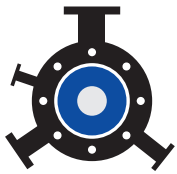


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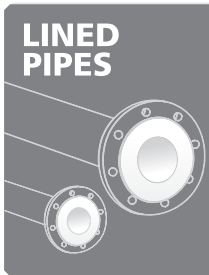
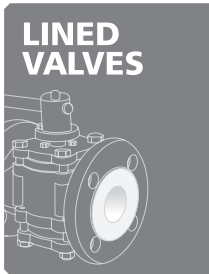
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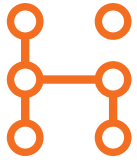


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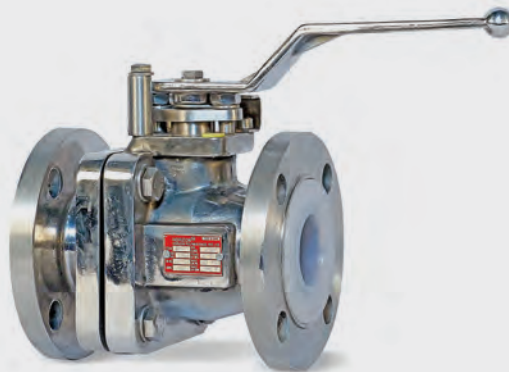
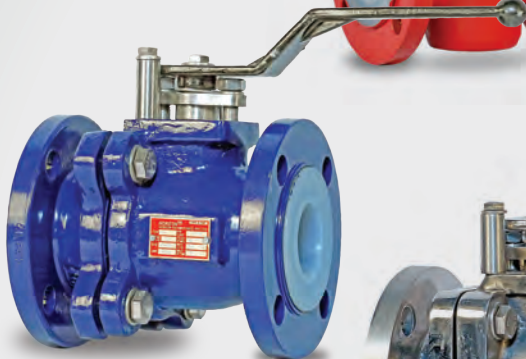
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## Cabinet approves Mechanism for procurement of ethanol by Public Sector Oil Marketing Companies (OMCs) under Ethanol Blended Petrol (EBP) Programme

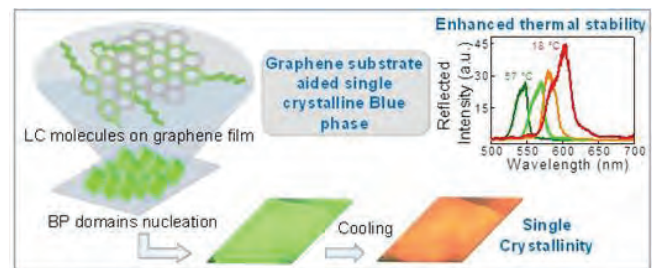
**New Delhi, India:** The Cabinet Committee on Economic Affairs chaired by Hon'ble Prime Minister Shri Narendra Modi has approved higher ethanol price derived from different sugarcane based raw materials under the EBP Programme for the forthcoming sugar season 2022-23 during ESY 2022-23 from 1st December 2022 to 31st October 2023. The price of ethanol from C heavy molasses route be increased from Rs.46.66 per litre to Rs.49.41 per litre, The price of ethanol from B heavy molasses route be increased from Rs.59.08 per litre to Rs.60.73 per litre, The price of ethanol from sugarcane juice/sugar/sugar syrup route be increased from Rs.63.45 per litre to Rs.65.61 per litre, Additionally, GST and transportation charges will also be payable.

All distilleries will be able to take benefit of the scheme and large number of them are expected to supply ethanol for the EBP programme. Remunerative price to ethanol suppliers will help in early payment to cane farmers, in the process contributing to minimize difficulty of sugarcane farmers.

Government has been implementing Ethanol Blended Petrol (EBP) Programme wherein OMCs sell petrol blended with ethanol up to 10%. This programme has been extended to whole of India except Union Territories of Andaman Nicobar and Lakshadweep islands with effect from 01st April 2019 to promote the use of alternative and environment friendly

fuels. This intervention also seeks to reduce import dependence for energy requirements and give boost to agriculture sector.

## Graphene-stabilised tunable photonic crystal can make more durable & better reflective display and lasers devices



**New Delhi, India:** A soft tunable photonic crystal with enhanced thermal stability and optical purity developed by researchers that reflects vivid colours in the visible spectrum has potential applications in making more durable and better reflective displays and laser devices.

Photonic crystals are optical nanostructures in which the refractive index changes periodically. This affects the propagation of light in the same way that the structure of natural crystals gives rise to X-ray diffraction and that the atomic lattices (crystal structure) of semiconductors affect their conductivity of electrons. Photonic crystals occur in nature in the form of structural coloration and animal reflectors. Examples found in nature include opal, butterfly wings, peacock feathers, etc., exhibiting distinct iridescent colours.

When artificially produced or engineered in laboratories, photonic crystals promise to be useful in a range of applications ranging from reflection coatings to optical computers.



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Thanks to glass feedthrough, the point level detection with vibrating level switch VEGASWING provides an additional process separation. Different sealing and housing materials ensure long-term and maintenance-free operation.

They enable the PCs to exhibit structural colours in the visible spectral regime. Ever since researchers have learnt how to fabricate photonic crystals, they have been on the constant lookout for tuning the properties in-situ post-fabrication. Liquid crystalline (LC) materials exhibiting self-organization, phase transition, and molecular orientation behaviours in response to external stimuli are attracting significant attention for tuning of advanced photonic materials and devices.

Blue phase (BP), a unique thermodynamic phase of liquid crystals, is a 3D photonic crystal by virtue of the combination of a cubic lattice structure and fluidity. With the lattice spacing of a few hundred nanometres, the cubic BP exhibits selective reflection of colours in the visible spectrum. Due to the soft stimuli responsiveness of BP, the Photonic Band Gap (PBG) (phenomenon that prevents light of certain frequencies or wavelengths from propagating in one, two, or any number of polarisation directions within the materials) can be efficiently tuned with relatively low-magnitude thermal, electric and optical fields.

## **An indigenous technology from IIT Madras can now produce new-generation super-abrasive tools**

**Madras, India:** A newly developed technology can now produce new-generation multi-point/single-layer super abrasive tools for advanced grinding applications to meet high productivity and energy-efficient material removal requirements. The tools produced also have enhanced tool life. A research team led by Dr. Amitava Ghosh at IIT Madras has used advanced chemical bonding technology

with an application-specific novel formulation of filler material and controlled spacing of grits on the tools by an indigenously developed semi-automatic grit-printing device.

The team recommends application-specific-advanced coatings to develop such new-generation super abrasive tools. The novel formulation offers an excellent blend of strength, wear resistance, and wetting characteristics. The grit-planting (planting/placing of grits in pre-defined co-ordinate position on grinding wheel's working surface) setup allows a manufacturer to print grit in customised pattern to suit the requirement of an application. The recommended coating enhances the durability of the bond, thus adding life to the developed tools.

These super abrasive tools can be produced using active brazing technology with remarkably striking attributes of high crystal exposure above bond level. The joint strength and wear-resistant characteristics of bond of these tools are superior to those of their commercial counterparts. These tools can withstand more grinding force, offer significantly higher tool life, and execute load-free grinding of advanced materials with an extremely high material removal rate. This new technology offers a competitive cost with a superior quality tool, which is also tailor-made as per the needs of industries like aerospace, automobile, mining, and dental surgery.



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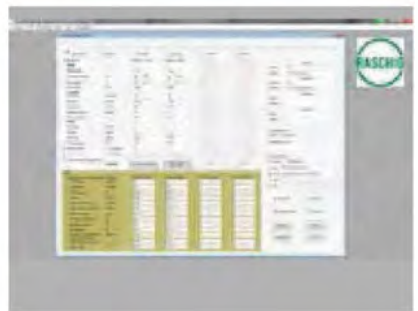
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## MNRE notifies National Bio Energy Programme

**New Delhi, India:** The Ministry of New and Renewable Energy (MNRE), Government of India has notified the National Bioenergy Programme on November 2, 2022. MNRE has continued the National Bioenergy Programme for the period from FY 2021-22 to 2025-26. The Programme has been recommended for implementation in two Phases. The Phase-I of the Programme has been approved with a budget outlay of Rs. 858 crores.

The National Bioenergy Programme will comprise of the following sub-schemes: Waste to Energy Programme (Programme on Energy from Urban, Industrial and Agricultural Wastes /Residues) to support setting up of large Biogas, BioCNG and Power plants (excluding MSW to Power projects).

