries during the 25th Prime Minister's Science, Technology & Innovation Advisory Council meeting

New Delhi, India: The 25th Prime Minister's Science, Technology & Innovation Advisory Council (PM-STIAC) meeting was held on 09 July 2024 at Vigyan Bhawan Annexe in New Delhi and chaired by Professor Ajay Kumar Sood.

Along with the PM-STIAC members, the meeting brought together key government officials and industry players to discuss robust policy formulation for effective Carbon Capture, Utilization, and Storage (CCUS) in India. They discussed the reports prepared by inter-ministerial technical committees constituted by NITI Aayog's Advisory Committee on developing a policy framework for implementing CCUS initiatives in India. The meeting also discussed India's carbon market and carbon credit scheme to reduce emissions, pursue a low-carbon path, and provide market support for mitigation methods and technologies.

India has set a target to achieve a 45 per cent reduction in emission intensity by 2030 and is aiming for Net Zero by 2070. This makes CCUS one of the important measures to achieve decarbonization from the hard-to-abate sectors.

The meeting was joined by Dr. V.K. Saraswat, Member S&T, NITI Aayog, Scientific Secretary Dr. Parvinder Maini, Office of the Principal Scientific Adviser to the Government of India and the Secretaries of all relevant departments including Secretary (Power) Shri Pankaj Agarwal; Secretary (Department of Chemicals and Petrochemicals) Ms. Nivedita Shukla Verma; Secretary (Earth Sciences) Dr. M Ravichandran; Secretary (Coal) Shri Amrit Lal Meena; Chairman (Indian Space Research Organisation) Dr. S. Somanath; Chairman (Defence Research and Development Organisation) Dr. Samir V Kamat; Secretary (Biotechnology) Dr. Rajesh Gokhale; and Secretary (Department of Health Research) Dr. Rajiv Bahl.

Representatives from the Ministry of Environment, Forests & Climate Change, the Department of Scientific and Industrial Research, the Ministry of Steel, and the National Council of Cement and Building Materials also participated in the meeting.

In his opening address, Prof. Sood highlighted the government's prioritisation of CCUS as a solution for CO₂ emission reduction. He discussed the opportunities for widespread adoption and large-scale deployment of CCUS technologies, focusing on economic feasibility, supportive policy measures, institutional arrangements, and technological feasibility for installing CCUS projects in industries like Power, Iron & Steel, Cement, and Chemicals. He also emphasized the role of carbon markets in promoting CCUS by exploring options such as pricing on carbon emissions and driving investments in emission reduction technologies among others.

Dr. V.K. Saraswat, Member S&T, NITI Aayog noted that technical committees were established by NITI Aayog for adopting CCUS technologies. He highlighted the need for prioritizing R&D, regulatory framework and the way forward to large-scale capacity plants. He asserted the significance of the carbon credit market, suggesting measures such as incentivization to industry to foster its development. Additionally, Dr. Saraswat recommended that hub and cluster approach may be adopted for development of the CCUS ecosystem in the country.

The first session of the meeting commenced with the presentation by Mr. Rajnath Ram, Advisor/Head, Energy, NITI Aayog outlining the findings of the inter-ministerial technical committees' reports on four identified areas of CO_2 capture; CO_2 utilisation; CO_2 transportation and storage; and safety and technical standards development. He highlighted the need for the formulation of the CCUS policy framework in India.

Representative from the Department of Science and Technology and Dr. Vikram Vishal, Professor, Department

of Earth Science, IIT Bombay presented the various initiatives in the R&D sector of the CCUS landscape. They highlighted the R&D interventions and the Government of India's support aimed at promoting CCUS in India.

In the second session, the Bureau of Energy Efficiency presented on the Indian carbon market and carbon credit scheme.

After the presentations, the Chair invited interventions from the representatives of the inter-ministerial technical committees. It was discussed that there is a need to identify adoptable technologies and life-cycle assessment of CCUS projects. It was also discussed that while standards for carbon capture and storage are in place, standards for carbon utilisation and transportation are being developed.

Thereafter, Secretaries and representatives of ministries gave their inputs on how various ministries and departments of Government of India can work together to address this important issue. It was suggested that a national portal for CCUS projects may be developed to bring all stakeholders on a common platform.

During their interventions, the PM-STIAC members emphasized the need for institutional mechanisms for CCUS R&D, implementation, and policy framework. Further, community awareness and outreach for CCUS were emphasized. The need for mapping of emission data was also discussed.

Coal Sector achieves remarkable growth of 10.2% in May 2024

New Delhi, India: The coal sector has demonstrated highest growth of 10.2 per cent (provisional), following the electricity industry among the eight core industries for the month of May 2024 as per the Index of Eight Core Industries (ICI)) (Base Year 2011-12) released by Ministry of Commerce & Industries. The index of coal industry has reached 184.7 points during May 2024 as compared to 167.6 points during the same period of last year and its cumulative index has increased by 8.9 per cent during April to May 2024-25 over corresponding period of the previous year.

The ICI measures the combined and individual production performance of eight core industries, viz. cement, coal, crude oil, electricity, fertilizers, natural gas, refinery products, and steel. The Combined Index of Eight Core Industries experienced a notable 6.3 per cent increase in May 2024, compared to the same period of previous year, underscoring the coal sector's substantial contribution to overall industrial expansion. The driving force behind this remarkable growth can be attributed to a significant surge in coal production during May 2024, with output reaching an impressive 83.91 million tonnes, marking a remarkable increase of 10.15 per cent compared to the same period in the previous year. This surge in production underscores the sector's capacity to meet growing demand of energy and manufacturing industries.

Centre issues Scheme Guidelines for funding of testing facilities, infrastructure, and institutional support under the National Green Hydrogen Mission

New Delhi, India: The Government of India has come out with guidelines for funding of testing facilities, infrastructure, and institutional support for development of Standards and Regulatory framework under the National Green Hydrogen Mission.

The scheme will support identification of the gaps in the existing testing facilities for components, technologies, and processes in the value chain of Green Hydrogen and its derivatives. The scheme will support creation of new testing facilities and upgradation of existing testing Facilities to ensure safe and secure operations.

The scheme will be implemented with a total budgetary outlay of ₹200 crore till the financial year 2025-26. The National Institute of Solar Energy (NISE) will be the Scheme Implementation Agency (SIA).

The scheme encompasses the development of robust quality and performance testing facilities to ensure quality, sustainability, and safety in GH₂ production and trade.

The National Green Hydrogen Mission was launched on 4th January 2023, with an outlay of ₹19,744 crore up to FY 2029-30. It will contribute to India's goal to become *Aatma Nirbhar* (self-reliant) through clean energy and serve as an inspiration for the global Clean Energy Transition.

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BPCL plans mega expansion

New Delhi, India: Bharat Petroleum Corporation (BPCL) is planning to invest ₹1.7 lakh crore over the next five years to focus on core segments of oil refining, fuel marketing and petrochemical business as well as hydrogen as clean energy. Of this, ₹75,000 crore has been earmarked for refineries and petrochemicals.

The company is planning to take up strategic pipeline projects with a total investment of ₹8,000 crore, out of which projects worth Rs5,000 crore have already been identified. It will further invest more than ₹20,000 crore in marketing business. The company has also earmarked investment to the tune of ₹32,000 crore in upstream production, mainly in Mozambique and Brazil. In addition, it will invest ₹25,000 crore on gas business, and Rs10,000 crore on green energy business.

BPCL is planning to expand refining capacity to 45 MTPA by March 2029 from its current 35.3 million tonne. The capacity addition would be majorly done at Bina refinery in Madhya Pradesh, which is being expanded to 11 million tonne from the existing 7.8 million tonne. Meanwhile, smaller capacity additions through debottlenecking are planned at Mumbai and Kochi refineries.

The clean energy business will comprise producing green hydrogen 30,000 tpa by 2030. It will also conduct pilots for green hydrogen fuelled mobility and other application. The company is also planning to set up 26 compressed biogas plants sometime soon.

ONGC, EverEnviro enter JV to build 10 CBG plants



Team members of EverEnviro and ONGC during the signing of MoU.

New Delhi, India: Energy Maharatna, ONGC and EverEnviro Resource Management Pvt. Ltd., a leading developer of compressed biogas (CBG) in India have

formed a joint venture (JV) to set up 10 CBG plants across India. The two firms have inked a Memorandum of Understanding (MoU) for the same.

The 50:50 JV between ONGC and EverEnviro aligns with the Government of India's initiatives, including the Global Bio-Fuels Alliance and the ambitious goal of achieving Net Zero carbon emissions by 2070. By harnessing diverse feedstocks such as agri-waste, agro-industrial waste, energy crops, and municipal solid waste (MSW), the partnership aims to mitigate approximately 7.5 lakh tonnes of CO₂ equivalent annually.

Mr. Satyan Kumar, Executive Director, Chief Corporate Strategy, ONGC, said, "ONGC has set sights on being Net Zero by 2038 and hence we recognize the urgency of transition to clean energy by utilizing agro-industrial waste and municipal solid waste. Our partnership with EverEnviro in establishing CBG plants will significantly contribute to mitigating carbon emissions."

Mr. Deepak Agarwal, Executive Director, BD and Strategy, EverEnviro said, "Our collaboration with ONGC, represents a significant milestone in our journey towards advancing renewable energy production in India. We are confident that our partnership will make a substantial impact in the CBG sector."

GAIL India to set up ethane cracking unit in MP

New Delhi, India: GAIL (India) is planning to invest up to ₹50,000 crore to build a 1.5 million tpa ethane cracking unit at Sehore in Madhya Pradesh. The new facility is expected to help the natural gas company meet the domestic petrochemicals' demand. The new facility is in the planning stage and would nearly double GAIL's existing 810 KTA (thousand tonne per annum) petrochemicals facility in Pata near Kanpur in Uttar Pradesh. It is likely to come up in the next five to six years.

Engineers India is working on the detailed feasibility report for the project. GAIL is planning to import ethane, as a petrochemical feedstock and transport it through its pipeline systems to demand centres.

The company recently signed a tripartite memorandum of understanding (MoU) with ONGC, and Shell Energy India to explore opportunities for imports. The MoU would also explore the development of evacuation infrastructure at Shell Energy Terminal, Hazira.

NHPC, Ocean Sun sign MoU



Team members of NHPC and Ocean Sun, during the signing of the MoU.

New Delhi, India: NHPC Limited, the largest organization for hydropower development in India, has signed a Memorandum of Understanding (MoU) with Ocean Sun, a Norwegian company operating as a technology provider to the floating solar industry. As per the MoU, NHPC and Ocean Sun will explore key areas of cooperation for demonstration of Ocean Sun's floating solar energy technology based on photovoltaic panels. The panels would be mounted on hydro-elastic membranes, at relevant sites to be identified by NHPC.

The agreement is in continuation of efforts towards sustainable development and addition of renewable energy capacity by NHPC, which is engaged not only in hydro power development but also in various renewable energy projects such as solar, wind and green hydrogen projects.

The MoU was signed in hybrid mode by Mr. V.R. Shrivastava, Executive Director (REGH), NHPC and Mr. Kristian Tørvold, CEO, Ocean Sun in the august presence of H.E. Ms. May-Elin Stener, Ambassador of Norway to India, Mr. Raj Kumar Chaudhary, Director (Technical), NHPC and Mr. Rajat Gupta, Executive Director (SBDC), NHPC at Embassy of Norway, New Delhi and H.E. Dr. Acquino Vimal, Ambassador of India to Norway, Oslo on 29th April 2024.

SAIL-Bhilai to install floating solar plant in Chhattisgarh

New Delhi, India: Bhilai Steel Plant (BSP), the arm of Steel Authority of India (SAIL), will be installing the state's first 15 MW floating solar project at its Maroda-1 reservoir in Chhattisgarh. The solar plant will be set up in Durg district. The project is being implemented through NTPC-SAIL Power Supply (NSPCL), a 50:50 joint venture (JV) company of National Thermal Power Corporation (NTPC) and SAIL.

The Maroda reservoir is spread across 2.1 sq. km, with a water storage capacity of 19 cubic mm. The water stored in the Maroda-I reservoir not only feeds the plant but also the township. The total green power generation estimated from this plant is likely to be about 34.26 million units annually, which will be consumed by BSP as captive power. The project is expected to reduce the CO_2 emission of BSP by 28,330 tonne annually. The project is scheduled to be completed by next year.

JSW Group revises investment target to US\$70 bn

Mumbai, India: The JSW Group has revised its investment target to US\$70 billion by 2030 from its US\$65 billion investment announced in 2023. The new investment includes US\$ five billion investment in electric vehicle (EV) projects in Odisha announced in February this year.

The project in Odisha comprises a 50 GWh EV battery plant, EVs, lithium refinery, copper smelter and related component manufacturing units. The Group is also planning to expand its capacity in steel, cement and electricity generation verticals.

Adani Green secures US\$400 million for 750 MW power projects

Ahmedabad, India: Adani Green Energy Ltd (AGEL), one of the world's leading renewable energy (RE) companies, has announced US\$400 million financing for its underconstruction 750 MW solar projects in Rajasthan and Gujarat by a consortium of five leading international banks. It will provide financing for projects that are expected to come online from November 2024 onwards.

One of the projects is being developed in Rajasthan with 500 MW capacity and has a long-term power purchase agreement (PPA) with the Solar Energy Corporation of India (SECI). The second one, with 250 MW capacity, is a

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standalone merchant power project being implemented at the world's largest RE cluster at Khavda in Gujarat.