Biomass Programme (Scheme to Support Manufacturing of Briquettes & Pellets and Promotion of Biomass (non-bagasse) based cogeneration in Industries) to support setting up of pellets and briquettes for use in power generation and non-bagasse-based power generation projects.

Biogas Programme to support setting up of family and medium size Biogas in rural areas.

To utilize huge surplus biomass, cattle dung, industrial and urban biowaste available in the country for recovery of energy, the MNRE has been promoting bioenergy in India since 1980s. One major support extended by MNRE has been Central Financial Assistance provided for setting up of Bioenergy projects such as Biogas, Bio-CNG, Power from urban, Industrial and Agricultural Waste / Residues

for reducing their capital cost/ interest on loan therefore increase project viability.

## Evonik Venture Capital invests in Fund VIII of Global Brain Corporation, Japan

**Tokyo, Japan:** Evonik Venture Capital has invested in Fund VIII of a Japanese venture capital company- Global Brain Corporation. This investment marks Evonik's first venture to invest in Japan. The Fund focuses on start-ups with disruptive technologies in the fields of biotechnology, food and agricultural technology, clean technologies, innovative materials and DeepTech. Bernhard Mohr, head of Evonik Venture Capital has said "Japan is a highly innovative country with a well-developed chemical industry, an interesting research landscape, and a flourishing start-up scene."

## World's largest petrochemical crackers in South Korea to be built by Aramco affiliate S-OIL

**Ulsan, South Korea:** In line with the Aramco's strategy to maximize the crude to chemicals value chain, the company has made their largest ever investment in South Korea, The US \$7 billion Shaheen project will convert crude oil into petrochemical feedstock and would represent the first commercialization of Aramco and Lummus Technology's TC2C thermal crude to chemicals technology, which increases chemical yield and reduces operating costs.

The new plant located at S-Oil's existing site in Ulsan, is planned to have the

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capacity to produce up to 3.2 million tons of petrochemicals annually and include a facility to produce high-value polymers. The steam cracker is expected to process by-products from crude processing, including naphtha and off-gas, to produce ethylene — a building block petrochemical industry and is used to make thousands of everyday items, along with propylene, butadiene, and other basic chemicals. The project is expected to start in 2023 and be completed by 2026.

## Yara India signs agreement with Sea6 Energy for AG Boost marketing

**Bengaluru, India:** Yara India, which is part of Norwegian multinational Yara International, the world's leading crop nutrition company and a provider of agricultural, industrial, and environmental solutions, has signed an agreement with Bengaluru-based start-up Sea6 Energy to market and distribute its Bio stimulant 'AG Boost' in India.

'AG Boost' is being launched under the umbrella brand Nourish and fits well into the Integrated Nutrient Management (INM) program. It is a technologically advanced and patented Bio stimulant that aims to bolster agricultural productivity and improves fertilizer use efficiency and nutrient uptake, resulting in better productivity for the farmers.

## Evonik commences commercial scale ceramides production

**Heidelberg, Germany:** Evonik Industries AG has started manufacturing commercial quantities of ceramides (a special class of lipids) at its site in Dossenheim near

Heidelberg in Germany Maximizing capacity utilization at the Dossenheim site. This provides Evonik with further flexibility and supply security, including increased independence from alternative routes of supply to cater to the growing demand for ceramides in the personal care market.

The market for ceramides offers considerable opportunities with a growing number of applications in skin care, hair care, sun care, colour cosmetics, advanced food additives and animal care. Crucial to the effect of ceramides is the active ingredient delivery system, which transports the active ingredients to the correct layers of the skin.

"Expanding our in-house production capacity for ceramides enables us to meet the demand of our strategic customers who have minimum volume commitments and very long-term agreements with us. We are also in a strong position to supply other customers with the flexibility and security they need," said Johann-Caspar Gammelin, head of the Nutrition & Care division at Evonik.

## LG Chem develops first carbon mitigation facility using proprietary technologies

**Seoul, South Korea:** LG Chem, advancing their progress towards 2050 Net Zero goals will construct an innovative carbon mitigation facility that will produce raw materials for plastics using carbon dioxide. LG Chem announced that they will construct a DRM (Dry Reforming of Methane) facility which can produce plastics using carbon dioxide captured at the plant and the by-product gas,





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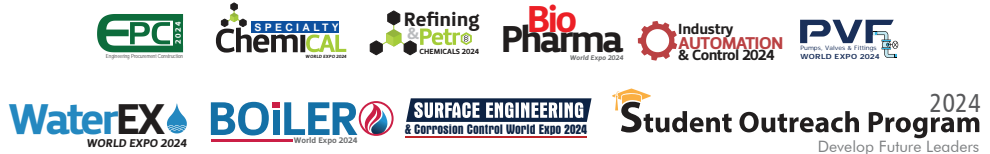
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methane. With this development LG Chem is the first in Korea to commercialize DRM facilities using proprietary technology-based processes and catalysts.

DRM is a type of CCU (carbon dioxide, capture, and utilization) technology and an innovative carbon mitigation facility that reduces carbon dioxide emissions by more than 50% while producing polycarbonates, etc., which are primary plastic materials. By 2023, the DRM facility will be constructed as a 1,000-ton pilot plant at the Daesan Plant in Chungcheongnam-do. After verifying the process technologies and catalysts developed using proprietary technologies, plans are to expand its scale until 2026.

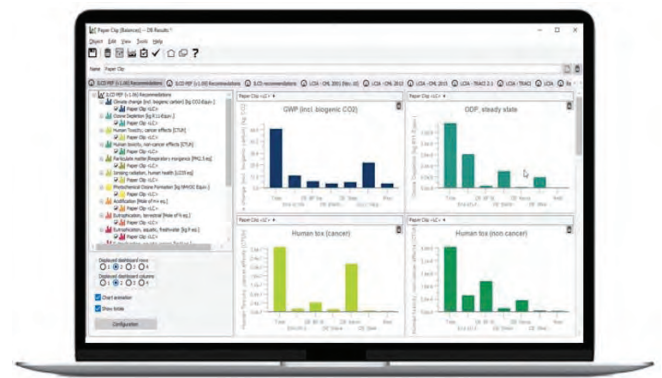
## PyroGenesis using plasma process develops successful conversion of methane into hydrogen production

**Toronto, Canada:** PyroGenesis to address problems caused by environmental pollutants designs, develops, manufactures, and commercializes advanced plasma processes and sustainable solutions to reduce greenhouse gases (GHG) has announced that the company had filed a patent for a new Zero Carbon Emission (ZCE) hydrogen production process, it has successfully produced hydrogen from methane using this revolutionary ZCE hydrogen production technology. The hydrogen generated by any methane process that is driven by heat produced with electricity, rather than combustion of fossil fuels, is typically referred to as "Turquoise Hydrogen"

This novel plasma-based hydrogen production process converts this methane into a valuable

solid carbon and hydrogen, thereby creating a ZCE hydrogen. The solid carbon is a by-product that has many industrial applications, including the production of car tires, coatings, plastics, and batteries, and is considered an essential raw material.

## Sphera and Eastman collaborate on Life Cycle Assessment Software for Process Industry



**Chicago, United States:** Sphera, has announced forthcoming iteration of Sphera's Life Cycle Assessment (LCA) Automation software with their long-time collaborator-customer, Eastman, an innovative global specialty materials company. LCA Automation tool will help businesses more effectively reduce their greenhouse gas (GHG) emissions at every step of production, from design to assembly. The next phase of LCA Automation will meet the complex needs of the chemical industry.

Sphera launched its next-generation LCA Automation solution that allows businesses to quickly receive holistic, real-time analysis and insights into the environmental footprint of their product portfolios and integrates seamlessly with their existing systems, earlier this year.

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**Facts & Figures**  
 2020

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 4

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## **Novecare Unit in Vadodara R&I Centre of Solvay to offer path breaking solutions**



**Vadodara, Gujarat:** Solvay is now gearing up to develop new formulated solutions targeted at consumer end markets by expanding the presence of its Novecare Global Business Unit at the Vadodara Research and Innovation (R&I) Centre. Now, the Novecare teams will benefit from the proximity to prospective customers, building pathways for further collaborations in India and Southeast Asia.

The diverse teams at Global Business Unit will combine Novecare's core technologies - surfactants, natural and synthetic polymers, and green solvents along with formulation know-hows and application knowledge to deliver high-performing, differentiated solutions across the Agro, Home and Personal Care, Coatings, and Industrial markets.

## **Crystal Crop gets ₹ 300 crore (approx. 35 million USD) from IFC to promote green crop solutions**

**New Delhi, India:** An investment of Rs. 300 crores (approx. 35 million USD) by IFC and IFC Emerging Asia Fund (EAF) in Crystal Crop Protection Ltd., a leading agrochemical player in India, will allow the company to boost farm

productivity, easing supply chain disruptions triggered by COVID-19, and contribute towards infrastructure for sustainable production of crop protection products.

The project will provide farmers an access towards customized, affordable, and environment-friendly crop protection products, and in doing so, enhance their productivity.

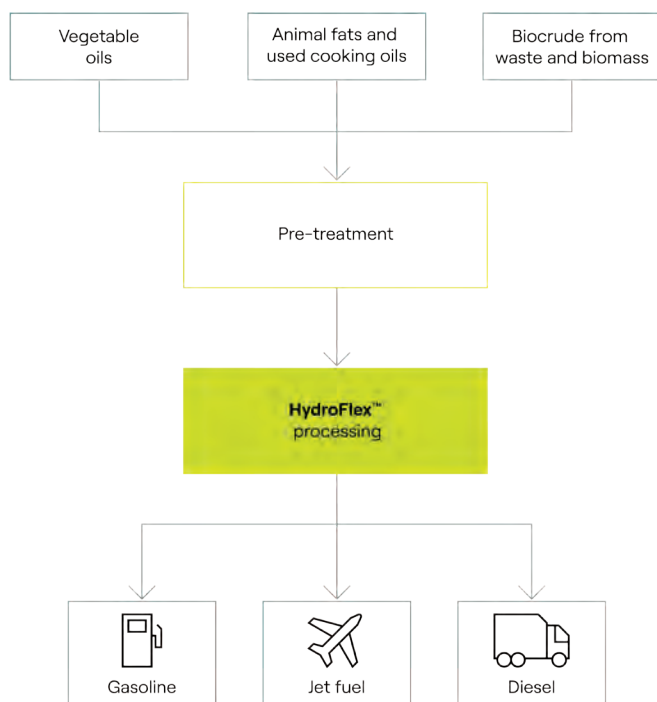
## **Public launch of the Corporate Coalition for Innovation & Technology to Net Zero (CCITNZ)**

**Sharm El Sheikh, Egypt:** A coalition of six global companies has announced the public launch of the Corporate Coalition for Innovation & Technology to Net Zero (CCITNZ), a cross-sector business alliance dedicated to helping countries meet decarbonization and climate change goals through technology. CCITNZ intends to serve as an accelerator for industries across sectors and geographies to innovate and develop breakthrough technologies to help achieve these goals. Bechtel, GE, GM, Honeywell, Invenergy, and Johnson Controls are the Founding members of the coalition.

The core objectives of CCITNZ include Innovation and technology: Promote concrete, practical and cost-effective technology solutions to tackle emissions and decarbonization challenges; Partnership: Promote strong partnerships with stakeholders in the private, public and social sector across international venues and forums to enable solutions beyond what any one stakeholder can realize; Energy

security; Partner with governments and other stakeholders to advance energy security, decarbonization, and sustainable development needs, Policy: Support sound public policies that are consistent with improving environmental effectiveness and foster innovation; Resource: Provide expertise and thought leadership to governments and other stakeholders on technology and innovation as they seek to achieve their decarbonization and climate change goals.

## Topsoe's HydroFlex technology to support Panama's SGP BioEnergy in renewable fuels production



**Panama, Panama:** Topsoe and SGP BioEnergy will join hands to commence the production of renewable fuels in South America's largest upcoming renewable fuels plant located in Panama. Topsoe will provide its innovative HydroFlex technology to produce SAF and RD and deploy its

H2bridge™ technology to ensure the plant has a net-zero greenhouse gas footprint, recycling green hydrogen generated by waste carbon and production by-product back into the plant's operations.

Once fully operational, the biorefinery will have a producing capacity of 180,000 barrels per day culminating to 2.6 billion gallons per year of biofuel and 405,000 metric tons of green hydrogen annually. Construction is on schedule for commencing production by 2025.

## KBR launches 10,000 MTPD blue and green ammonia

**Huston, US:** To help meet the growing global sustainable energy and fertilizer demands of today and tomorrow, KBR announced the launch of its mega 10,000 MTPD blue and green ammonia. The new offering leverages KBR's proven leadership in capacity scale-up and integrates the company's robust implemented designs with advanced digital technologies to provide owners the reliability, flexibility and scale required to deliver clean ammonia and hydrogen demands for energy transition.

"We are truly excited to launch our mega ammonia technology for the green hydrogen and ammonia space," said Doug Kelly, KBR president of Technology.

## IMCD India to acquire speciality chemical distributor Parkash DyeChem



**New Delhi, India:** IMCD, a distributor of specialty chemicals and ingredients, has signed an agreement to acquire 100% of the shares of Parkash DyeChem Private Limited, established in 1988 and headquartered in Delhi. An asset light speciality chemical distributor Parkash DyeChem Private Limited, serves the coatings and construction segments (e.g., construction chemicals, printing inks, paints, and coatings) as well as personal care and advanced materials markets.

The closing of the transaction is expected to take place in December 2022, subject to customary closing conditions.

## Aarti and Deepak Fertilisers sign Rs 8,000 (approx. 1 billion USD) crore nitric acid supply agreement

**Mumbai, India:** Aarti Industries Ltd (AIL) and Deepak Fertilisers & Petrochemicals Corporation Ltd (DFPCL) have signed a binding term sheet for a 20-year period for offtake and supply of Nitric Acid. The agreement, over the period of 20 years, will enable DFPCL to achieve market security for a

significant portion of its nitric acid production and would result in revenue of more than Rs. 8,000 crores, approx. 1 billion USD. The parties plan to execute the formal agreement before the close of this calendar year and the supply arrangement comes into effect from 1st April 2023.

Rajendra Gogri, CMD, AIL said, "The combination of these strengths and capabilities will help in making the business more sustainable and help both of us to leverage and focus on individual growth opportunities. DFPCL has been a long-term partner for us by supporting our key raw material needs. This deal will enable us to focus on our forward integrated opportunities and help channel our resources effectively for driving more research driven long term and high growth avenues for global markets." ■

## The Prime Minister dedicates Fertilizer plant at Ramagundam to the nation

**Ramagundam, India:** The project has been set up under the aegis of Ramagundam Fertilizers and Chemicals Limited (RFCL), a Joint Venture company of National Fertilizers Limited (NFL), Engineers India Limited (EIL), and Fertilizer Corporation of India Limited (FCIL).

RFCL was entrusted with the responsibility of setting up the New Ammonia-Urea Plant with investment of more than ₹ 6,300 crores (approx. 780 million USD). Gas to RFCL Plant will be supplied through Jagdishpur – Phulpur – Haldia Pipeline. The plant would ensure adequate and timely supply of urea fertilizer to the farmers in the state of Telangana as well as in Andhra Pradesh, Karnataka, Chattisgarh, and Maharashtra. The plant would not only improve the availability of fertilizer but will also boost overall economic development in the region including development of infrastructures like roads, railways, ancillary industry etc.

## GACL's ₹ 520 crore (approx. 65 million USD) phosphoric acid plant to be commissioned by February 2023

**Gujarat, India:** Gujarat Alkalies and Chemicals Limited (GACL) currently having a production capacity of 1087 TPD, has announced that their new phosphoric

acid plant is expected to be commissioned by February 2023. Presently, the Phosphoric acid plant is 90% complete. The Capex for the plant is Rs. 520 crores (approx. 65 million USD).

A Caustic Soda with coal-based power plant constructed as a JV with NALCO has been recently commissioned and is under stabilization. The plant has a capacity of 800 TPD, of which Unit 2 is expected to be commissioned by January 2023. The total cost of the project for both Unit 1 and Unit 2 is ₹ 2,300 crores (approx. 280 million USD).

Chlorotoluene Project at Dahej with a capacity of 90 TPD will cost ₹ 350 crore and presently, basic engineering work is under progress for the plant.

## ReNew Power signs Framework Agreement with Government of Egypt to build Green Hydrogen Plant

**Cairo, Egypt:** ReNew Power Private Limited, a subsidiary of ReNew Energy Global Plc, has signed the Framework Agreement with the Government of Egypt to set up a green hydrogen plant at the Suez Canal Economic Zone with an investment of 8 billion USD and a targeted annual production of 220,000 tons of green hydrogen.

Memorandum of Understanding (MoU) regarding the same project was signed in July, earlier this year. This project is

scheduled to be implemented in multiple phases, project will start with a pilot phase to produce 20,000 tons of green hydrogen, along with derivatives, annually. In Phase I, the production of 200,000 tons per year of green hydrogen, along with derivatives, will be achieved thereby bringing the project's total Green Hydrogen production capacity to 220,000 tons per year. The pilot phase project is expected to be commissioned in 2026.