The US\$400 million construction facility along with the funding solutions also provides the syndicated guarantee-backed assurance program in sync with AGEL's procurement strategy. The transaction paves the way for a sustainable debt structure, developed as part of AGEL's capital management plan, for financing merchant exposure. It marks a milestone for the Indian RE sector as it steers the industry's transition to the next phase of market integration, with the commitment to deliver the low-cost green electrons through promotion of merchant market projects with right financing structure demonstrating overall trust and competitiveness for the Indian renewable energy sector to drive clean energy transition and decarbonisation.

Avaada Energy secures green financing for new solar project in Gujarat

Mumbai, India: Avaada Energy, the renewable energy arm of Avaada Group, has secured Green Financing of about ₹1,190 crore (~USD 143 million) from India's largest public sector lender, the State Bank of India (SBI).

This financing will support the development of a 400 MWp utility-scale solar PV power project in the Surendra Nagar district of Gujarat. The entire power generated from the project will be procured by Gujarat Urja Vikas Nigam Limited (GUVNL), an apex body of the Government of Gujarat engaged in the bulk purchase and sale of electricity.

The financing from SBI, sanctioned and disbursed as a 20-year project loan facility, was obtained at competitive terms, showcasing Avaada's strong project financing capability.

Mr. Vineet Mittal, Chairman of Avaada Group, said, "This partnership not only reflects our strategic vision to build a diverse and high-quality portfolio of energy transition assets but also highlights the trust and commitment of leading financial institutions to support renewable energy projects with stable, long-term cash flows."

SJVN inaugurates first multi-purpose green hydrogen pilot project

New Delhi, India: SJVN Limited has achieved a significant milestone with the inauguration of India's first multipurpose (combined heat and power) green hydrogen

pilot project at SJVN's 1,500 MW Nathpa Jhakri Hydro Power Station (NJHPS) in Jhakri, Himachal Pradesh. The green hydrogen produced from the project will be utilized for High Velocity Oxygen Fuel (HVOF) Coating Facility of NJHPS for meeting its combustion fuel requirements. In addition, it will also generate electricity through its fuel cell of 25 kW capacity.

The state-of-the-art Green Hydrogen Pilot Project is set to produce 14 kilograms of Green Hydrogen daily during eight hours of operation. The hydrogen produced will be stored at a pressure of 30 bars, in six storage tanks, with a total storage capacity of 12 m³. The project will produce hydrogen using alkaline electrolyzer of 20 Nm³/ hour capacity, which would be powered by renewable energy supplied from 1.31 MW Solar Power Plant of SJVN in Wadhal, Shimla.

Tata Power Renewable Energy signs PPA with SJVN Limited

New Delhi, India: Tata Power Renewable Energy Limited (TPREL), a leading entity in India's renewable energy landscape and a subsidiary of Tata Power Company Limited, has signed a Power Purchase Agreement (PPA) with SJVN Limited (SJVN), an Indian Public Sector Undertaking (PSU), for a 460 MW Firm and Dispatchable Renewable Energy (FDRE) project.

The plant, designed to meet the 460 MW FDRE requirement, integrates solar, wind, and battery storage technologies to ensure efficient energy dispatch during peak hours, thereby stabilizing the grid. FDRE enables round-the-clock power supply, assisting Distribution Companies (Discoms) in fulfilling Renewable Purchase Obligations (RPO) and Energy Storage Obligations (ESO).

The plant is anticipated to generate approximately 3,000 MUs of power while offsetting around ~2,200 Mn Kgs of CO_2 emissions annually. With addition, the total renewables capacity of TPREL has reached 9,421 MW (PPA capacity is 7,978 MW) including 4,906 MW projects under various stages of implementation.

Mahindra Susten to invest Rs 21,000 cr in five years, build RE portfolio

New Delhi, India: Mahindra Susten, the renewable energy arm of the Mahindra Group, is planning to invest ₹21,000 crore over the next five years to develop a renewable energy (RE) asset portfolio of nearly 5.5 GW. The company, with its partner Ontario Teachers' Pension

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Plan, has committed equity to build peak capacity in the next four to five years.

These renewable energy assets will constitute storage projects and round-the-clock (RTC) power projects. In January 2024, Mahindra Group and Ontario Teachers co-sponsored an infrastructure investment trust (InvIT) holding assets in the RE space. Sustainable Energy Infra Trust (SEIT) has raised primary capital of ₹1,365 crore as part of the initial offer of units and will help facilitate the growth capital to ₹21,000 crore.

Last month, the company entered the hybrid RE segment with a plan to set up a ₹1,200 crore, 150 MW solar wind energy project in Maharashtra. The project includes the installation of 101 MW wind and 52 MW solar capacity. The facility is expected to generate 460 million kWh of clean energy, with the potential to offset 420,000 tonne of carbon dioxide emissions.

The company, which builds solar projects for other developers, has built about 1,540 megawatts peak (MWp) of projects.

CVPPL to set up Greenfield Hydroelectric Project



The agreement was signed in the presence of Managing Director, Mr. Ramesh Mukhiya; General Manager (C&P), Mr. Vasant Hurmade; and General Manager (Finance), Mr. Sanjay Kumar Gupta from Chenab Valley Power Project Private Limited (CVPPPL), and Deputy General Manager, Mr. Pramod Kumar Soni; and Deputy General Manager, Mr. Rishabh Jain from REC Limited.

New Delhi, India: REC Limited, a Maharatna Central Public Sector Enterprise and leading NBFC under the Ministry of Power, has signed an agreement with Chenab Valley Power Project Private Limited (CVPPPL), under which REC will provide CVPPL with a financial assistance of ₹1,869.265 crore as term Ioan. The Ioan will be utilized for development, construction and operation of the

Greenfield 4 x 156 MW Kiru Hydro Electric Project on River Chenab, in Kishtwar district of Jammu and Kashmir.

The 624 MW Kiru Hydro Electric Project is a run-of-river scheme, which envisages construction of dam of height 135 metres and an underground Power House with 4 units of 156 MW each

Gensol Engineering bags additional 250 MW for GUVNL's Battery Energy Storage Project

Mumbai, India: Gensol Engineering Ltd, one of the leading companies in solar power engineering, procurement, and construction (EPC) services and electric mobility sector, has received the second tranche under greenshoe option allotment of 250 MW/500 MWh from Gujarat Urja Vikas Nigam Limited (GUVNL) for standalone Battery Energy Storage Systems (BESS) project to reach 500 MW / 1000 MWh. The project including first and second tranche will generate a total revenue of ₹2,685 crore over the 12-year Battery Energy Storage Purchase Agreement (BESPA) tenure.

The project will supply electricity on an 'On-Demand' basis to Gujarat State's DISCOMs during peak and off-peak hours, thereby extending renewable energy availability beyond solar hours, fulfilling energy storage purchase obligations, and enhancing grid resilience. The project once commissioned at two Gujarat Energy Transmission Corporation (GETCO) substations, will deliver 500 MW/1000 MWh energy for two charge/discharge cycles per day.

Commenting on Gensol's pivotal role sector's growth in India, Mr. Anmol Singh Jaggi, Managing Director, Gensol Engineering Limited, said, "We are proud to receive the second tranche under greenshoe option allotment from GUVNL taking our BESS order book to over ₹3,100 crore. Gensol is committed to supporting India's energy transition goals through innovative and sustainable solutions."



Biomass to Biofuels: Towards a Greener Future

GAURAV LUNAWAT

Assistant Director, Centre for High Technology Ministry of Petroleum & Natural Gas, Government of India

India is a pivotal player in the global energy landscape, balancing energy security and environmental sustainability amidst surging demand. From pellet co-firing to BioCNG production and novel applications like methanol production, the bioenergy sector in India is poised for transformative growth, driven by innovation and sustainability goals. By navigating the opportunities and challenges, India can chart a course towards a greener, more sustainable energy future, resonating across the global energy landscape.

ndia stands as a pivotal player in the global energy landscape, grappling with surging demand amidst pressing climate challenges. As the world's most populous nation and third-largest energy consumer, India's dynamic economy needs a balanced approach to energy security and environmental sustainability.

It was estimated that annually India has more than 750 million metric tonnes of available biomass from crops, with around 2/3 of the total biomass produced being used for domestic purposes and other purposes like cattle feeding, compost fertilizer, etc. The remaining portion, about 230 million tonnes has resulted as surplus biomass, equal to a potential of about 28GW, with further technological progress in new and existing projects, the total estimated potential for biomass power is about 42GW.

Despite hurdles such as demand-supply gaps, logistical constraints, and price sensitivity, there is optimism within the sector. Innovations in digital supply chains and technology, along with exploration of new markets, offer promising solutions. From pellet co-firing to BioCNG production and novel applications like methanol production, the bioenergy sector in India is poised for transformative growth, driven by innovation and sustainability goals.

Government initiatives such as the National Bioenergy Programme, the National Biofuels Policy, and the SATAT scheme, among others, exemplify India's commitment to promoting modern bioenergy solutions. Policy and regulatory frameworks play a pivotal role in facilitating bioenergy deployment. From financial incentives to awareness programs, the Indian government has instituted a set of comprehensive strategies to incentivize bioenergy projects and foster a conducive ecosystem for their development. By navigating the opportunities and challenges outlined in this document, India can chart a course towards a greener, more sustainable energy future, resonating across the global energy landscape.

A major milestone for the boost of biofuels in India was the formation of the Global Biofuels Alliance in the last G20 Summit held in 2023 in Delhi. The initiative aims to position biofuels as a key to energy transition.

Government on 08.03.2019, has launched Pradhan Mantri JI-VAN Yojana for providing financial support to Integrated Bioethanol Projects using lignocellulosic biomass and other Renewable feedstock with an aim to set up Second Generation (2G) ethanol projects across the country. Centre for High Technology, MoPNG is the Nodal agency for implementation of the scheme.

The financial outlay of the scheme is ₹ 1,969.5 crore. Under the scheme, 12 commercial projects and 10 demonstration projects will be supported. For commercial projects, the maximum financial support per project has been capped at ₹ 150 crore. For demonstration projects, the financial assistance will be limited to ₹ 15 crore per technology.

Under Request for Selection (RFS-I) financial assistance of 4 commercial plants (₹ 150 crore each) were approved by MoPNG (details in below table):

Major challenges in 2G Bioethanol Projects

2G bioethanol production involves the conversion of lignocellulosic biomass into ethanol through processes like enzymatic hydrolysis and fermentation. While 2G bioethanol has the potential to be more sustainable and less reliant on food crops compared to 1G bioethanol (produced from food crops like corn or sugarcane), there

PD	Location	Cap. (KLPD)	Feedstock	Plant Status
IOCL	Panipat, Haryana	100	Rice Straw	Commissioned
ABRPL	Numaligarh, Assam	185	Bamboo	Advance stage of Commissioning
HPCL	Bathinda, Punjab	100	Rice Straw	Advance stage of Commissioning
BPCL	Bargarh, Odisha	100	Rice Straw	Advance stage of Commissioning



are still several challenges associated with 2G bioethanol plants:

Biomass Feedstock Availability and Cost: Sourcing a consistent and reliable supply of lignocellulosic biomass can be challenging.

Biomass Quality: Major mechanical equipment involved in pre-treatment of Biomass works at optimum level, only at lower moisture composition in the biomass.

Feedstock Heterogeneity: Lignocellulosic biomass is diverse, and its composition varies based on factors like species, location, and time of harvest. This heterogeneity affects the efficiency of enzymatic hydrolysis and subsequent fermentation, leading to inconsistent ethanol yields.

Pre-treatment Challenges: Lignocellulosic biomass is highly complex and resistant to enzymatic degradation. Pre-treatment processes are required to break down its structure and make cellulose and hemicellulose more accessible to enzymes. **Lack of experienced vendors:** The technology which itself is at a nascent stage, has faced several issues from the package suppliers/vendors due to lack of expertise available.

Enzymatic Hydrolysis Efficiency: Efficient enzymatic hydrolysis of cellulose and hemicellulose to fermentable sugars is crucial for high ethanol yields. However, the enzymatic process can be slow, require high enzyme loading, and can be sensitive to feedstock variations.

Enzyme Cost: The cost of enzymes used for hydrolysis constitutes a significant portion of the overall production cost. Developing cost-effective enzymes that maintain their activity over extended periods is essential.

Fermentation Challenges: Fermenting lignocellulosic hydrolysates into ethanol can be complex due to the presence of inhibitory compounds generated during Pretreatment. These compounds can affect the growth and metabolism of microorganisms, reducing fermentation efficiency.



Water and Energy Usage: Bioethanol production processes, including pre-treatment, hydrolysis, and distillation, can be energy and water-intensive. Developing more efficient processes and recycling strategies is important to minimize the environmental footprint.

Economic Viability: The combination of high feedstock, enzyme, and operational costs, along with the fluctuating price of fossil fuels, can make 2G bioethanol production economically challenging, especially in comparison to cheaper 1G bioethanol.

Byproduct Valorization: As byproducts like Ash, Silica, Lignin, Syrup are formed, their purity is considered as a challenge for assured offtake/usage.

Major challenges in CBG Projects

- Availability and storage of feedstock throughout the year.
- Ensuring purity / quality of biomethane.
- Challenges in offtake due to lower quality of biomethane leading to low plant capacity utilization.

- Monetisation of Fermented Organic Manure which is a by-product.
- Plant CAPEX financing challenges.

Recommendations & Way forward:

Investment in Research and Development: Continued investment in R&D is essential to address technological challenges and optimize bioenergy processes, especially for second-generation ethanol production, biomass palletisation, and biogas upgrading technologies.

Enhanced Policy Support: Further policy interventions are needed to incentivize bioenergy adoption, including targeted subsidies, tax incentives, and regulatory frameworks that facilitate biomass procurement, storage, and transportation.