ReNew Power will be further undertaking project and site studies in the coming months and is expected to make the Final Investment Decision (FID) over the next 12-16 months based on the Framework Agreement.

## **Shiva Engineering Services bags Agro and specialty chemical greenfield projects**

**Maharashtra, India & Gujarat, India:** Shiva Engineering Services (SES), a wholly owned subsidiary of Shiva Pharmachem Limited, a leading manufacturer and a global supplier of acids, chlorides, and other multi-functional intermediates, provides technical expertise in engineering & construction of greenfield and brownfield industrial projects around the globe has been awarded EPCm contracts for the specialty chemicals and agrochemical greenfield project in Maharashtra and Gujarat respectively.

The latest contract awarded to Shiva Engineering Services has a greenfield

chemical project with a capex of ₹ 120 crores and agrochemical greenfield project with a capex of ₹ 220 crores.

“SES Engineering is a leading player in the EPCM segment for specialty chemicals and agrochemical companies. The company has executed a lot of projects in the chemical, specialty chemicals, paints, aroma, bromine derivatives and adjacent markets in India and globally. We have developed an excellent track record of quality delivery within desired timelines,” said Business Unit Head at Shiva Engineering Services.

## **Aarti Industries Ltd (AIL) to complete Jhagadia and Vapi expansion projects by FY 2024**

**Vapi, Gujarat:** Aarti Industries Limited (AIL), is planning to complete all projects related to 3rd long term contract at Jhagadia; NCB capacity expansion at Vapi; Specialty chemical blocks at various locations; Expansion cum asset upgradation for acid unit at Vapi; and Expansion, asset restoration, sustainability initiatives et cetera by FY24.

At Jhagadia after obtaining the environmental clearances (currently in process), the site development work will commence on 100+ acre land at Jhagadia. The construction for Jhagadia will start from FY 2023 to FY 2024.



## Madhya Bharat Agro Products MBAPL Planning ₹ 70.34 crore (approx. 1 million USD) expansion

**Madhya Pradesh, India:** Madhya Bharat Agro Products Limited (MBAPL), a unit of Ostwal Group of Industries, is working for another expansion for better backward integration of operating process, consisting Sulphuric Acid plant, Granulation Plant capacity, Phosphoric Acid plant, and DAP/NPK capacity enhancement.

The DAP/NPK capacity enhancement is being implemented, the remaining three projects are expected to be in operation by the end of FY 2023-24.

The Sulphuric Acid Plant will cost ₹ 35.02 crore; Granulation Plant - ₹ 6.36 crore; Phosphoric Acid Plant - ₹ 13.09 crore; and Capacity Enhancement for DAP/NPK Plant - ₹ 15.87 crore.

## Praj & ESIIC partner to set up ethanol projects to accelerate bioeconomy in Egypt

**Cairo, Egypt:** During the COP27, Praj Industries Limited (Praj) has announced that they have entered an MoU with Egyptian Sugar and Integrated Industries Company (ESIIC) of Egypt. As a part of this MoU, both parties will drive sustainable climate actions to combat adverse effects of climate change.

Praj, an Indian Biotech company and ESIIC, an Egypt based sugar sector

company have come together to set up 1st and 2nd Generation ethanol projects in Egypt. Praj and ESIIC will develop infrastructure, help formulate policy framework, and create awareness etc. to mainstream Bioeconomy.

Sugarcane bagasse and rice straw are envisaged to be feedstock for conceiving Egypt's first 2nd Generation ethanol project.

## Kerala, IH2A partners for Kochi Green Hydrogen Hub

**Kerala, India:** India Hydrogen Alliance (IH2A) and the Government of Kerala has announced that it is jointly evaluating a proposal for building the Kochi Green Hydrogen (KGH2) Hub, a large-scale green hydrogen hub with multiple use-cases. The proposal envisages potential capital expenditure of 575 million USD, to build a 60-tonnes per day (TPD) green hydrogen plant with a 150 MW Electrolyser, storage, and infrastructure, which could achieve giga-watt scale and build the hydrogen economy in Kerala. The plan was shared by IH2A and the Kerala Government, after a consultation meeting between government, industry, and funding agencies.

In Phase 1, it will focus on the transport use-case, aligning with the state government's plans for zero-emission transport, to power Hydrogen-ICE retrofitted bus fleets of 60 buses and build the required infrastructure.

In Phase 2, industrial demand for green hydrogen from refineries, fertilizer and chemical plants is expected to drive capacity expansion and scale-up the KGH2 hub.

## Clean Science planning investment of ₹ 300 crores in first phase

**Pune, Maharashtra:** The new 34-acre land parcel undergoing development will house Clean Science's subsidiary, Clean Fino-Chem Limited. These new sites, new series of products along with strong R&D pipeline, will enable Clean Science to continue to focus on diversifying our product portfolio and geographical presence while simultaneously improving yields and operational efficiencies.

"We have incurred a Capex of ₹ 62 crores during H1 FY '23 with majority of this going towards our new plant for HALS in Unit 3. We have made further investment in our subsidiary Clean Fino-Chem of about ₹ 65 crores during H1 FY '23," said Siddharth Sikchi.

"Clean Fino-Chem Ltd. has a 34-acre facility. The first ₹ 100-odd crore is going into building common facilities like utility block, admin block, QC block, R&D block, ETP facility, and overall landscaping. The next ₹ 200 crore is all going into building HALS facilities. Now what happens is after this HALS, when we are coming up with a new product, then the expense or the Capex is only going into building that particular plant, which will be far lower

than doing the entire facility again," added Siddharth.

## Supreme Petrochem plans Capex of ₹ 1,200 crores (approx. 150 million USD)

**Raigad, India:** Supreme Petrochem Limited (SPL), manufacturer of Styrenics and Expandable Polystyrene (EPS) is planning a Capex of ₹ 1,200 crores (approx. 150 million USD) to cater to additional demand. SPL's brownfield expansion for enhancing its existing Polystyrene, EPS capacities at its Amdoshi Plant, Raigad, Maharashtra is complete and is awaiting Consent to Operate (CTO) from the State Pollution Control Board.

To cater to the additional demand, the company is undertaking Capex for enhancing Masterbatches and Compounds and XPS capacities at Amdoshi Plant and brownfield expansion at Chennai which is nearing completion and the commissioning is likely to take place by end-November '22.

The company has entered into an agreement for License and Basic Engineering Design with Versalis for Mass ABS which is the favoured engineering plastic when it comes to application in automotive parts. Basic engineering package for the first line of this plant is under preparation. Negotiations are underway with Versalis to advance the second train of Mass ABS to complete both lines by March 2025. ■

# Energy Efficiency Improvement for Environmental Protection: A Case Study

*Oil and gas will remain part of the energy mix until renewable energy sources adequately replace them. For the world to meet ambitious emissions reduction targets, a premium value needs to be associated with the lowest carbon-intensity oil and gas assets. The most effective way to reduce the emission of Green House Gases is to reduce the consumption of fossil fuels. Distillation systems are responsible for the highest amount of energy consumption in refineries. Technologies coupled with improved energy efficiency can support a more sustainable energy system with less carbon emissions.*

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**D**istillation systems are responsible for the highest amount of energy consumption in refineries.

Use of fossil fuels is responsible for environmental problems such as global warming and air pollution, which cause health problems and affect the quality of life of populations. Technologies coupled with improved energy efficiency can support a more sustainable energy system with less carbon emissions. The most effective way to reduce Green House Gas (GHG) emissions is to reduce the consumption of fossil fuels. Optimization of process parameters, digital transformation, use of Dividing Wall Columns (DWC) etc. can deliver increased energy efficiency

as well as minimize the carbon footprint of the industry. BPCL refineries are embarking the journey to meet the Net Zero target by 2040. This paper shares about the reconfiguration of Naphtha Splitters in BPCL Mumbai Refinery, which is a step towards BPCL's Net Zero commitment.

## Improving Gross Refining Margin via Naphtha Management

Naphtha management is crucial for improving the overall Gross Refining Margin (GRM) of any refinery. Naphtha can be managed by effective separation and upgradation and optimizing the blending strategies, which in turn minimizes the overall Naphtha production.

BPCL Mumbai Refinery (MR) consists of two Crude Distillation Units, namely CDU-3 and CDU-4. Straight Run Naphtha from Stabilizer bottoms of both CDU-3 and CDU-4 is being received in Naphtha Splitters. MR was having three Naphtha Splitters namely Reformer Feed Preparation Unit (RFU) Splitter I, RFU Splitter II and Isomerization Unit (ISOM) Naphtha Splitter, to split 6000 tons/day of Stabilized Naphtha from the Crude Distillation Units into light and heavy components. RFU Splitter I & II were operating in series configuration wherein Splitter I bottoms were fed to Splitter II.

#### ▪ Pre-Reconfiguration scenario

RFU, with series configuration of the two Splitters, was processing 4300 tons/day of Stabilized Naphtha and ISOM Naphtha Splitter was processing 1700 tons/day of Stabilized Naphtha. Details of these columns (pre-reconfiguration) are provided as below:

In the pre-reconfiguration scenario of Naphtha Splitters, Top cuts (C5-85oC)

from RFU Splitter I as well as ISOM Naphtha Splitter were getting routed to Naphtha Hydrotreating Unit (NHT), where it was getting hydrotreated to get ISOM feed. Bottom cut from Splitter I was getting fed to Splitter II. Mid cut from Splitter I, Top cut from Splitter II and Mid Cut from ISOM Naphtha Splitter were getting routed to Naphtha product pool. Bottom cuts (95-135oC) from RFU Splitter II as well as ISOM Naphtha Splitter were getting routed to Naphtha Hydrotreating Unit (NHT), where it was getting hydrotreated to get CCR feed. RFU pre-reconfiguration scenario is as indicated in Figure 1.

#### **With an objective to improve the performance of these Splitters, we had done a detailed analysis of Naphtha operations in MR**

Based on the analysis of feed and products data, it was found that:

- Existing configuration was outdated and requires upgradation as per changes in refinery configuration

Sr. no.	Equipment Description	Outer Diameter (m)	Height (m)	Internals
1	RFU Splitter I	3	21.75	3 beds (Total 48 layers) of structured packings
2	RFU Splitter II	3.4	21.75	3 beds (Total 51 layers) of structured packings
3	ISOM Naphtha Splitter	2.6	43.9	60 nos. of Valve trays with tray spacing of 610 mm

- Separation efficiency was low and overall energy consumption was high.
- ISOM feed was having low amount of C6 components, which are active reactants in ISOM Unit for RON improvement

In order to address the above issues, different schemes were configured and simulated using Aspen Plus. Stream properties (quality and quantity) as well as energy consumption of each configuration was compared with existing configuration. Based on economical and operational benefits, one of these configurations was finalized and proposed for implementation. The selected configuration was to convert

RFU Splitter II into a DWC so that RFU Splitter I & II can be operated in parallel and ISOM Naphtha Splitter can be shut down.

#### ▪ Reconfiguration of Naphtha Splitters Using DWC Technology

The main objective of reconfiguration of Naphtha Splitters was to increase RFU feed processing capacity from 4300 tons/day to 6000 tons/day by operating Splitter I & II in parallel configuration so that ISOM Naphtha Splitter can be shut down.

Post-reconfiguration, RFU Splitter I continues to operate as a conventional side cut column whereas Splitter II has got converted into a middle Dividing Wall

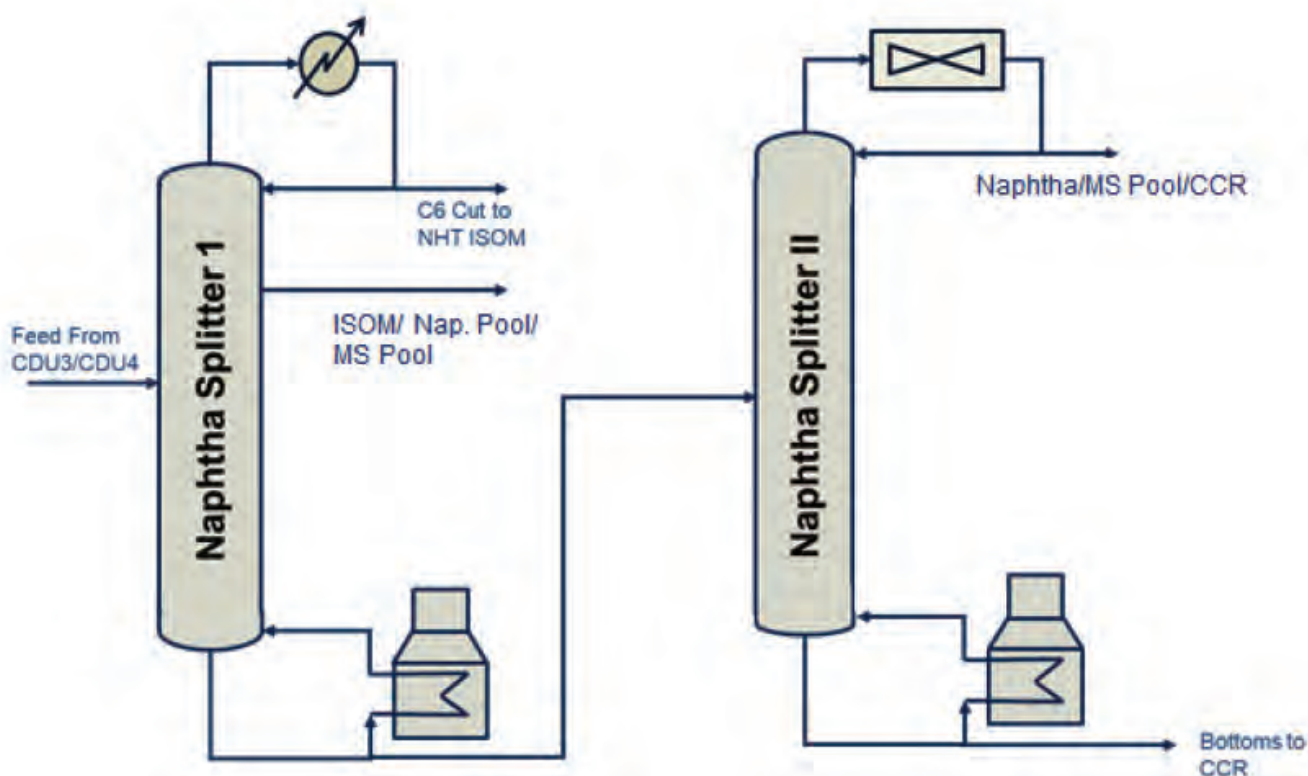
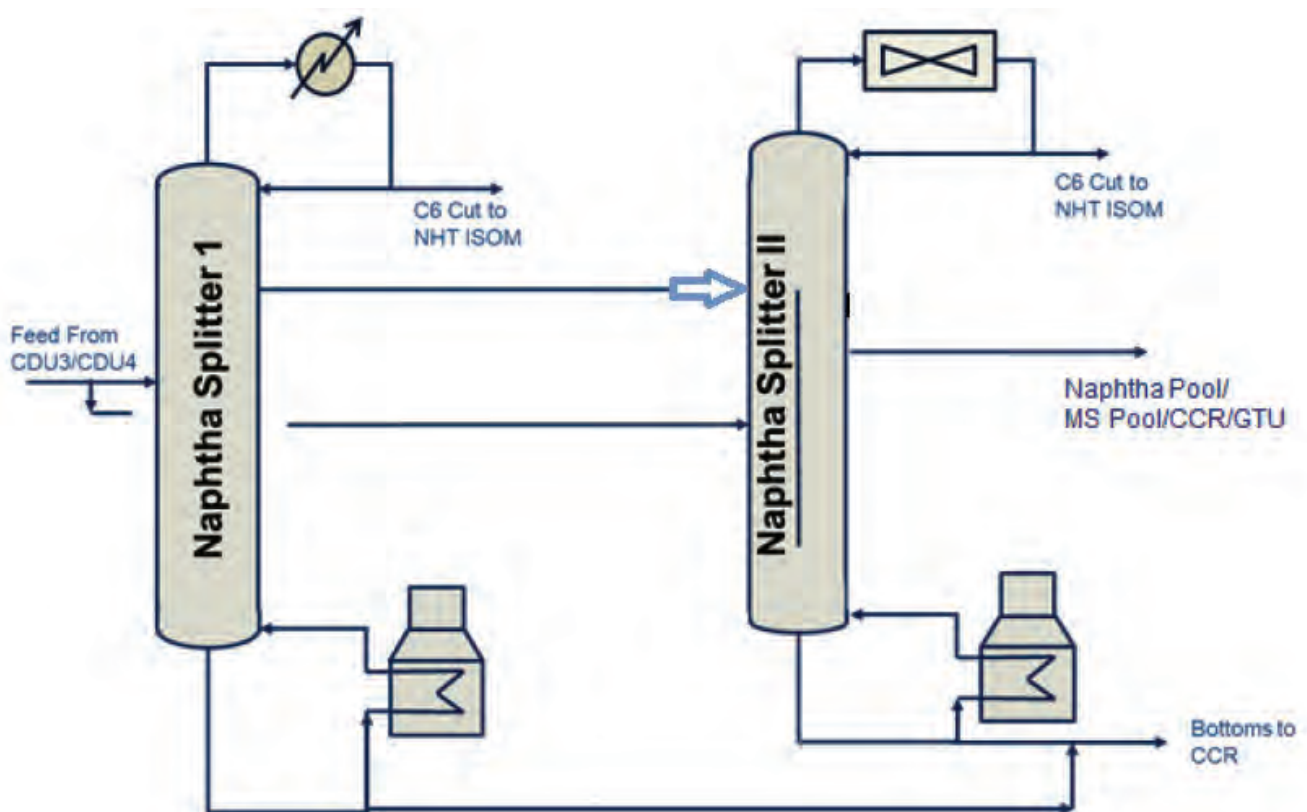


Figure 1: Pre-reconfiguration of Naphtha Splitters



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Figure 2: Post-reconfiguration of Naphtha Splitters

Column. RFU post-reconfiguration is as indicated in Figure 2.