Strengthening Supply Chains: Developing robust supply chains for biomass feedstocks is critical, requiring collaboration between stakeholders, investment in infrastructure, and leveraging digital platforms for efficient biomass trading and aggregation. Efforts should focus on improving logistics, storage facilities, and market linkages to ensure reliable and sustainable biomass supply.

Capacity Building and Knowledge Sharing: Promoting capacity-building initiatives and knowledge-sharing platforms can enhance awareness, skills, and technical capabilities across the bioenergy value chain, fostering innovation and best practices adoption.

Market Diversification: Exploring new markets and applications for bioenergy, such as sustainable aviation fuels, industrial process heat, and clean cooking fuel solutions, can unlock additional growth opportunities and expand the sector's contribution to India's energy mix. ■





Biomass Biorefineries: Paving the Way to a Sustainable Economy

DR. SANGEETA SRIVASTAVA Executive Director Godavari Biorefineries Ltd

A key factor in the realization of a successful bio-based economy is the development of biorefinery systems allowing highly efficient and cost-effective agriculture and processing of biological feedstocks to a range of bio-based products with successful integration into existing infrastructure. Industry is increasingly viewing chemical and polymer production from renewable resources as an attractive area for investment.

The accelerated transformation towards a net zero circular economy is an ongoing growing trend towards the development of more sustainable production systems based on reliable and sustainable raw materials. One of the most promising alternatives is to use biomass feedstock obtained from crops, residues from agriculture, forestry, and other industry activities to produce a range of different products that could potentially replace products based on fossil fuels. For example, biomass is used to produce transport fuels (e.g., biogasoline or biodiesel) as well as polymer precursors (e.g., bioethylene). Similarly, electricity is obtained from direct combustion of biomass, with the option of using carbon capture technologies to further reduce carbon emissions and attain better environmental performance

Biomass-based products have better environmental footprint than their fossil-derived counterparts. Biogenic carbon sequestration during plant growth can potentially achieve carbon neutral life cycle emissions, or even carbon negative, when coupled with carbon capture and storage. Such advantages make bioproducts promising alternatives to conventional fossil-derived energy and products and the selective transformation of biomassderived platform chemicals into high-value chemicals has become one of the important topics of current economy.

A key factor in the realization of a successful bio-based economy is the development of biorefinery systems allowing highly efficient and cost-effective agriculture and processing of biological feedstocks to a range of biobased products with successful integration into existing infrastructure. Industry is increasingly viewing chemical and polymer production from renewable resources as an attractive area for investment. Within the bio-based economy and the operation of a biorefinery, there are significant opportunities for the development of bio-based building blocks and materials. The economic production of biofuels and biomaterials is often a challenge. The coproduction of chemicals, materials, food and feed can generate the necessary added value and the technology plays a very important role.

According to the technology used in the biomass conversion, biorefineries implement two main types of platforms, which can be used in a single or combined way: thermochemical platforms and biotechnological platforms. The main pre-processing and processing technologies used in biorefinery are:

- Mechanical processes, e.g., pressing, fractionation, and size reduction
- Chemical processes, e.g., acid hydrolysis, oxidation, and esterification
- Thermochemical processes, e.g., hydrothermal processing, pyrolysis, and gasification
- Biochemical processes, e.g., fermentation

Moreover, according to the number of feedstocks processed and the number of products produced, biorefineries are classified into phase I, phase II, and phase III. Phase I biorefineries use a single feedstock material to prepare a primary product, such as biodiesel biorefineries that produce biofuel from vegetable oils (Inamuddin et al., 2021), (Caullet and Le Nôtre, 2015) or from algae (Inamuddin et al., 2021; Konur, 2021). Phase II biorefineries carry out a set of processes to produce different products from a single feedstock material, for example, processing grain to produce ethanol and carbon dioxide (Kamm and Kamm, 2004). Phase III biorefineries produce multiple types of products from multiple feedstock materials through a diverse processing technology (Fernando et al., 2006).

Phase III biorefineries, there are four additional subgroups that are commonly mentioned:

- Whole-crop biorefinery (Koutinas et al., 2022), (Thongchul et al., 2022): Raw crops like corn and other grains are used as a feedstock material to produce value-added products.
- Green biorefinery (McEniy and O' Kiely, 2014): Natural-wet biomass such as cereals or grass are processed and transformed into marketable chemicals and fuels.

Within the bio-based economy and the operation of a biorefinery, there are significant opportunities for the development of bio-based building blocks and materials. The economic production of biofuels and biomaterials is often a challenge.

- Lignocellulosic biorefinery (De Bhowmick et al., 2018): Lignocellulosic biomass is converted into value-added products such as bio-oil, biochar, or other bio-based chemicals.
- **Two-platform concept biorefinery** (De Bhowmick et al., 2018; Buck et al., 2020): Both thermochemical and biochemical conversions take place in an integrated design to produce valuable products and fuels.

There are various groups of biotechnological platforms for example:

Syngas platform: The main constituents of syngas are carbon monoxide and hydrogen, which are produced through gasification. These intermediates can be subjected to a broad range of chemical and microbial transformation, to give gaseous and liquid fuels and many other fine chemicals (Dahmen et al., 2017). Syngas production from biomass is receiving increasing attention now.

Biogas platform: The term biogas describes the mixture of gasses obtained from the anaerobic digestion of biomass, that is, mostly methane and carbon dioxide (Bio-Based Chemicals: A 2020 Update, 2020). Methane can be used for heating or power generation within the biorefinery, but it can be also incorporated into the conventional natural gas distribution system, compressed for its use as fuel transportation or as a precursor of bio-based chemicals such as ammonia, methanol (Speight, 2022).

Carbohydrates platform: Valorisation of sugars from several sources is probably the best-developed branch in current biorefineries. These C5 and C6 carbohydrates can be accessed from the depolymerization of starch or hemicellulose and cellulose. To increase the yield and speed up biomass decomposition, first pre-treatment process is done, which is then followed by an either chemical or enzymatic treatment simple sugars which can be further transformed into fuels and chemicals.

Another major platform technology which is gaining a lot of interest is Lignin valorization. Lignin is the second most abundant biopolymer in nature after cellulose, and the first source of aromatic chemical moieties, excluding crude oil. Hence, lignin's relevance as a renewable raw material is unquestionable, and in fact crucial for the success of integrated biorefineries in the context of a biobased economy. According to the isolation method, or the industrial process from which lignin is derived, it can be classified into following types:

- **Organosolv lignin:** This lignin is obtained directly from biomass by extraction with organic solvents.
- Steam-exploded lignin: This lignin is obtained from wood that is treated with steam at high temperature and high pressure.
- **Kraft lignin:** It is the lignin obtained as a byproduct in the pulp and paper industry using sulfides in an alkaline environment with temperatures up to 170°C.
- Sulfite lignin: It is the lignin that is also obtained in the pulp and paper industry in a process of biomass with SO₃ 2- salts or HSO₃ - at a range of temperatures from 100 to 160°C.

Within the lignin platform reductive catalytic fractionation is gaining importance to derive aromatic functional compounds.

Reductive catalytic fractionation (RCF) is a promising lignin-first biorefinery strategy that yields a deeply depolymerized lignin and nearly theoretical amounts of lignin monomers with reductive catalysts (Qiu et al., 2020). The most essential ingredients to operate an RCF biorefinery are (i) lignocellulosic biomass, (ii) an alcohol (or cyclic ether) solvent, and (iii) a heterogeneous redoxactive catalyst (Renders et al., 2019).

One of the main challenges for lignin valorization is the recondensation processes, i.e., new carbon-carbon bond formation that occurs during depolymerization in many of the most traditional fractionation processes, i.e., organosolv, kraft, and sulfite (Guadix-Montero and Sankar, 2018). Addressing this issue is crucial for the development of lignin valorisation strategies.

With these identified challenges and the current technological advances industry will surely find the most workable solution for the current decarbonisation goal.

We as a company are actively developing a pathway to develop more and more bio-based products and renewable raw materials are essential for the same. This is the need of the hour for all of us belonging to the chemical industry to look for more and more sustainable products and bring them as part of mainstream products for a better tomorrow.

Leveraging Technology for Efficient Refinery Project Management

Refinery project management is a complex and multifaceted process involving the coordination of various disciplines, schedules, and resources to ensure the safe, timely, and cost-effective delivery of refining projects. Historically, this task was managed with limited technological tools, leading to inefficiencies and increased risks. However, over the years, advancements in technology have significantly transformed how refinery projects are managed, enhancing efficiency, safety, and profitability. This article explores the evolution of technology in refinery project management, from its early days to the present and possibilities on future advancements.



Early Days: Limited Technological Resources

In the early days of refinery project management, technology resources were rudimentary. Project managers relied heavily on manual processes, including paper-based documentation, hand-drawn blueprints, and face-to-face meetings. Communication was slow, often relying on postal services or landline telephones. Data collection and analysis were labour-intensive and prone to human error.

Project planning and scheduling were typically performed using basic tools such as Gantt charts and elementary project management software, if available. Risk management was often reactive rather than proactive, as the tools for predictive analytics and scenario planning were not yet developed. The lack of real-time data made it difficult to monitor progress and make informed decisions promptly. As a result, projects were often plagued by delays, cost overruns, and safety incidents.

Evolution of Technology in Refinery Project Management

The advent of digital technology in the late 20th and early 21st centuries marked a significant turning point in refinery project management. The introduction of personal computers, project management software,

and early versions of computer-based design software revolutionized the industry.

- Digitalization and Early Project Management Software: The digitalization of project management began with the introduction of project management software like Microsoft Project in the 1980s. These tools allowed project managers to create detailed project plans, assign tasks, and track progress more efficiently than ever before. However, these early tools were still limited in their capabilities, often requiring significant manual input and lacking integration with other systems.
- Computer-Aided Design (CAD) and Building Information Modelling (BIM): The introduction of CAD systems in the 1980s and 1990s transformed the way refineries were designed. Engineers could now create detailed 2D and 3D models of refinery components, reducing the need for physical prototypes and enabling more accurate and efficient design processes. Building Information Modelling (BIM) further enhanced this capability by providing a collaborative platform for sharing detailed project data among all stakeholders, improving coordination and reducing errors.
- Enterprise Resource Planning (ERP) Systems : The implementation of ERP systems in the 1990s and 2000s provided a comprehensive solution for managing various aspects of refinery projects, including procurement, inventory, human resources, and finances. These systems offered integrated data management, real-time reporting, and enhanced decision-making capabilities.
- Advancements in Communication Technology: The proliferation of the internet and mobile communication technologies transformed how project teams communicated and collaborated. Email, instant messaging, and video conferencing enabled real-time communication across geographically dispersed teams, improving coordination and responsiveness.
- Project Management Methodologies and Software Integration: The adoption of modern project management methodologies such as Agile, Lean, and Six Sigma, combined with advanced project management software like Primavera and SAP, further streamlined project management processes. These methodologies and tools enabled more flexible, iterative approaches to project planning and execution, improving adaptability and reducing waste.

Present Day: Advanced Technology in Refinery Project Management

Today, technology plays a central role in refinery project management, offering sophisticated tools and capabilities that were unimaginable a few decades ago.

- Internet based Real-Time Monitoring: The Internet based real time monitoring has revolutionized data collection and supervision in refinery projects. Internet based devices and sensors provide realtime data on equipment performance, environmental conditions, and safety parameters. This real-time data enables proactive maintenance, early detection of issues, and improved safety management.
- Artificial Intelligence (AI) and Machine Learning: AI and machine learning algorithms are now used to analyse vast amounts of project data, providing insights into patterns, trends, and potential risks. Predictive analytics help project managers anticipate and mitigate risks before they become critical issues, improving project outcomes.
- Virtual and Augmented Reality (VR/AR): VR and AR technologies are being used to create immersive training environments, simulate project scenarios, and facilitate remote inspections. These technologies enhance safety training, improve design visualization, and enable more efficient project planning and execution.
- Cloud Computing and Data Analytics: Cloud computing has enabled the storage and processing of large datasets, providing project teams with easy access to critical project information from anywhere in the world. Advanced data analytics tools allow for the integration and analysis of data from multiple sources, improving decision-making and project management efficiency.
- Digital Twin Technology: Digital twin technology involves creating a virtual replica of a physical refinery. This digital model can be used to simulate and analyse various scenarios, optimize



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performance, and predict maintenance needs. Digital twins provide a powerful tool for improving the efficiency and reliability of refinery operations.

Future: Emerging Technologies and Trends



The future of refinery project management promises to be even more technologically advanced, with several emerging technologies poised to further enhance efficiency and effectiveness.

 Artificial Intelligence, Internet of Things (IoT) and Autonomous Systems: The continued advancement of IoT and AI will enable the development of autonomous systems capable of performing tasks complex with minimal human intervention. Autonomous

drones and robots could be used for inspections, maintenance, and even construction activities, reducing the need for human presence in hazardous environments.

- Advancements in HSE system implementation: Use of AI including intelligent surveillance cameras, drones, automatic warning systems for hazardous areas are some areas where progress is being made in order to make the construction industry safer for workers.
- Blockchain Technology: Blockchain technology offers the potential to enhance transparency, security, and accountability in refinery project management. By providing a tamper-proof record of transactions and project activities, blockchain can help prevent fraud, ensure compliance, and improve trust among stakeholders.
- Advanced Predictive Analytics and Digital Twins: Future advancements in predictive analytics and digital twin technology will enable even more precise and proactive management of refinery projects. These technologies will provide deeper insights into project performance, allowing for realtime optimization and continuous improvement.