With this configuration in place, RFU



Figure 3: New Dividing Wall Inside RFU Splitter II

Splitter I & II are sufficient to split the entire quantity of Stabilized Naphtha from Crude Distillation Units. New dividing wall installed inside RFU Splitter II is indicated in Figure 3.

### Major Modifications Done in Reconfiguration

- No modification was envisaged in Splitter I Reboiler & Splitter II Reboiler, which are fired heaters.
- Major modifications done in Columns during the reconfiguration are listed below:

In addition to the product quality

Sr. No.	Equipment Category	Modifications Done
1	RFU Splitter I	<ul style="list-style-type: none"> <li>Packing of Top Bed (10 layers) completely replaced with 13 layers of new type of packing.</li> </ul>
		<ul style="list-style-type: none"> <li>Bed height reduced (from 12 layers to 8 layers) for middle bed.</li> </ul>
		<ul style="list-style-type: none"> <li>26 layers of packings reused without any change in bottom bed.</li> </ul>
2	RFU Splitter II	<ul style="list-style-type: none"> <li>All beds except bottom bed completely replaced with new structured packings and bed height reduced (from 27 layers to 13 layers) for bottom bed in stripping section of the column.</li> <li>A dividing wall was installed inside the column which runs between top and bottom beds. The dividing wall section runs approximately middle 1/3rd of the column.</li> </ul>

improvement post-reconfiguration, yield of Top as well as Bottom cuts have been increased considerably thereby reducing the mid cut which goes to Naphtha pool. Mid cut generation has decreased

considerably and quality of Mid cut has improved with less overlap of the stream with Top and Bottom cuts. On account of shutdown of ISOM Naphtha Splitter, MR could achieve considerably high savings in energy consumption, which contributes to

a reduction in emission of approximately 29000 tons/annum of GHG.

### Product Specifications

Product specifications post-reconfiguration are provided in table below:

Parameter	Top Product	Mid Cut	Bottom Product
IBP, oC	-	-	> 95
D86 5%V, oC			> 98
D86 95%V, oC	< 80		-
FBP, oC	< 85		
Benzene, %w	< 4		
C6 Naphthenes, %w	< 10		
C7 Hydrocarbons, %w	< 3		
Toluene, %w	-	< 2	

### Conclusion

With the latest advances in process simulators and design methods, DWCs have emerged as a viable technology, which can also be integrated in existing refining

technologies to reduce operating cost. With the reconfiguration of Naphtha Splitters, BPCL Mumbai Refinery is having two dividing wall columns i.e., a middle dividing wall column in RFU and a top dividing wall column, which is a Deisohexanizer, in ISOM Unit, with huge savings in terms of energy. Our third DWC, which is Dearomatized Solvent Splitter in Lubricating Oil Base Stock (LOBS) Unit, will be operational in another couple of months. Use of Dividing Wall Columns is one of the effective ways to reduce energy consumption and GHG emissions in distillation systems. ■

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# CHEMICAL ENGINEERING WORLD

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## Industrial Metaverse

*We are living amid times of great change. Global factors such as political unrest, economic inflation and the ongoing war in Ukraine are stoking market volatility. What's more, these pressing factors are playing out against the stark backdrop of climate change. The global effort to reduce carbon emissions is making progress, but continuous pressure must be applied in order to meet challenging targets in line with the Paris Agreement.*

**F**resh from COP27 Sharm el-Sheikh, Egypt the message from business and civil society leaders is clear. It is time for action if we are to deliver on the objectives of the Paris Agreement and limit global warming to 1.5°C above pre-industrial levels. We need to work collaboratively and relentlessly to halve global emissions by 2030, and many companies are rapidly diversifying their energy portfolios, divesting their higher carbon emitting businesses and transitioning to greener power supplies, and renewable options.

To add complexity to the challenge however, most nations do not yet have

an energy mix which can rely solely on renewable energy sources. As such, traditional fossil burning techniques are still necessary to plug the energy shortfall. Global businesses are now working overtime to develop sustainability strategies which promote the right balance of future investments and existing profit targets.

AVEVA believes that one of the key drivers of a successful sustainability strategy is a strong and committed digitization strategy. Those organizations who heavily fund their move to a completely digital business are creating a strategic differentiator; they are able to deliver their services

more efficiently with greater insight into their business operations. At the heart of a mature digitization strategy lies the Digital Twin – a connected data ecosystem which allows the business to have a single source of the truth.

The creation and delivery of a digital twin is no small feat. A digital twin is a virtual representation of a real-world physical system that connects real-time data sources, models, and analytics from across the asset lifecycle in one single place. AVEVA customers who have successfully executed their Digital Twin projects will attest to the huge benefits and positive changes that a fully digitized business can offer.

One example is state-owned Abu Dhabi National Oil Company (ADNOC). The energy giant's colossal industrial operations are powered and guided the Panorama Digital Command Center – a fully integrated, real-time data visualization platform that helps gain insights, unlock efficiencies, and identify new pathways to optimize operations. AVEVA's technologies form the foundation of the display, enabling integration across various systems and providing actionable insights. The Panorama center features a 50-metre-long screen, which curves to fit seamlessly with the wall and covers its height from floor to ceiling, giving ADNOC a single,

national view of their oil and gas assets and production.

## Step into the Industrial Metaverse

Taking one more step into the future, AVEVA believes that the Industrial Metaverse is primed to add powerful sustainability benefits to the digital twin. But what is an Industrial Metaverse?

AVEVA defines an Industrial Metaverse as: "A persistent virtual environment allowing live collaboration across teams, agnostic of interface device, open to the full gamut of data sources and delivering role-based access to real-time operations data streams and up-to-date engineering data."

The Industrial Metaverse is a virtual space that all employees can use to conduct their business and technical meetings. The Industrial Metaverse does not require a headset, can be used by a mouse and keyboard, and offers access to live SCADA data, up-to-date engineering data and 3D operating environments.

In short, the Industrial Metaverse is a virtual version of your actual operating assets with real-time streamed data which you can jump into with colleagues to investigate, discuss and manage tasking – all based on your digital twin. The

Industrial Metaverse is a real thing, and it will transform the way you work.

## Powerful digital sustainability benefits

The Industrial Metaverse provides immersive access to expertise from across your business and supply chain within a virtual space. This means you decrease the CO2 emissions generated by excessive travel, increase the speed of your business decision making, and reduce safety incidents within the virtual world.

In the coming years as the world's businesses look to radically decarbonize, digital solutions will be the catalyst for securing new sustainability wins. Smart companies will place their digitization strategies at the core of their business to prime themselves for a sustainable future driven by smart decision making and intelligent data.

AVEVA also sees great opportunities for more sustainable designs, reduced steel and concrete consumption and more automation for plant operations based on collaboration within virtual spaces. The Industrial Metaverse promotes democratization of access to the digital twin, respects your enterprise access rights and can level-up the value of information.

Being immersed in the Industrial Metaverse will be feel like the equivalent of being on-site, where you'll be able to work with colleagues and suppliers from around the world, interacting with our assets, share the same information in real time and enjoy a level of collaboration that closely maps face-to-face interactions.

The digital twin project is ultimately an information-centric endeavor – focused on data alignment, cleaning, and preparation. Utilizing the digital twin within the Industrial Metaverse powerfully connects the most important resource of all: our people. ■



## Author

**Simon Bennett**  
Global Head of Research  
AVEVA

## “We will time our energy transition and product diversification plans to match the projected shifts in national energy consumption patterns”



**Mr. Sanjay Khanna**  
Director Refineries, BPCL

India's energy recipe would need a combination of cleaner fossil fuels, compressed natural gas (CNG), biofuels and electric vehicles (EVs) for meeting its transportation and fuel needs. India's per capita petrochemical consumption of 8 kg is way below the world average of 35 kg. With expanding market demand this segment is expected to have robust growth. BPCL's plan to expand petrochemical business will naturally hedge the uncertainties and developments in transportation fuels. The energy major is setting up the largest Electrolyser to produce Green Hydrogen in Bina refinery, ramping up the current Renewable Energy portfolio to 1 GW by 2025 and 10 GW by 2040. **Sanjay Khanna, Director Refineries, BPCL** shares insights into the company's roadmap to achieve net zero emissions for scope 1 & 2 by 2040 to comply India's commitment to reach Net Zero by 2070.

**Since the announcement of our Honourable Prime Minister to reduce GHGs by 1 billion Carbon Neutrality by 2030, what steps has BPCL taken across all refineries in this regard?**

Sustainability has been part of Bharat Petroleum Corporation Limited (BPCL) corporate culture and is demonstrated by the efforts to be least energy intensive refineries and reduce GHG emissions. As a corporate, BPCL has laid out a stringent roadmap to reduce its GHG emissions by half till 2030 and achieve net zero

### **BPCL's Initiatives to Diversify Energy Mix**

1. Energy transition from Power generation from fossil fuels to Solar & Wind energy
2. Facilitation of Green Hydrogen production and utilization at refineries
3. Use of RLNG at refineries thereby reducing emissions.
4. Reduction of Scope-II emissions by importing Renewable power
5. Replacement of fuels burnt in furnaces with cleaner and renewable fuels
6. Production of 2G-Ethanol and blending with MS
7. Reduction of Energy consumption in the refineries to the extent of being in the world scale Standards of Quartile 1 performance
8. Use of Hydrogen also as a fuel with CNG with gradual increase in usage to 5% to reduce carbon emissions
9. Use of Bio – gas to reduce emissions

emissions for scope 1 & 2 by 2040, in line with the India's commitment to reach Net Zero by 2070.

In this direction, first and foremost step was taken to improve energy efficiency. Through various industry interactions, benchmarking studies and support from licensors, we have fairly good idea about way forward and such initiatives are kept on fast track. It includes electrification of heating system, tracing system, conversion of steam driven mega rotary machines to power driven machines, improving heater efficiency, improving process reliability etc. Parallely, a consultant is appointed to improve process efficiency to world scale Standards of Quartile 1 performance which will help us to achieve emissions reduction up to 10-15%.

BPCL group of refineries use large quantities of Hydrogen for de-sulfurization processes to meet on-spec Diesel, Gasoline etc. Currently, approximately 60% Hydrogen is produced through Steam Reforming of Natural gas / Naphtha which is over and above the quantity produced as by product from Catalytic Reforming. This results in high GHG emissions, resulting in what is termed as 'Grey hydrogen.' Maximization of Hydrogen recovery using indigenously developed membrane by our Corporate R&D Centre is another initiative to reduce carbon emission. The successful trial is conducted at Kochi refinery and it is being scaled up in all the refineries.

Renewable power generation has been identified as another thrust area, with the initial objective of addressing our in-house power requirements through renewable sources and subsequently being an established renewable power producer. The target is to ramp up from the current Renewable Energy portfolio of around 42 MW, to reach a level of 1 GW by 2025 and 10 GW by 2040.

BPCL has planned to set up large scale Electrolysers to produce Green Hydrogen at our Bina refinery. We are looking forward for CO<sub>2</sub> to chemicals conversion technologies development at Corporate R&D Centre. BPCL is also in the process of identifying proper Carbon Capture Utilization and Storage (CCUS) technologies which can be implemented in the refineries to capture GHG emissions. This will be adopted by 2030 and BPCL focus will be to make Scope 1 & 2 emissions zero with use of above technologies by 2040. CCUS technologies are still in a nascent stage and ever evolving, our Corporate R&D is working on developing technologies for the same.

### **Walk us through BPCL's plan to build the largest Hydrogen Electrolyser in Bina refinery**

BPCL is in process of setting up 20MW Electrolyser plant at Bina Refinery. We expect the completion and commissioning the facility by 2024. The Electrolyser technologies are still evolving & there are

many competing technologies like Alkaline, PEM, AEM and Solid Oxide. Each of these technologies has got some advantage over the other and in future it is expected that only one or maximum two will spearhead the transition to Green Hydrogen, while the others will fizzle out.

Refineries require a continuous and reliable hydrogen for sustained operation. Can Electrolysers supply continuous and reliable Hydrogen on 24x7 basis? Can the renewable power be made available on 24x7 round the clock basis? This gets difficult to answer considering the technology is still in the development stage. Considering 3-4 times renewable power & storage requirements, DISCOMs & Refinery grid infrastructure will also require major upgradation.

**As the automobile industry is mandated to move from fossil fuels to EVs, when is India likely to see the peak in petrol/diesel demand? How will this paradigm**

**Can Electrolysers supply continuous and reliable Hydrogen on 24x7 basis? Can the renewable power be made available on 24x7 round the clock basis? This gets difficult to answer considering the technology is still in the development stage.**

### **shift affect the future expansion plans and technology selection to prepare for sustainable growth?**

As per Petroleum Planning & Analysis Cell (PPAC) report, India's petrol and diesel demand will likely grow at a stable rate till late 2040s, with demand plateauing somewhere in 2045-50. BPCL has capacity augmentation plans at Bina Refinery and has products availability to address this growing demand. Electric Vehicles (EV) transition in India faces several infrastructure challenges and will likely happen in stages. Two-wheelers and light utility vehicles will be in transition first, and this will drive alternative utilization strategies for streams that form part of the petrol blend. BPCL, in its energy transition plan, is exploring the potential utilization of these streams in petrochemical feedstocks. However, heavy vehicles' transition to clean fuels will likely take more time and continue to dictate transportation fuel production from refineries.

BPCL will continue to meet our nation's energy demands and will work to ensure energy security. We will time our energy transition and product diversification plans to match the projected shifts in national energy consumption patterns. For the sustainable growth of the future, growth of technologies like use of Green Hydrogen, Carbon capture, and reduced / zero emissions will dictate the success of future technologies. There is a greater emphasis on building green sustainable units at the

design stage both for sustenance and financial funding of projects. These green energies will form a significant part in the future post 2035 and will reduce the fossil fuel significance.

### **Walk us through collaboration of BPCL with CSIR - IICT to develop innovative bio-reactor design to maximize bio-methane production CBG made from agricultural waste residues.**

The National Policy on Biofuels, 2018, notified by Government of India, emphasizes on promotion of Advanced Biofuels including Compressed Bio Gas (CBG). In the same year, the Ministry of Petroleum & Natural Gas (MOP&NG) has also launched Sustainable Alternative Towards Affordable Transportation (SATAT) scheme to extract economic value from bio-mass waste in the form of CBG and bio-manure. Under SATAT,

**New innovative bio-reactor design to maximize bio-methane production from agricultural waste residues shall be feed agnostic and will have salient features such as reduced hydraulic retention time & capability to process higher solid loading (>20% w/v) which is a limitation in the conventional systems**

Government is keen to set up 5000 CBG plants and for this purpose, production offtake guarantee is being given for such plants. These CBG plants produce Biogas using Anaerobic Digestion (AD), which is an effective technology for waste treatment and has been proven to have a significant role in renewable energy production. In this regard, municipal solid waste, sugar industry waste (press mud) and agricultural residue have significant potential for production of CBG.

BPCL R&D Centre has collaborated with CSIR-IICT, Hyderabad, which has a proven track record in the area of biogas production and previously worked on high rate biomethanation technology for the generation of biogas and bio manure from MSW (Municipal Solid Waste). As part of this collaboration, joint development of a new innovative bio-reactor design to maximize bio-methane production from agricultural waste residues is targeted. This digester design shall be feed agnostic and have salient features such as reduced hydraulic retention time & capability to process higher solid loading (>20% w/v), which is a limitation in the conventional systems. These developments shall reduce the size of the new reactor vis-à-vis conventional reactor of same capacity, in addition to improved process efficiency for higher biogas yield. These developments shall have a significant impact on the CAPEX of the CBG plant and will improve the economics of the CBG plants thereby attracting business investors in this area.

As part of the Phase-1 of the project the design shall be validated at pilot scale (10 -20 kg/day). The teams shall also work on the scalability aspect of the process. These joint efforts shall put both the entities on the map to offer a commercial viable technology that will help in realizing our Nation's goal of achieving carbon neutrality by year 2070.