- Enhanced Collaboration Platforms: The development of more sophisticated collaboration platforms will further improve communication and coordination among project teams. These platforms will integrate various tools and data sources, providing a seamless and unified environment for project management.
- Sustainability and Green Technologies: As the industry places greater emphasis on sustainability, future refinery project management will increasingly incorporate green technologies and practices. Advanced technologies will be used to design and manage projects with a focus on minimizing environmental impact, reducing emissions, and enhancing energy efficiency.

Conclusion

The evolution of technology has had a profound impact on refinery project management, transforming it from a manual, labour-intensive process to a highly efficient, data-driven discipline. As technology continues to advance, the industry will see even greater improvements in efficiency, safety, and sustainability. Embracing these technological advancements will be crucial for refinery project managers to navigate the complexities of modern projects and deliver successful outcome in an increasingly competitive and dynamic environment.



Author

Sudhir R Singh Head – Projects, Nayara Energy Ltd

Maximizing Refinery Efficiency and Profitability in a Volatile Market

In the ever-evolving landscape of the global energy market, refineries face the dual challenge of maintaining profitability while adapting to volatile market conditions. This feature article delves into the journey of the refining industry from traditional practices to the cutting-edge use of AI/ ML and digital technologies, culminating in a sustainable approach that anchors profitability with environmental stewardship, covered in the first section titled 'Transformation Journey of Refining Technologies'. The second section of this article delves into the 'Multifaceted Strategies Refineries must employ to thrive amidst Market Volatility'.

Transformation Journey of Refining Technologies

Traditional Approaches: The Bedrock of Refining

Historically, refineries operated on the principles of economies of scale, maximizing throughput and minimizing costs through large, complex operations. Traditional approaches focused on optimizing unit operations, enhancing yield, and reducing energy consumption through process improvements and rigorous maintenance schedules. These methods served as the foundation for the industry for a long time, setting the stage for future advancements.

Current Approaches: AI/ML and Digital Integration

Today, the integration of Artificial Intelligence (AI) and Machine Learning (ML) has revolutionized refinery operations. Predictive maintenance, powered by AI, anticipates equipment failures, minimizes downtime, and extends asset life. ML algorithms optimize process parameters in real-time, ensuring peak performance and adaptability to changing feedstock qualities and product demands. Digital twinning technology creates virtual replicas of physical assets, enabling simulation, analysis, and optimization of processes before implementation in the real world.

Emerging Approaches: The Digital Transformation

The digital transformation of the refining industry is underway, with the adoption of next-gen technologies such as hybrid digital twins, advanced analytics, and IoT. These technologies offer unprecedented levels of operational insight, efficiency, and flexibility, allowing refineries to respond swiftly to market shifts. The integration of these digital tools across the asset life cycle promises to unlock new horizons in refinery efficiency and profitability.

While tools facilitate to bring intelligence in front of the teams, a conscious decision to achieve Operational excellence will only bring the high-performance culture with contributions of the engaging minds. A continuous improvement culture with a systematic approach that clearly describes what excellence looks like, how to achieve it and how to improve on it, can bring multifactor difference, when combined with digitalization.

Sustainability: The New Cornerstone of Profitability

Sustainability is no longer an option but a necessity. Refineries are embracing low-carbon solutions, such as the direct hydrogenation of bio streams, development of low-emission fuels, and carbon capture and storage. The

Connecting agriculture in the energy chain is the most apt feature because of the nature assisted quick carbon recovery through agri-cycles generating crop waste for energy source while food crops continue to fuel humans and other living beings. Distributed channels of bio-mass torrefaction and densification using briquetting route to handle agri-waste material can add to viable alternative of renewable energy for agribased nations.



transition to renewable fuels production, co-processing, and colocation with bio-refineries are emerging as viable pathways to align profitability with sustainability.

In conclusion, the refining industry stands at the cusp of a new era. By harnessing the power of AI/ML, digital technologies, and sustainability-oriented approaches, refineries can navigate the volatile market to emerge more efficient, profitable, and environmentally responsible than ever before.

Even with the integration of digital technologies alongside traditional approaches to optimize asset operations, refineries today must still transform both their assets and their management approaches effectively to maintain profitability. In the following sections, we will delve deeper into this topic.

Transformative approaches towards Asset Management and Resource adaptation

Radical changes to asset management approaches are required as the asset class itself offers many challenges in the areas of economic operations and sustainability for existing asset upgrades, integration with overall refinery complex, innovative repurposing and timely retiring.

Few emerging areas of Fossil to Biofuels, SMR's to CO₂ capture or processing bio-feeds, Fischer-Tropsch process integrated with biogas or natural gas feeds and watergas shift reaction utilizing Green hydrogen to obtain sustainable fuels or syngas to chemicals are attracting industry attention. Current asset class must be evaluated on investment worthiness for modifications, component upgrades or retiring effectively, largely driven by overall cost-economics justification. Such detailed justifications normally incorporate considerations of maintenance expenditures, current vs future overheads, conversion costs, apart from new project viability on standalone Capex and Opex. The uncertainties in the business scenarios under the emerging landscape of energy transition have different dimensions of the cost on account of carbon emissions such as opportunity loss on increased financing costs directly or indirectly, cross border taxation on carbon tax, government policy shifts, loss function on demand diminishing streams from non-definite fossil fuel peaks.

The resilience can be brought back only with various new ways of conducting business such as:

- Collaborative approaches on supply chain for biofeeds and circular polymers channels
- Product off take agreements
- Reliable partnerships for power and utilities from renewable sources
- Building viable assets for credits through offsets
- Working partnerships for carbon sequestration and utilization, and
- Synergy with regulatory frameworks

Preparedness to invest with continuous innovation on tailor-made profitable business interventions for each existing enterprise configuration is a requirement to beat the volatility factor.

Portfolio of petrochemicals in the platter brings stability to refinery operations in general. However, the market scenarios of various polymers – polyester, PP and PE remain cyclic with new capacity additions globally from cheaper feedstocks and new energy-efficient processes for manufacturing. Competing in this space requires synergistic asset building with current products and new market volatility factors for flexible product mix between fuels and petrochemicals – LPG to C4 based chemicals, PX to Gasoline etc.

Porter's Five Forces analysis for the emerging scenarios of energy world sees a paradigm shift towards greater

collaboration. A brief perspective is presented below.

Current refining outlook and strategic focus areas

According to the report by IEA, global refining capacity is on track to expand by 3.3 million barrels per day between 2023 and 2030, well



below historical trends. However, this should be sufficient to meet demand for refined oil products during this period, given a concurrent surge in the supply of non-refined fuels such as biofuels and natural gas liquids (NGLs). This raises the prospect of refinery closures towards the end of the outlook period, as well as a slowdown in capacity growth in Asia after 2027.

- Growth on renewable energy is drawing strong support from policies and commitments
- Oil demand is increasing in near-term but eventually reducing, reflecting peak demand in the current decade
- Global demand for transportation fuels will continue to rise, partly supplemented by biofuels and NGLs
- Global demand for petrochemicals manufactured from oil could continue to be robust, driven by emerging economies in Asia

Hence a robust long-term strategy for refiner not only should have a clearly stated energy transition action plan for business excellence but also prioritize plant upgrades intelligently with optimal capex and flexibility to deal with uncertainties.

Shift towards digital know-how

True value of depth of digitalization is reflected in innate process stability and innovation that it can bring to the table through the people utilizing them and experimenting with the new tools mitigating the safety and operational risks associated with integrated complex processes.

Opportunities on on-site process integration and beyond boundaries are to be harnessed, encompassing external factors of variability related to feeds, products and financing instruments, smart and optimized hedging on risks, captured in digital platform with connected process innovations. Plant turnarounds and upgrade plans should synchronize with global demand patterns flexibly.

The real markers of success can be measured in outcomes and KPIs as below:

- Control room operator to experience a visible shift in stability of process, with less upsets and quality time on value opportunities.
- Process safety and reliability incidents and nearmiss events should show sharp decline.
- Predictive maintenance should get new strategic insights with overall reliability cost reduction (maintenance + outage).

- Product quality results should improve with high Cpk of 2 or more, with quality give away tending downwards.
- Execution excellence in steady state operational tasks and turnaround activities with minimum surprises and delays, digitally enabled with superior planning rigour and real-time intelligence based quick decisions, assisted by cognitive features of AI.

Collaboration with Government

There are evolving regulatory frameworks in different parts of the world while dealing with carbon emissions and these are not only influenced by climate impact and COP summits but various other negotiating factors of historic emissions by advance economies and oil producing nations apart from political scenarios in parts of the world. The shifts in energy sources are greatly influenced by the changing scenarios across supplying nations. This is bringing additional stress to the energy transition plans to policy makers. The innovations in this space are leading towards alternative clean energy deployment including nuclear apart from large drive in solar and battery giga factories. CO₂ sequestration and chemical routes from syngas are getting good traction with inclination to bio-based feeds for coprocessing.

Connecting agriculture in the energy chain is the most apt feature because of the nature assisted quick carbon recovery through agri-cycles generating crop waste for energy source while food crops continue to fuel humans and other living beings. Distributed channels of bio-mass torrefaction and densification using briquetting route to handle agri-waste material can add to viable alternative of renewable energy for agri-based nations.

Multifaceted strategies refineries must employ to thrive amidst market volatility

In the dynamic world of energy, refineries stand as critical

Crude oil prices are the heartbeat of the refinery business, dictating margins and operational decisions. To maximize efficiency, refineries must adopt flexible processing capabilities, allowing them to switch between crude types based on price advantages. Advanced analytics can forecast price trends, enabling proactive procurement strategies and inventory management. hubs, transforming crude oil into valuable products that fuel economies. However, the path to profitability is fraught with challenges, from fluctuating crude oil prices to geopolitical tensions. Strategies refineries must employ to thrive amidst market volatility are as following:

Adapting to Crude Oil Price Fluctuations: Crude oil prices are the heartbeat of the refinery business, dictating margins and operational decisions. To maximize efficiency, refineries must adopt flexible processing capabilities, allowing them to switch between crude types based on price advantages. Advanced analytics can forecast price trends, enabling proactive procurement strategies and inventory management. Processing of new and difficult crudes bring lot of challenges to plant operations. Hence, crude oil evaluations through detailed distillation, compatibility checks, suitable chemical treatment at desalter stage and specific markers to identify oxygenates, sulfur species in each stream, colour impact and finally yield structure within unit capability for both light ends and heavy tail processing are the key aspects refiners navigate through for economic blending.

Navigating Supply Controls: OPEC's supply quotas and other geopolitical factors can constrict crude availability, impacting refinery operations. Diversifying supply sources and investing in strategic reserves can mitigate these risks partially. Additionally, forming alliances with producing countries and investing in upstream assets can secure long-term supply and stabilize input costs.

Geopolitical Scenarios and Their Impacts: Geopolitical events can disrupt supply chains and alter global oil flows. Refineries must remain agile, with contingency plans to quickly adjust sourcing and logistics in response to sanctions or conflicts. Engaging in geopolitical risk assessments and scenario planning ensures refineries are not caught off guard by sudden market shifts.

Meeting Product Demands: Consumer preferences and regulatory changes shape product demands. Refineries must optimize their product mix to meet these demands, investing in technologies that increase yields of high-margin products. For instance, the growing demand for petrochemical feedstocks over transportation fuels may prompt refineries to adjust their outputs accordingly.

Investing in new technologies for all carbon range materials involve various options that need to be assessed for viability specific to each of the refinery configuration. Few examples are as below:

• Syngas to C1 based chemicals – Methanol, Acetic acid etc. and derivatives thereof.

- Utilizing C2 molecules for gas cracking integrated with other catalytic off gas processing, and further ethylene-based polymers.
- Catalytic routes for C3 C9 molecule range for olefins generation and aromatics value chain and further manufacturing of polymers, new materials of composites and specialty chemicals.

The key differentiating element to be focused is using lowest energy conversion process and linking with renewable energy resources where possible.

Overcoming Logistics and Shipping Issues: Logistics and shipping are the lifelines of refinery operations. Disruptions in these areas can lead to supply shortfalls or excess inventory. Implementing robust logistics management systems, exploring alternative transportation routes, and leveraging digital tools for real-time tracking can enhance logistical resilience.

The Emergence of Renewable Energy Sources: The rise of renewables is reshaping the energy landscape. Refineries can integrate bio-refining processes to produce biofuels, reducing their carbon footprint and tapping into new markets. Collaborating with renewable energy producers can also lead to innovative energy supply solutions for refinery operations.

Influence of sanctions on Refinery Efficiency: Sanctions on oil-rich countries can lead to discounted crude supplies but also pose reputational risks. Refineries must navigate these waters carefully, ensuring compliance with international regulations while exploring opportunities for cost savings. Strategic partnerships and thorough due diligence are key in these scenarios.

Conclusion

Refinery efficiency and profitability in a volatile market require a holistic approach, balancing cost management with strategic investments and innovation. By embracing flexibility, technological advancements, and sustainability, refineries can turn challenges into opportunities, ensuring their pivotal role in the global energy economy remains steadfast.



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A Journey Towards Cleaner Fuel: KHT Project at BPCL Mumbai Refinery



Refining hub and a net exporter of petroleum products, India, has an installed refining capacity of 256.8 MMT as on April 1, 2024, with majority (around 65%) being held by PSU refiners and their subsidiary/joint venture companies. BPCL, one of the leading PSU company of India, has oil refineries, wide marketing network and presence in upstream activities as well. Overall crude refining capacity of BPCL is 35.3 MMTPA out of which Mumbai Refinery (MR) contribution is 12 MMTPA.

BPCL Mumbai Refinery (MR) had commissioned 1.5 MMTPA Capacity Kerosene Hydrotreater Unit (KHT) in Feb'23. The unit was integrated with the existing Diesel Hydrotreater (DHT) unit having capacity of 2.83 MMTPA, to optimize space and inter-unit distances through sharing of heat load, recycle gas, amine & wash water facilities. The unit upgrades high sulfur kerosene to ultralow sulfur Superior Kerosene Oil, Aviation Turbine Fuel, Mineral Turpentine Oil and High-Speed Diesel making it environment friendly.

The project was executed in collaboration with reputed licensors, experienced project management consultants (PMC), and main contractors. The project involved 95 numbers of equipment, including 48 over-dimensional items. The project was completed and commissioned safely in just 22 months, without any Loss Time Accident, despite the COVID-19 pandemic. This achievement was made possible by the dedicated efforts of the Mumbai Refinery Team, with support from all internal and external stakeholders while maintaining the timeline and cost of the project.

The project team had adopted various execution strategies which facilitated faster execution. Some of the key strategies are mentioned below:

- Site readiness by removal / relocation of existing facilities to match project schedule.
- New initiatives viz. High Integrity pressure protection system (HIPPS), Prefabricated Pipe spools, Prefabricated Instrumentation hook-ups, Dual redundant Variable Frequency Drive (VFD) for Recycle gas compressor (RGC).
- Early commencement & completion of OSBL activities related to associated units during their respective shutdowns facilitated Project commissioning.
- Early formation of Pre-commissioning task force leading to synergy with other stakeholders.

- A new warehouse for storage of project material was constructed to facilitate KHT supplies.
- Continuous interaction with vendors for timely delivery of material.
- Construction of new approach road beside project plot for simultaneous working by multiple contractors.
- Carrying high pressure circuit dry out without commissioning DHT reactor effluent circuit. The KHT feed is preheated with the DHT reactor effluent, which couldn't be commissioned due to incomplete flare systems. To overcome this, a dedicated MP steam line was used to heat circulating N₂ via the KHT feed heat exchanger, saving 11 days in the commissioning process.

New Initiatives at MR for KHT Project

Prefabricated Piping Spools: For the first time in BPCL group refineries, prefabricated spools were used for entire project piping jobs. Use of prefabricated spools helped in reducing total procurement and construction time, enhanced safety, and quality.

Prefab Instrument Hook-up: Prefabricated Instrument Hook-up were installed for measuring process pressure and flow. Prefabricated Instrument Hook-ups are a convenient way of eliminating impulse piping by using









sandwich construction valves. Use of such hookups helped in reduced testing requirements at site as it is pretested at factory, reduced number of welding joints at site and faster erection.

High Integrity Pressure Protection System (HIPPS): HIPPS is used in KHT project. The use of HIPPS for hot feed lines minimizes flare load during power failure scenarios. With the help of HIPPS, the adequacy of existing flare in MR was ensured.

Dual Redundant Hot Standby VFD with DOL facility for RGC: Dual Redundant Hot Standby VFD system with DOL facility is provided for KHT RGC HT Motor. It is first of its kind in BPCL facilitating auto changeover from one VFD to another automatically without affecting the process parameters.

Awards: KHT Project has won IndSTT Trenchless Excellence Award 2022 for Best Project Management, Best Project, HSE and 13th CIDC Vishwakarma Award 2022.

Safety: Multi-tier Safety approach Including Dedicated External Safety agency for enhanced safety, helped us in achieving 3 million manhours without lost time accident. Key safety features are as mentioned below:

State of Art Process Interlocks for automatic safe shutdown.



KHT Feed Cut-in: In presence of Sanjay Khanna, Director (Refineries); M R Subramoni Iyer, ED (MR); P K Bhowmick, ED (E & AS, P & PP); R R Ghalsasi ED (RPO); N Chandrashekhar, CGM (Operations); P G Karthikeyan, GM (Projects) & other senior officials.

- High Integrity Pressure protection system (HIPPS) Installed at Feed lines to make Flare KOD adequate (as per OISD 106) for revised liquid flare.
- One emergency depressurization valve (HP Circuit).
- Provision of HC, H₂S and H₂ leak detectors at strategic locations.
- Closed Blow down and Amine Blow Down system.
- Closed loop sampling for $H_{2'}$ HC and Amine.
- Sour Gas processing in existing ATU facility.
- Sour Water processing in existing SWS- facility.

The successful completion and commissioning of the KHT project at BPCL Mumbai Refinery marks a significant milestone in the journey towards producing cleaner fuels. The integration of innovative technologies and strategies, along with the collaborative efforts of all stakeholders, underscores BPCL's commitment to operational excellence and environmental sustainability. This project not only enhances the refinery's capability to produce ultra-low sulfur fuels but also sets a benchmark for future projects in terms of efficiency, safety, and environmental stewardship. ■

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Optimizing Refinery Operations with Advanced Process Simulation Tools

MIKE AYLOTT Chief Technology Officer KBC Advanced Technologies

The global energy landscape is evolving, compelling refiners to adapt to challenges such as geopolitical instability, technological advancements, and sustainability needs. Refiners must balance competitive operations with environmental responsibilities. KBC's process consulting and technology, including digital simulations and AI, help refiners improve profitability and adapt to change. This article will introduce KBC's latest developments and discuss how these solutions help refiners maintain sustainable operations on their decarbonization journey in this evolving world.

The global energy landscape is undergoing a significant shift, compelling refiners to adapt to emerging challenges and opportunities. Amidst the challenges posed by geopolitical instability, technological advancements, regulatory changes, and the pressing need for sustainability, refiners must balance competing priorities to stay competitive while upholding their environmental, social, and regulatory responsibilities.

This pursuit of safe, responsible, and profitable operations has become increasingly demanding, requiring refiners to continuously improve their processes and embrace innovative solutions.

Digital technologies are key to helping refiners navigate these pressures, with the rise of cloud and artificial intelligence (AI) techniques providing the building blocks, plus allowing refiners to grow towards more autonomous and optimal operation.

For over 40 years, KBC's process consulting and technology have been helping the refining industry improve profitability and adapt to change, using process simulation solutions and techniques based



Figure 1: Petro-SIM process simulator dashboard

on fundamental engineering principles. We have been continuously advancing our technology, including the addition of adding first-principles physics-based modelling of energy transition processes and by taking advantage of AI and digital technologies.

This column will introduce KBC's latest developments and discuss how these solutions help refiners maintain sustainable operations on their decarbonization journey in this evolving world.

Simulations Support Decarbonization Journey

Refiners face a myriad of ways to reduce their energy and carbon footprints while producing sustainable fuels. To achieve this, refiners must benchmark their operations and make informed decisions regarding capital investments, which are key to creating a successful roadmap towards sustainability.

KBC supports this roadmap activity in two ways. Firstly, our Petro-SIM[™] simulator capability has grown to include modeling new process technologies, such as renewable diesel and sustainable aviation fuel production, as well as the characterization and co-processing of biogenic

> feedstocks, electrolysers for hydrogen production, and carbon capture, as depicted in Figure 1. They also enable integrated modelling of utility and energy systems, carbon intensity tracking and associated economics in ways that let you explore different processing options and evaluate roadmaps over time.

> Secondly, KBC has enhanced its Profit Improvement Program consulting methodologies to assist refiners in asking the right questions, ensuring refiners get the expertise needed as they plan their journey towards reaching their net zero goals.

Sustainable Real-time Optimization

Increasing demands for operating

flexibility have led to growing interest in real-time optimization (RTO): automated systems that can operate in closed loop to keep process units running optimally. While RTO principles themselves are not new, they have historically presented challenges such as poor uptime, high maintenance costs, reliance on steady state conditions, and often low convergence rates.

KBC has introduced a unique approach to real-time optimization, addressing challenges faced by traditional methods. This dynamic solution combines the power and accuracy of online, rigorous Petro-SIM simulations models with a proven platform for advanced control and estimation (PACE), as shown in Figure 2. We separate the process modelling from the optimization itself by using a calibrated and tuned Petro-SIM model to calculate non-linear gain updates as plant operations shift, transferring these gains to dynamic optimization every few hours, or as needed. Optimization cycles run every 5 to 10 minutes, eliminating the need for steadystate conditions and increasing the RTO benefits over traditional approaches.

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Figure 2: Pace dashboard

We improve maintainability of the overall solution by using the same process models for gain generation as are used by plant engineers for offline unit troubleshooting and scenario analysis. Additionally, we incorporate new automated techniques for validating and updating the models themselves, which are discussed in the next section. This approach enables engineers to build and maintain consistent Petro-SIM models for monitoring, and troubleshooting, as well as real-time optimization, significantly reducing the knowledge and effort needed to keep systems operational. Hence, we believe our approach makes RTO systems more sustainable and efficient.

Sustainable Process Digital Twins

Process digital twins, in our definition, model the process aspects of refinery units. These digital twins accurately predict the yields and qualities of unit and intermediate stream, adjusting to changes in feedstocks and operating condition. Process digital twins should respond as the plant responds and should handle fixed bed reaction systems where catalyst activity decays, as well as regenerating systems and all necessary aspects of separation and heat integration. Our process digital twin systems predominantly use first-principles modelling, allowing augmentation with machine learning models running alongside within the same simulation platform.

There are two key challenges with process digital twin models for operations. Firstly, engineers need assurance that the model results are reliable. We routinely address this by automatically comparing the models against actual data on a daily or weekly basis. This information provides engineers with performance trends and KPIs, allowing them to build trust in the models. Over the past 15 years, KBC and our clients have successfully been building and implementing systems that meet this challenge, making our technology and underlying models highly reliable.

However, it's important to acknowledge that all models have limitations. While models can be calibrated to match current operation, the real question is how they respond to changing feeds, operating conditions, and catalyst performance. Will a well-tuned model continue to operate effectively as the plant's operating window evolves? This is the second challenge we face, as poor models can impact achieving optimal performance.

Our traditional model assurance techniques help us understand when models need attention, but human resource limitations often mean engineering teams lack the staff to update models in a timely manner.

To overcome this challenge, we recently launched a new solution called KBC Acuity[™] Process Twin Pro. This cloud-based solution gives engineers an AI-based model health index, alerting them when models need attention. It filters the bad data and prediction blips and offers AI-enabled model tuning algorithms that automate the tuning process, as shown in Figure 3.



Figure 3: KBC Acuity Process Twin Pro workflow

With this solution, engineers dramatically reduce the skill, time and effort required, ensuring the long-term reliability of their model fleet.

Enabling Platforms

Cloud technologies have been chosen for the new KBC Acuity Process Twin Pro solution because it offers a host of benefits to simplify deployment. With the help of scalable computation resources and a reliable AI platform, the application can be easily updated as we learn, and algorithms improve. This not only streamlines the process but also reduces the IT burden on the refiner.

Furthermore, this work is part of a broader effort to embrace true cloud-native deployment across our technology suite. This approach enables seamless integration with refiners and third-party systems, fostering new integrated workflows. While we cannot have a complete picture of the technologies and workflows needed for the Energy Transition and journey to net zero, we are preparing our systems to be agile and adaptable. Our aim is to future-proof our solutions as much as possible.

Conclusion

In conclusion, the use of cloud technologies is transforming businesses by providing scalability and flexibility. With advanced process simulation tools like Petro-SIM, refiners can optimize their operations and stay competitive in the changing energy landscape. Real-time optimization, digital twins, and cloud-native deployment enable refiners to navigate industry complexities and achieve operational excellence. Embracing these technologies is a strategic move that positions refiners for sustainable growth in the global energy market. By prioritizing innovation, the company ensures customers stay ahead of advancements while Bringing Decarbonization to Life[™]. ■





Steam Turbines for Petroleum Refining Industry

S. NARAYANA PRASAD CEO, Triveni Turbines

Triveni Turbines has established a reputation for delivering benchmark efficiencies to EPCs building new oil and gas plants or modernizing existing oil and gas plants worldwide through its steam turbine products in the API segment. **S. Narayana Prasad, CEO, Triveni Turbines,** throws more light on the role of steam turbines in petroleum refining industry.

The petroleum refining industry has experienced steady growth in recent years due to robust demand, high refinery margins, and the establishment of new refineries¹ in the Middle East, the U.S., and China. Oil supply is projected to increase to 102.9 million barrels per day² in 2024, after considering Organization of the Petroleum Exporting Countries (OPEC) production cuts. Onshore oil inventories in various countries are expected to be lower in 2024 compared to pre-COVID-19 levels due to disruptions in shipping routes and increased offshore inventories.

The chemical and petroleum industries together contribute approximately 7 per cent and 2.5 per cent to global GDP^{4,5} respectively. Both industries require extensive process heating, with the petroleum refining sector⁶ utilizing nearly 90 per cent of onsite fuel for this purpose, around 25 per cent of which is for generating steam used in process heating.

Refinery Industry for Net Zero Emissions 2050 scenario – Innovations & Policy Framework

The petroleum refining sector has the highest process

heating energy demand among all manufacturing sectors and, consequently, is the largest source of onsite greenhouse gas (GHG) emissions from combustion. Α significant portion of the electricity used in the refining industry is generated offsite, with approximately 30 per cent produced onsite⁶ through cogeneration / combined heat and power (CHP) applications. Onsite energy production through CHP is roughly twice as efficient as energy supplied through the grid.

In the pursuit of Net Zero Emissions by 2050 (NZE 2050), the refinery industry is expected to play a crucial role in reducing Scope 1 emissions, which include direct energy and process emissions. According to an International Energy Agency (IEA) report⁷, approximately \$450 billion is invested annually worldwide in energy efficiency improvements and other end-use applications. Energy efficiency is central to the path towards a low-carbon future; it is the lowest-cost option and is often referred to as the 'first fuel' — the resource to be utilized before all other energy options. Enhancing energy efficiency not only reduces emissions but also improves energy security, relieves pressure on national budgets, boosts competitiveness, and enhances operational efficiency. Energy efficiency measures are characterized by high technological maturity and commercial-scale deployment.

Countries are working towards the NZE 2050 goal. For example, a major Middle Eastern nation has developed standards and procedures for energy efficiency at the Front End Engineering Design (FEED) stage, which are advisory in nature and have made third-party energy efficiency audits mandatory. They have also incentivized project managers and Engineering, Procurement, and Construction (EPC) contractors to meet longterm performance metrics for facilities. National oil exploration and refining companies are increasingly forming partnerships with oil, gas, and petrochemical companies to build new facilities aimed at enhancing plant efficiencies.



API 612 - 1.5 MW installed at the customer site



API 612 - 2.7 MW installed at the customer site

In India, the government is also supporting the petroleum industry through the new Petroleum, Chemicals and Petrochemical Investment Regions (PCPIR) 2020-35 policy, which includes provisions for 100 per cent Foreign Direct Investment (FDI) and 20 per cent Viability Gap Funding (VGF). This policy aims to expedite the establishment of refinery facilities to meet energy demands and build efficient energy ecosystems. Additionally, initiatives by the Bureau of Energy Efficiency (BEE) to collaborate with EPC contractors and Energy Service Companies (ESCOs) are expected to enhance and promote the country's energy efficiency.

Driven by the goals of NZE 2050 and Nationally Determined Contributions (NDCs), the petroleum refinery industry is increasingly emphasizing the importance of energy efficiency and equipment reliability. This trend presents new challenges for Original Equipment Manufacturers (OEMs) of steam turbines and gas turbines, pushing them to meet higher standards of performance and efficiency.

Petroleum Refining & Steam Turbines

Refining industry converts crude into more than 2,500 refined products and feedstocks for the petrochemical industry. Petroleum refining consists of four primary processes:

- Distillation (~600°C) for separation of fuels
- Petroleum conversion (cracking, reforming, coking, etc. at ~400°C)

 Petroleum treating (desulphurization and hydrotreating) and

 Feedstock handling (storage and blending)

For the primary processes, process heat requirements are met through fuel burning and electric heaters. Steam in refinery processes is used for heating petroleum products in heat exchangers, for steam stripping in distillation towers for enhancing separation efficiency and also as a medium for producing vacuum (vacuum distillation towers) through steam ejectors.

The petroleum refinery industry is one of the largest adopters of Cogeneration / Combined Heat

and Power (CHP) systems. A significant reason for the widespread adoption of CHP in petroleum refining is the availability of large quantities of by-product, the waste gas.

Steam turbines used in refinery applications can be backpressure or condensing types, with or without extraction, depending on the plant cycle design. Steam turbines can be used for mechanical drive pumps and compressors within refineries, and also for power generation by coupling with alternator. CHP systems incorporating steam turbines and gas turbines can be configured to operate as either electrical load matching or thermal load matching systems.

CASE STUDY

Triveni API (Refinery) Product Portfolio

Triveni Turbines has a substantial installed base of turbines in refineries worldwide and maintains a strong project pipeline for API steam turbines under 100 MW, with installations planned over the next several years.

Case Study 1: Project is driven by Triveni Turbines' 1.5 MW (4 No's) and 2.7 MW (4 No's) back pressure Steam Turbine Generators (STG) for drive applications in Kuwait



API 612 - 3.6 MW during dispatch from Peenya factory

Project Description: Triveni Turbines Limited has successfully executed a contract from a national oil company and a leading petroleum refining company in Kuwait to design, supply, and commission an API 612 steam turbine for use in fan drive applications and as per Shell Design Engineering Practices (DEP) plus AMEC FW project variations. Each steam turbine powers four combustion air blowers and flue gas fans respectively for the world's largest reformer package.

Challenge: These special purpose steam turbines are designed, manufactured and tested as per the project specifications which includes design for outdoor installation, ensuring a minimum design metal temperature suitable for -30°C, and they must meet the classification for electrical hazard area zone 1, IIC, and T3.

Solution: The supplied steam turbines have a design life of 30-year service life and six years of continuous operation. The supply scope also encompassed gear units, lube oil systems, unit control panels, and gland steam condensers. The project was commissioned successfully to meet the specifications.

Case Study 2: Project is driven by Triveni Turbines' 3.6 MW back pressure steam turbine generators (STG) for drive applications in India

Project Description: Triveni Turbines Limited has executed a contract from a national oil company and a leading petroleum refining company in India to design,

supply, and commission an API 612 steam turbine for use in compressor drive applications.

Challenge: The steam turbines designed are to meet the specifications, project featuring instrumentation appropriate for electrical hazard areas and highhumidity environments. The steam clutch, coupling turbines, and driven equipment are mounted on a common base frame that complies with applicable standards.

Solutions: The steam turbines were successfully mounted on a common base frame in compliance with API RP 686 standards. They were supplied to the customer with advanced

governing and control systems (including the Woodward FT 5009 TMR Governor and MOOG Hydraulic actuator) to drive an induction generator/motor and compressor. Additionally, they feature instrumentation suitable for Zone 1, IIC, T3, and high-humidity environments.

References

1 2022-23 Annual Report – Reliance Industries Limited

2 IEA Oil Market Report of March 2024

3 NACE Rev. 2 - Statistical classification of economic activities in the European Community, Eurostat, European Commission

4 https://innovamas.nakasawaresources.com/en/petroleum-and-itsdecisive-role-in-the-world-economy/ - Petroleum and its decisive role in the world economy

5 The Global Chemical Industry: Catalyzing Growth and Addressing Our World's Sustainability Challenges

6 U.S. Manufacturing Energy Use and Greenhouse Gas Emissions Analysis

7 World Energy Investment 2022, a report published by International Energy Agency (IEA)

8 CHP Factsheet, US Department of Energy





Embracing Innovation: Technology-Driven Project Management for U.S. Refineries

AJITKUMAR GOSWAMI, PMP Vice President, Burns & McDonnell India

In the dynamic world of refinery project implementation - technology and innovation play a pivotal role in enhancing efficiency, productivity and sustainability. In this guest column, **Ajitkumar Goswami, PMP, Vice President, Burns & McDonnell India,** explores how the tech innovations and digital solutions that most U.S. refiners have adopted are driving competitiveness in the global market.

he complexity of U.S. refinery projects stems from environmental regulations, technological advancements, economic conditions and shifting energy markets.

Speed to market and cost efficiency drive refinery project implementation, and require innovation and technology adoption by refinery owners, operators, consultants and engineer-procure-construct (EPC) contractors. Technology-driven solutions in engineering, planning, project monitoring, procurement and construction are enhancing cost, schedule, safety and quality outcomes in a variety of ways.

BIM 3D Modeling

Three-dimensional building information modeling (BIM) is essential in various project phases, from conceptualization and design to construction and maintenance. In the initial stages of a refinery project, BIM visualizes the layout and design, allowing stakeholders to understand spatial arrangements and functionalities, thus preventing costly delays and rework. Detailed engineering utilizes 3D models for precise equipment, piping and structural designs, identifying clashes, optimizing layouts, and confirming seamless component integration during construction.

Construction Visualization, Planning and Simulation

3D models are used to plan and simulate construction activities, including sequencing, resource allocation and safety measures. This allows project managers to optimize construction workflows, improve efficiency and mitigate risks before work begins on-site. This enhances communication among stakeholders and helps confirm that construction proceeds according to the intended design.

As-Built Documentation

Once construction is completed, 3D models are updated to reflect the actual built condition of refineries. These as-built models serve as valuable documentation for future maintenance, renovation and expansion projects, providing an accurate representation of facilities' infrastructure.

Overall, the use of 3D models improves design accuracy, construction efficiency and long-term asset management, contributing to the successful execution and operation of complex facilities.



Figure 1: The 3D design of a refinery or any project is the first step in bringing the project to life.

4D Construction Planning

4D construction planning augments traditional BIM 3D modeling by integrating time-related data, thereby yielding a sophisticated and dynamic visualization tool that significantly enhances scheduling efficacy. This advanced integration promotes superior decisionmaking capabilities and fortifies project management controls.

Firms that use this technology will find that it helps stakeholders visualize construction progress and sequencing in real time, thereby furnishing a comprehensive understanding of the project life cycle. Such real-time visualization is instrumental in the early identification of spatial and scheduling conflicts. Moreover, 4D construction planning facilitates enhanced coordination and communication, optimizes the allocation and management of resources (i.e., staffing, materials and machinery) and aids in the strategic planning and visualization of safety protocols. These improvements markedly elevate site safety standards and contribute to robust risk mitigation strategies.

Digital Data Transfers

The sharing of information in the form of digital data among project owners, authorities, suppliers, contractors and consultants helps integrate participants throughout all stages of a project. This integration fosters the creation of a "single version of the truth," eliminating the challenges typically associated with legacy systems, such as coordination lapses and information voids. Access to the appropriate data at the correct time enables decisions to be made based on accurate and timely information that can streamline processes and improve overall project outcomes.

Advance Work Packaging (AWP)

Traditionally, contractors encounter significant rework due to inadequate site planning and poor coordination between engineering and construction teams. This inefficiency can be mitigated through the implementation of advanced work packaging (AWP). AWP encompasses the comprehensive workflow of all detailed work packages, including construction, procurement, engineering and installation. Characterized as a construction-driven process, AWP embodies the philosophy of beginning with the end in mind. It aims to reduce unproductive and non-value-added time, thereby enhancing overall project efficiency.

Successful work packaging leads to several benefits: It enhances the productivity of construction resources, improves schedule performance, boosts worker morale and elevates safety outcomes. By employing AWP, project teams proactively manage field constraints and communicate necessary time and resources well in advance. This proactive management allows project leaders to achieve more predictable and reliable project success.

RFID Tagging and GPS Tracking of Materials

Radio frequency identification (RFID) tagging facilitates the automated tracking of materials from procurement through installation, providing real-time data to improve efficiency, accuracy and security in project management.

Global Positioning System (GPS)

GPS tracking of materials provides real-time location data for materials, which is needed for optimizing the supply chain procurement process. By knowing the precise location and status of materials, project managers are able to better coordinate just-in-time



Figure 2: An integrated advanced work packaging flow helps eliminate unproductive tasks and improves overall project efficiency.

Light Form Modeler (LFM), a powerful 3D laser technology, is a transformative tool for refinery expansion and revamp projects. This method provides high-precision, 3D data by capturing comprehensive geometric information about a facility.

deliveries, minimizing the need for extensive onsite storage and avoiding project delays because of unavailable materials.

3D Laser Scanning

Light Form Modeler (LFM), a powerful 3D laser technology, is a transformative tool for refinery expansion and revamp projects. This method provides high-precision, 3D data by capturing comprehensive geometric information about a facility. Lightweight and mobile 3D laser scanners use light detection to measure and record precise locations and distances, producing a point cloud file. Project teams find that this form of 3D laser scanning helps in early detection of potential clashes between new designs and existing infrastructure, and it's often integrated with BIM to enhance visualization, simulation and project planning.

Drones/Unmanned Aerial Vehicles (UAVs): The incorporation of unmanned aerial vehicles, commonly known as drones, marks a significant advancement in the adoption of cutting-edge technology aimed at boosting efficiency and safety. Drones provide capabilities that are transforming numerous facets of project execution. These capabilities include site surveying and mapping, 3D modeling of terrain and existing infrastructure, inspection and progress monitoring, material and equipment, tracking and safety response, inspection and compliance monitoring.

Drones, when equipped with suitable sensors, are capable of detecting and measuring gases and pollutants, thereby assisting refineries in adhering to environmental regulations. Prior to initiating new projects or expansions, refinery owners can use drones to evaluate the impact on local wildlife and habitats, supporting more environmentally conscious decisionmaking. As technology progresses, the range of drone applications in industrial settings is expected to broaden. This ongoing development underscores the integral role of drones and other innovative technologies in optimizing industrial construction, development and operations.

Modularization

Modularization involves assembling large components or systems within a controlled manufacturing environment and transporting them to a project site. Modules are fully fabricated, assembled and tested offsite to the greatest extent feasible, minimizing the need for on-site construction. This approach is becoming increasingly adopted in the construction industry because of its numerous benefits, including enhancing efficiency, reducing costs and improving safety and quality controls.

Technology-driven solutions in engineering, planning, project monitoring, procurement and construction are enhancing cost, schedule, safety and quality outcomes. Innovative technology helps with collaboration between design and construction teams, allowing for alignment of all facets of a project, which leads to smoother, more efficient execution.



Towards a Brighter Future: Reducing Kerala's Carbon Footprint

DR. R HARIKUMAR Director Energy Management Centre – Kerala

The Energy Management Centre (EMC) of Kerala, a pioneering state-level organization established in 1996, is committed to energy transition, embracing cleaner energy sources across all sectors of the economy. **Dr. R. Harikumar, Director, EMC, Kerala,** takes us through the various energy efficiency measures taken by EMC in reducing Kerala's carbon footprint and fostering a sustainable future.

The recent rise in extreme weather events, including severe floods and scorching summer temperatures, serves as a stark reminder of the urgency of climate action. Kerala has been at the forefront of this fight, experiencing unprecedented energy demands during the past summer. The state responded effectively, not only by increasing power generation but also by promoting widespread energy conservation efforts.

Large campaigns were organized by the Government of Kerala through EMC, with initiatives like 'Set@26°C' which urged people to set their air conditioners at 26°C, promotion for use of white cotton clothes, improved energy-efficient appliances, and adoption of cool roofs to address the rise in demand.

Kerala has ambitiously planned to become a 100 per cent renewable energy-based state by 2040 and to achieve net carbon neutrality by 2050. We are committed to an energy transition, embracing cleaner energy sources across all sectors of the economy. Even with the handicap of limited land availability, Kerala is maximizing efforts to enhance renewable energy generation especially through roof top solar. Notably, the state has achieved remarkable milestones, surpassing 1,087.71 MW of solar energy capacity. Given the capital investments involved for renewable energy installations, improving energy efficiency to reduce the demands becomes critical. With continuous efforts and support from stakeholders, Kerala has emerged as a leader in the State Energy Efficiency Index published by the Bureau of Energy Efficiency. Our initiatives, coupled with the efforts of our energy consumers, resulted in savings of 626 million units of electricity and 37,503 tonnes of oil equivalent during 2023-24.

Pathway to Improve Energy Efficiency

With more than two-third of the energy usage of the state attributed to buildings, EMC is implementing the 'Chaithanyam' and 'Urjayan' Projects, which aim to improve the energy efficiency of buildings in the government health sector and other government buildings, respectively. These act as pilot projects for replication in other sectors. EMC also notified the Kerala State Energy Conservation Building Code (KSECBC) to ensure minimum energy efficiency levels in the building sector and ensured its inclusion in Kerala Municipality Functioning under the Department of Power, Government of Kerala, the Energy Management Centre (EMC) also serves as the State Designated Agency (SDA) for the Bureau of Energy Efficiency (BEE) under the Ministry of Power, Government of India. In this capacity, the EMC holds the critical responsibility of coordinating, enforcing, and implementing the Energy Conservation Act, 2001, within Kerala.

Building Rules (KMBR) and Kerala Panchayat Building Rules (KPBR).

Furthermore, our 'UrjaKiran' program acts as a beacon, illuminating the path towards a more sustainable future. Through a multitude of activities, including awareness programs, training sessions, and interactive workshops, the public is empowered with knowledge and the necessary tools to manage energy efficiently and embrace sustainable practices in their daily lives.

EMC offers its technical support to corporations, municipalities, and panchayats for the implementation of energy-efficient street lighting program. Replacing traditional streetlights with LED lights translates to a substantial reduction in electricity consumption and associated carbon emissions. This collaborative effort also lightens the financial burden on electricity bills for the local bodies while contributing to a cleaner environment.

Agriculture sector: Agricultural sector is a key area for a state like Kerala. EMC implements demonstration pilot projects like replacing 'petty and para' pump sets with energy-efficient vertical axis pump sets. Vertical axis pump sets may be new to some readers. They are used in areas like Kuttanad, where the land is below sea level, requiring continuous pumping of water back to the water bodies. The traditionally used 'petty and para' pump sets are undeniably inefficient. These new pump sets need only 50 per cent of the electricity as compared to their predecessors.

Unarvu: Students are the future, and they need to be nourished with the importance of energy conservation and made aware of how to conserve energy. In light of



The 'Angan Jyoti' project aims to transform a staggering 33,115 Anganwadis (early childhood care centers) in Kerala into energy-efficient and ultimately energy-neutral havens.

this, EMC is organizing 'Unarvu' and school capacity building programs exclusively for school students, which handhold students to attract them to energy conservation methods. EMC also carries out various competitions such as painting, essay writing, cartoons, etc., on subjects related to energy conservation to increase their interest in this field.

Shining Examples of Sustainability

One of our flagship initiatives, the 'Angan Jyoti' Project, embodies our vision. It aims to transform a staggering 33,115 Anganwadis (early childhood care centers) in Kerala into energy-efficient and ultimately energyneutral havens. This project has already seen successful implementation in 424 Anganwadis across Chittur and Kazhakkottam Legislative Assembly Constituencies. By equipping these centers with induction cooktops, energy-efficient utensils, and solar PV plants, we not only achieve a significant reduction in energy consumption but also elevate the quality of life for both children and staff. A more sustainable environment fosters a nurturing space for their well-being. **Cool roof project:** Similar in its impact is the Cool Roof Project, another noteworthy initiative aimed at boosting energy efficiency. This project tackles the issue of heat absorption in buildings by installing reflective and insulated roofing materials. The result? A reduction in reliance on air conditioning, leading to lower energy consumption. This initiative holds particular significance in urban areas where the heat island effect is a growing concern. Cool roofs not only contribute to a greener environment but also ensure a more comfortable indoor temperature, leading to improved well-being and significantly reduced electricity bills.

The cool roof project tackles the issue of heat absorption in buildings by installing reflective and insulated roofing materials.

Transforming Mobility

The 'Go Electric Campaign' acts as a catalyst for transitioning to cleaner mobility solutions. This campaign raises awareness about the benefits of electric vehicles and electric cooking, while providing technical support

At the Energy Management Centre, our mission is unwavering: To cultivate a culture of energy conservation and efficiency that permeates every facet of life in Kerala. Through our diverse programs and initiatives, we strive to create a future that will be not just sustainable but also flourishing.

for establishing essential charging infrastructure. Kerala's remarkable surge in electric vehicle adoption (over 0.17 million vehicles) without government subsidies underscores the effectiveness of these initiatives. We acknowledge the commendable support provided by Kerala State Electricity Board Limited (DISCOM) and the Agency for New and Renewable Energy Research and Technology (ANERT), the State Nodal Agency of MNRE, in setting up public charging stations. More private players are coming forward to establish charging infrastructures. The combined efforts, had made Kerala the state having second-highest number of electric vehicles and charging infrastructures, in India.

Financing of Energy Efficiency Projects

To incentivize energy efficiency projects across Kerala, EMC has implemented a multifaceted approach. A key initiative is the establishment of a revolving fund for such projects under the Kerala State Energy Conservation Fund. This fund, supported by the Bureau of Energy Efficiency (BEE) and the Government of Kerala, offers attractive loan options with lower interest rates to both public and private sectors within the state. Additionally,



The cool roof project tackles the issue of heat absorption in buildings by installing reflective and insulated roofing materials.

interest subvention schemes provide further financial support for energy efficiency endeavors. The EMC's innovative approach also includes organizing 'investment bazaars'. These events connect potential borrowers with banks willing to offer loans for energy projects, thereby enhancing access to the financial resources necessary for such initiatives. These combined measures contribute to a more sustainable energy landscape in Kerala by making energy efficiency projects financially viable and attractive.

A Legacy of Achievement

Kerala's position as a frontrunner in energy efficiency is a direct result of the innovative and impactful schemes implemented by the EMC.

At the EMC, our mission is unwavering: to cultivate a culture of energy conservation and efficiency that permeates every facet of life in Kerala. Through our diverse programs and initiatives, we strive to create a future that will be not just sustainable but also flourishing. By minimizing our carbon footprint and promoting the adoption of clean energy technologies, we are making significant strides towards a future where Kerala shines even brighter, a beacon of sustainability for generations to come.



The future of power trading in India

With successful operation of Renewable Energy Certificates (REC) and Energy Saving Certificates (ESCert) markets by Power exchange over the past 14 years, the Exchanges are poised to play a significant role in development of Carbon market.



Power markets and the sector are at a very interesting stage right now, with significant policy initiatives being taken to drive forward the power sector in the country. We are awaiting approval for increasing tenure of longer tenure contracts from existing 3-months to up to 11-month ahead, this would enable market participants to meet their power trading requirements on our 'PRATYAY' platform on yearly basis, that captures the seasonal variation in demand-supply for any Discom. In near future, Power Exchange India Limited (PXIL) will be introducing Capacity Contracts, SRAS, etc. for meeting their requirements.

In addition to the series of steps being taken to drive the power sector forward, there is also a focused drive to enhance the efficiencies of the sector by utilising market frameworks. The power markets and especially power exchanges as Market Infrastructure Institution ('MIIs') are an important instrument in this drive towards enhancing efficiency for all consumers in the country.

Policy Initiatives

Many power sector reforms are being introduced by the Government to bring efficiency, promote decarbonization, and ensure a 24x7 reliable and affordable power supply. In order to move towards a green economy, the National Carbon Market was notified in June 2023 with an objective to involve different sectoral entities towards energy saving and carbon emission reductions.

The carbon market will pave the way for a large-scale promotion of clean energy technologies in India leading to de-carbonization of Indian economy through active participation by various stakeholders. With successful operation of Renewable Energy Certificates (REC) and Energy Saving Certificates (ESCert) markets by Power exchange over the past 14 years, the Exchanges are poised to play a significant role in development of Carbon market.

Introduction of 'Market Coupling'

We have a highly supportive policy and regulatory environment today and a lot of opportunities to serve the marketplace through a wide variety of contracts of various tenures and catering to various segments of the market. There are regulatory provisions like Market Coupling, which is now in pilot phase that helps reduce fragmentation and inefficiencies in the market. Recently, Central Electricity Regulatory Commission (CERC) issued an order on 06.02.2024 regarding 'Implementation of shadow pilot on power system and cost optimisation through market coupling' wherein it has directed GRID-India as under:

- Develop, within two months from the date of this order, the necessary software as required for running the shadow pilot for coupling of RTM of the three power exchanges as well as coupling of Real-Time Market (RTM) and Security Constrained Economic Dispatch (SCED), and for coupling of DAM of the three power exchanges. The software so developed should be scalable for running the shadow pilot for coupling of Day-Ahead Market (DAM) and Security Constrained Unit Commitment (SCUC), as and when decided by the Commission.
- Implement the shadow pilot of coupling
 - a. RTM of the three power exchanges
 - b. RTM and SCED and
 - c. Day Ahead Market (DAM) of the three power exchanges, for a period of four months after the development of the necessary software
- Share the operational experience of running a shadow pilot in the form of a monthly report during the period of four months and a feedback report at the end of the four-month period.
- Suggest the feasibility of coupling of the DAM and SCUC within two months from the date of this order.

The CERC order provides a broad outline for undertaking the pilot phase, since implementation requires coordination between National Load Despatch Center (NLDC) and the three power exchanges, a focused approach of consultation and consensus between the participants and guidance from Regulator from time-totime would play a crucial role in fulfilling the objectives of pilot phase.

With introduction of 'Market Coupling' in near future, Indian power market is poised to grow significantly aligning with the expectations that have persisted since inception of power exchanges from 2008 onwards. It is observed that in developed economies of Europe power markets account for nearly 50 per cent of total consumption, this when compared to Indian context has risen to nearly 7 per cent, about five years back the contribution was up to 4.5 per cent. With envisaged Policy and Regulatory measures this may increase up to 25 per cent in near future. One major trigger for this shift being current unwillingness to sign long-term Power Purchase Agreement (PPA) due to general uncertainty around thermal capacity and introduction of new generation technologies in electricity/energy space. Consequently, major part of future incremental demand is likely to be geared towards the market.

Future Outlook: FY 2023-24 and Beyond

The dynamic landscape of India's power sector, coupled with its impressive growth, underscores the immense potential of power trading in the country. The robust growth of renewable energy installations, coupled with the evolution of power markets and trading mechanisms, showcases the forward momentum.

As India marches towards installing 500 GW of renewable energy and achieving its net-zero targets, power exchanges will play a much more significant role. Though power exchanges account for 6-7 per cent of the

With introduction of 'Market Coupling' in near future, Indian power market is poised to grow significantly aligning with the expectations that have persisted since inception of power exchanges from 2008 onwards. As India marches towards installing 500 GW of renewable energy and achieving its net-zero targets, power exchanges will play a much more significant role. Though power exchanges account for 6-7 per cent of the country's power consumption, power trading through exchanges provides flexibility, competitive prices, transparency, payment security, risk management and greater choices for market participants.

country's power consumption, power trading through exchanges provides flexibility, competitive prices, transparency, payment security, risk management and greater choices for market participants.

Power exchanges would be crucial in facilitating efficient integration of the projected RE capacity into the grid. Exchanges will be instrumental in managing the intermittencies of renewable energy, reducing the cost of integration, and providing price signals for further capacity additions. Globally, power exchanges have played a key role in reducing the cost of renewable energy integration and providing efficient price signals for newer capacity addition. Taking cognisance, the Government aims to increase the share of power exchanges to 25 per cent by 2030.

In line with the country's sustainability vision, green market segments at exchange platforms are going to increasingly become significant over the next few years. Consequently, innovative products such as green contracts would gain traction. Also, in the Term Ahead Market (TAM) existing contracts with delivery up to 90 days would be extended up to 11 months. These longer duration contracts would enable Discoms to hedge risk against volatility in spot prices. In FY 23-24, two distinct segments witnessed commencement of trading on exchanges, one was the High Price Day Ahead Market (HP-DAM) segment, to help bring surplus liquidity to spot markets during high demand months and the other being the Tertiary Reserve Ancillary Services (TRAS) market segment. This segment began trading from the delivery date of 1st June 2023 for the Day Ahead Market Ancillary Services as well as for the Real Time Market Ancillary Services.

It is expected that by 2030, grid scale Battery Energy Storage Systems (BESS) would play a crucial role in large scale RE integration having reached an installed capacity of 27 GW. The Solar Energy Corporation of India (SECI) and the Ministry of New and Renewable Energy (MNRE) have been working towards promoting the use of market options for storage tenders.

Conclusion

In the dynamic landscape of India's energy sector, PXIL is redefining itself as a catalyst for transformation. With its role in facilitating efficient transactions, encouraging renewable energy integration, and promoting competition, the company is geared to hold the promise of a cleaner and more resilient energy future.



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CASE STUDY

Shaping a More Sustainable Future

EverEnviro Resource Management's initiative in the city of Indore, highlights the remarkable impact of Compressed Bio Gas (CBG) on the environment and community. This case study examines the plant's journey, illustrating its substantial impact on the city's cleanliness initiatives and its alignment with India's **Swachh Bharat** Mission, with the goal of establishing 'Garbage Free Cities.'



India's largest Municipal Solid Waste (MSW-based) Compressed Bio Gas facility, set up by EverEnviro Resource Management Pvt Ltd.

ndore, a beautiful city nestled in Madhya Pradesh is a vibrant hub for industry, education, culture, and innovation. It is recognized as the cleanest Urban Local Body (ULB) in India with over 95 per cent waste segregation, despite of its status as the most populous city in the state. The city is also home to Indore Clean Energy Pvt Ltd, India's largest Municipal Solid Waste (MSW-based) CBG facility, set up by EverEnviro Resource Management Pvt Ltd.

From once being a landfill burdened with 2 lakh MT of waste, the facility today handles 550 MT of organic waste daily. It has the capacity to produce 17 tons of BioCNG and 40 MT of organic fertilizer each day, preventing the potential accumulation of over 4 million tons of waste in the next 20 years. The plant has been visited by national and international delegates, including Alex Ellis, British High Commissioner; Shri Chiri Babu Maharjan, Mayor of Lalitpur Metropolitan City, Nepal and delegates representing PAN India ULBS, amongst others. To date, the plant has processed more than 6,000 MT of waste and produced over 3,500 MT of CBG.

The Indore Plant - A Beacon of Environmental Change

Largest Cleanliness Drive: EverEnviro's Indore plant is at the forefront of the city's largest cleanliness drive. The



EverEnviro Resource Management's initiative in the city of Indore, highlights the remarkable impact of Compressed Bio Gas on the environment and community.

CASE STUDY



The plant has the capacity to produce 17 tons of BioCNG and 40 MT of organic fertilizer each day.

company recognizes that segregation is a key to success of many wastes to energy projects. EverEnviro and Indore Municipal Corporation ensure regular training programs to achieve meticulous source segregation.

Waste Collection and Processing: The waste collection process involves gathering both wet and dry waste at collection points. EverEnviro's skilled work force identifies and removes maximum quantity of non-organic waste and ensures only organic waste reaches the site.

Processing and Digestion: The collected waste is transported to the site by 45-55 trucks daily. The received waste is processed through a series of pretreatment steps to extract the organic.

Biogas Production: The extracted organic material is anaerobically digested with a retention time of 30-40 days. The biogas which is produced during the anaerobic digestion process is purified to the level of >96 per cent by state-of-the-art upgradation technology. The purified gas is then compressed and sold as BioCNG.

Success Amid Challenges

The commencement of this first-of-its-kind and magnanimous facility in India posed an initial testing phase for the entire project team that experienced difficulties in operating the plant, contributing to fluctuating production levels. Overcoming these challenges required strategic planning and adaptation to ensure the financial sustainability of the project in the long run. During this experimental period, substantial investments were made to incorporate cutting-edge global technologies for efficient waste processing and anaerobic digestion. With the advent of these technologies, frequent equipment break downs have been minimized and significant improvements were observed in waste to gas conversion.

The Way Ahead

The project reduces 1 lakh MT of CO_2 and replaces 20,000 litres per day of fossil fuel, leading to reduced Green House Gas (GHG) emissions and carbon footprint. The Indore Municipal Corporation (IMC) utilizes 50 per cent of the CBG produced daily as transportation fuel for their city buses. This is not only reducing the dependency on diesel but also, at the same time is contributing to a cleaner environment.



The Indore Municipal Corporation utilizes 50 per cent of the CBG produced daily as transportation fuel for their city buses.

The success story - from tackling environmental problems - to aiding sustainable agriculture, reflects the positive outcome of CBG produced at Indore Clean Energy Pvt Ltd. Challenges along the way have become learning opportunities for growth and for shaping a more sustainable future. ■

The twin role of hydraulic and all-electric systems

The focus on alternative energy is offering considerable opportunities and challenges. There appears to be a consensus that the world needs secure, affordable, and low-carbon energy. We have a role to play in developing the technical solutions to unlock pathways to affordable, low carbon energy. To do this, we must maintain continued and sustained investment in today's energy system, including traditional hydrocarbons – and also in the technologies enabling the gradual transition.

ydrocarbons will continue to be an integral part of the global energy mix, with the world's demand for energy continuing to grow according to projections by the International Energy Agency (IEA)¹, outpacing the rate at which low-carbon energy solutions can be brought online. As a result, we are seeing continued commitment to developing new hydrocarbon reserves. This is underlined by the level of activity we are seeing in the industry. For example, growth in demand from China is reflected in growing Floating Production Storage and Offloading (FPSO) demand, with Brazil earning the title of 'FPSO capital', with more than 50 vessels at sea since 2005 and a growing order book to accommodate the unrelenting demand for low cost energy, according to an analysis from Rystad Energy.

In subsea alone, the investment in the subsea systems market is estimated to increase to US\$15.3 billion by 2030 alone. This surge of demand is a willingness among stakeholders to explore new solutions to deliver low cost energy. In particular, technological advances

in subsea robotics, sensors, and communication systems - Carbon Capture, Utilisation and Storage (CCUS), are also coming to the fore. Particularly, subsea control systems are an area of innovation with new subsea system solutions, such as second-generation allelectric systems, coming into operations across the globe with a wider application for the harshest environments whilst helping to reduce the energy intensity of operations, all whilst helping the global economy grow faster.

But, the subsea industry needs to balance innovation while also addressing the need for proven fast-tomarket solutions, as we can see from the development of all-electric control systems as a subsea solution to the development of new hydraulic control fluids. All aspects of the system, especially control fluids, need to be fieldproven to meet the increased scrutiny with skyrocketing demand without onerous costs. Yet, do we risk getting carried away with the hype around all-electric systems and overlooking technology that is already available, has proven reliability, and can deliver known performance and value today?

Trust What Works

While all-electric technology holds real potential, we must not overlook the reality of the status quo regarding current or planned subsea systems. The reality is that



Oil Gas & Power

in the next five years, the majority of new subsea wells will be Electro Hydraulic Multiplexed (EH-MUX) system controlled. And the data shows that only between 5 to 10 per cent of the 1,200 Christmas Trees (XT) forecasted to be installed in the next five years will be all-electric, and this is only possible if suitable fields for all electric make it through Financial Investment Decision (FID).

It is clear that operators will use solutions they can trust. And EH-MUX systems will be a compelling offer for the foreseeable future. With hydraulics, operators get a

use spanning decades.

API17F High Temperature Testing

high level of reliability and field-proven solutions with the highest Technology Readiness Level (TRL) and in service

Proven track records are fundamental in ensuring the success of any new technology in our industry, which has a history of being slow to adopt new technology. Investment into further improving the reliability of EH-Mux systems continues in line with all electric systems to ensure continuity for not only new, but also legacy systems and infrastructure.

There is confidence, underpinned by decades of performance in reliability and hydraulics along with an established supply chain that we should not underestimate where operators want things to work safely, effectively, and reliably. For example, operators want systems that require minimal intervention during commissioning and start up enabling fields to be brought online in the most cost-efficient way. Supply chain optimisation and standardisation make conventional hydraulic systems cheaper and faster to produce, and whilst this is also true for the modular design of all electric systems, knowledge, awareness, and experience of EH-MUX systems, are the current preferred solution. Ultimately, operators want to operate their assets safely, with minimal downtime and intervention and a well-supported supply chain that will lead them to proven and cost-effective solutions.

When it comes to a fundamental change in how a system is designed, manufactured, deployed, and operated, it is often highlighted that the industry is reluctant to adopt novelties without substantiated evidence, and quite rightly so. When so much is at stake from a safety, environmental and sustainability perspective, why would an unproven technology be selected over an offering with a known and established track record? We must, however, continue to invest and develop technologies that will help simplify and reduce system costs as well as help with the decarbonisation of the industry. Whilst the status quo might seem comfortable, we must always look at how we can utilise technological advances to better perform as an industry. We should be doing all we can and learning from adjacent industries to see solutions that make a genuine positive impact, as well as what makes sense for operators throughout the life of their field and system.

Hydraulic control fluids are not a legacy solution

Hydraulic systems are the go-to for subsea production technologies, with 20,000 hydraulically operated wells that will continue to operate for decades. Control fluids will be the lifeblood of the control systems, continuously evolving to meet the ever-challenging demands of wells and fields, such as depth, temperature, and hydrate management. Having proven and effective control fluids for different systems is crucial.

Beyond the technical capability of a subsea control fluid to ensure safe and reliable operation of the system, an arguably even more fundamental element of their development lies in ensuring the environmental performance of the fluids in compliance with relevant environmental legislation. As standards continue to evolve, sustained investment is required to ensure product compliance is maintained.

It is clear that investments in our existing product offerings are vital in ensuring both technical and environmental requirements are met. One particular challenge the industry faces is tackling gas hydrates, which can cause the blockage of some of the small bore control lines within the system, in particular the subsea surface safety valves.

Methane can migrate across seals in the Subsurface Safety Valve (SSSV) and up the line and accumulate and there is a risk, should the relevant environmental conditions be present, that hydrate crystals can occur during the pressurization of the line, to operate the down hole valve.

To mitigate against this risk, we have recently introduced our new Castrol Transaqua[™] SP-HC subsea control fluid. It is a water-based hydraulic control fluid specifically formulated for use as the control medium in subsea production control systems and, in particular highpressure gas wells. This new control fluid is an example of how today, even control fluids are capable of innovation to meet the demands of the offshore oil and gas segment as opposed to being solely a legacy system.

The transition towards all-electric

For new technology to be adopted, it has to offer real value to the user – in this instance, the operators. All electric systems will certainly have their place in the industry if the current claimed benefits can truly be realised. Depending on the system provider, this includes a Capital Expenditure (CAPEX) reduction as well as other claimed benefits such as lower carbon intensity and reduced lead times.

The transition to all-electric technology is welcome, especially with its strong track record in key application areas, such as manifolds and some tree functionality. Already, subsea electric power networks are boosting pump and autonomous vehicles for subsea intervention and powering XTs.

Yet, the conversations within the industry show we are looking to rationalise operations and reduce costs while boosting production. Therefore, we must be patient with the transition to all-electric. Any rush to adopt the technology could be counter-intuitive and certainly will only happen after a period of time. Meanwhile, hydraulic subsea control fluids are crucial in underpinning reliability throughout field life because they are reliable, assured, and proven. The subsea sector will continue to use hydraulically controlled subsea wells, especially on legacy installed assets that use hydraulic technology throughout their lifecycle, which can last decades and on new, increasingly extreme and remote locations for years to come. We know that the three pillars that the industry wants to focus on are uptime, reliability of production, and, now increasingly, conversations surrounding sustainable operations. For now, we should rely on proven, viable and commercially feasible solutions that have done the job for over 40 years. At the same time, we should continue to invest in technology that has the potential to unlock the desired efficiencies and meet the new challenges thrown at us. We must call upon our expertise within the sector, to achieve this aim. For the offshore oil and gas segment to fulfil its mission to provide the energy the world needs, it must have the solutions to ensure reliability and uptime, and both hydraulics today and all-electric in the future can support.

References

 Outlook for energy demand – World Energy Outlook 2022 – Analysis -IEA

 https://www.bp.com/en/global/corporate/energy-economics/energyoutlook/oil.html

 https://www.fpsonetwork.com/events-fpsobrazilcongress/ downloads/2023-brazil-market-outlook-rystad-energy-report

 https://www.offshore-mag.com/subsea/article/14290517/subseasystems-market-witnessing-steady-growth

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PRODUCTS

Acuity Process Twin Pro from KBC

KBC (a Yokogawa Company) announces the release of KBC Acuity[™] Process Twin Pro, a web-based software as a service (SaaS) application. This AI-powered application leverages rich data analytics and optimization methods to automatically monitor and update Petro-SIM[®] digital twin solution to ensure consistent value is delivered. From one centralized platform, KBC Acuity Process Twin Pro technology provides meaningful insights to help refiners accelerate decision-making and facilitate efficient asset management and operational effectiveness.



The KBC Acuity Process Twin Pro application uses data-driven insights and automated work processes to update digital twins for identifying business opportunities, mitigating risks, and optimizing assets, thereby improving refining operations. This new application operates within the KBC Acuity Industrial Cloud Suite and seamlessly integrates with the Petro-SIM process simulator and RTO (real time optimization) systems. With KBC's expertise and first-principles modeling and simulations, the new solution accelerates digital transformation and provides sustained value.

Key benefits of KBC Acuity Process Twin Pro technology include:

Health Index Monitor: Proactively alerts users of any inaccuracies and risks in one or more assets across sites to prevent outdated digital twins from being used for unit optimization and profitability studies.

Automated Workflow: Performs calibrations and tuning studies within the application to profile candidate cases based on quality and prediction analysis to facilitate efficient data handling while increasing employee productivity and engagement.

Perfect Digital Twin: Fine-tunes the model's parameters, enhancing the digital twin's accuracy long-term. By reducing dependency on domain expertise, it empowers users to make well-informed decisions.

Cloud Collaboration: Provides a scalable and centralized platform to monitor, maintain, and visualize multiple assets that simplifies asset management, planning, and sharing best practices across all business units.

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Schunk's extruded graphite bipolar plates for fuel cells are manufactured specifically for the proton exchange membrane fuel cell (PEMFC) and directmethanol fuel cell (DMFC) types. The graphite bipolar plates exhibit high corrosion resistance to various electrolytes. They have good mechanical strength without brittle fracture as well as very good liquid tightness. The other advantage of the thermoplastic material is that the flexible bipolar plate can be welded directly to the frame of the battery stack. This replaces conventional sealing solutions and ensures a compact design.

The thermoplastic-bonded high-performance material is transferred into a continuously produced film. This makes it possible to produce bipolar plates in large formats (> 1,000 mm length and 380 mm width). The film can be given additional features by surface treatment and finishing.

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