**In August this year, BPCL announced the plans to spend Rs. 4.14 lakh crores on Petchem business. Please share insights into the expansion plans and planned value chains across Mumbai, Kochi & Bina refineries.**

BPCL has identified expansion of Petchem Business as a natural hedge to uncertainties and recent developments with respect to transportation fuels. To enhance its market share in polymer sector, BPCL is planning to install a 400 KTPA Polypropylene Unit at Kochi Refinery and a world scale 1.2 MMTPA Ethylene Cracker Complex along with downstream Polymer Units such as LLDPE, HDPE and PP units at Bina Refinery. These projects shall increase BPCL's Petrochemical Intensity Index (PII) to 8.0 % of crude capacity from 2.3% at present.

In 2021, Kochi Refinery commissioned Propylene Derivative Petrochemical Project (PDPP) for production of Acrylic Acid, Oxo-Alcohols and Acrylates. Future projects at Kochi Refinery include setting up a 400 KTPA capacity Poly-Propylene



Unit in order to further diversify further petrochemical portfolio. At Mumbai Refinery we are planning to set up a De-Aromatized solvent unit for production of solvents like D40 , D80 , D110 , D130 which are total import substitutes.

**In the backdrop of climate change and strong intent to move away from petro based feedstocks, how do you plan to ensure the viability of the investment in Petchem in the long run? How are the market dynamics going to play out for refiners and what kind of opportunities do you see for BPCL in India and overseas?**

With low per capita consumption (India – 8 Kg vs world average of 35 Kg) and expanding market demand, petrochemical segment in India is expected to have a robust growth. On a long term basis, diversification to petrochemicals would provide an alternative hedge to anticipated reduced growth of transportation fuels. Demand for petrochemicals in India is projected to increase more than 3 folds from 26.2 MMT in 2020 to 86.8 MMT in 2040. New capacities to the tune of 37.8 MMT are required to be built by 2040 to cater to the above demand.

Considering this, BPCL is moving ahead with its plan to enhance its Polymer Portfolio through projects at Kochi and Bina. Provisions for handling surplus petroleum products at group refineries is kept as cracker feedstock to handle swing

in demand. Further, BPCL is planning to set up Product Application Development Centers (PADC) to rapidly develop new grades and applications for catering to market and consumer demands. With strong foothold in Indian market, flexible future configuration plans and in-house R&D capabilities, BPCL is quite favourably placed to handle the market dynamics. Detailed analysis for selection of optimized feed and operating cost ensures production of petrochemicals at the competitive cost of production. Detailed market analysis is also done for availability of market around the production area. Regarding overseas market, BPCL is targeting to cater to the domestic demand at present, however we are open to consider export markets based on overall economics.

**What is the future of Refining?**

India is emerging as the world's new oil demand centre, with burgeoning consumption providing huge potential for downstream oil and gas growth. With a GDP ranked in the top 10 globally and a large growing population, India has seen continuous increase in demand for energy in all forms. India's domestic refining capacity sits at approximately 4.6 MMbpd. The country's refining network capacity has more than tripled over the past two decades. India's refining capacity is adequate to meet present consumption rates, but due to the projected growth in demand, additional refining capacity

is needed. India's energy recipe would need a combination of cleaner fossil fuels, compressed natural gas (CNG), biofuels and electric vehicles (EVs) for meeting its transportation and fuel needs.

With near to 250 MMT of refining capacity in India (currently), BPCL has a design capacity of 35.3 MMT of refining capacity with actual capacity to process near to 39 MMT. We are self-supplied on any given day for the marketing needs of our products. It is observed that the demand of major transportation fuels, MS and HSD are going strong. Their demand has reached almost Pre-COVID levels and is peaking now. With Ethanol blending and EV influencing MS market and Gas based economy influencing the HSD economy, growth of fossil fuels seems to be reducing. The change in energy transition is definite and gradual; and the demand for the current MS / HSD is expected to co-exist at least till 2040. Fossil fuels will co-exist with all other forms of energy. In view of the increasing energy demand, Refining industry has a future even beyond 2040, which would be met thru evolving green fuels added with expanded Crude Refining capacity and capability in India. ■

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# CHEMICAL ENGINEERING WORLD

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# Building India's Energy Infrastructure



## Prabhjit Didyala

Managing Director, Accenture Strategy

In recent years, given the multitude of changes in the energy industry, there have been several projects in the Indian energy sector that have experienced major cost schedules, overruns, and an unprecedented pressure to improve and expand the targeted energy distribution. That's where the efficiency-boosting method that core sector organisations can implement is the early integration of engineering and construction within the engineer-procure-construct (EPC) delivery model. The EPC industry contributes about 8% of national GDP which is expected to nearly double in the next two decades. The

industry has matured with the use of the latest technologies, processes, and expert talent.

The Indian EPC industry owns many technical processes necessary for attaining lower costs of production. Due to its extensive benefits such as – the ability to accelerate project schedules by integrating construction planning and long-lead equipment procurement with the design, the ability to provide owners with a single responsible party, the ability to transfer at least partial project delivery risk to a third party, and ability to outsource full project delivery when an organization is in

Highlights from draft of National Electricity Plan (dNEP)		
2017-22	Review of Developments	
2022-27	Detailed Capacity Addition Plans	Increase in Power Generation Capacity- <b>114%</b>
2027-32	Projections for Capacity Addition	Increase in RE Power Generation Capacity- <b>351%</b>
2030	500 GW of non-fossil fuel-based power generation capacity	

full operation mode among many others, EPC projects are gaining acceptance at a very high rate in India.

After the lull period due to the pandemic, the opportunities for Indian EPC players have increased tremendously. This can be attributed to the expansion plans taken up by the India PSUs as well as some leading private companies. Considering the energy transition scenario, the investment opportunities in India are expected to pick up in medium term. Public sector spending is estimated to increase in line with the COP26 target announcements towards decarbonization. This shall provide a good space for investments for Global players. With the number of investments coming up in a variety of products, India is inching towards self-reliance, and this shall result in more employment opportunities. Our clients with their growth mindsets are exploring, experimenting & investing in newer solutions and emerging technology projects.

Recently, the draft National Electricity Plan of the CEA (Central Electricity Authority) was released in September 2022 (NEP 2022) for public consultation contains a review of developments in 2017-22, detailed capacity addition plans for 2022-27 and projections for 2027-32. The projects for power generation capacity are in line with the goal of installing 500 GW (gigawatts) of non-fossil-based power generation capacity by 2030 where overall power generation capacity is expected to increase by over 114 percent in 2022-2032. In this period, RE power generation capacity is expected to increase by over 351 percent, nuclear by over 230 percent, hydropower by over 46 percent, coal by over 16 percent and gas by just 1.5 percent. Though coal-based power generation capacity is expected to slow down, coal will continue to make the largest contribution to power generation even by 2032. The key challenge for policy will be to ensure availability of financial, technological, and natural resources,

redesign the market to accommodate zero marginal cost power from RE and invest in battery and other forms of energy storage to strengthen energy security. To address these challenges, EPCs will play an absolute critical role.

## Moving towards Sustainable Processes

The industry is certainly moving towards decarbonisation for example, Refinery, Fertiliser & Indian Steel sectors are planning to participate aggressively in the Green Hydrogen value chain and downstream applications. Complexities of EPC business are exacerbated primarily due to changing nature of sector by rapid energy transition. We know that many consultants/ contractors globally have

joined hands with Green Technology providers to offer integrated sustainable solutions. Over the next 3-5 years, as the newer business model transformations are forthcoming due to acceleration in energy transition, more EPC opportunities are expected as well. So, with the energy transition clearly happening, it becomes imperative for EPC players to adapt to the new environment and upcoming changes towards greener solutions. Adaptation of these sustainable technologies shall evolve over time as the end consumers are primarily exploring new value chains and diversifications.

At present these newer technologies are mainly sourced from outside India, and therefore EPC contractors will have to consider the challenges related to global

<b>Top 2 advanced DIGITAL CAPABILITIES deployed for executing capital projects by outperforming EPCs</b>	
<b>Project Phase</b>	<b>Top two digital capabilities deployed across project stages</b>
Business Planning	<ul style="list-style-type: none"> <li>▪ Levelized Cost of Energy (LCOE) optimisation</li> <li>▪ Bidding &amp; tendering automation</li> </ul>
Engineering & procurement	<ul style="list-style-type: none"> <li>▪ Cognitive supply analytics</li> <li>▪ Software verification of design</li> </ul>
Project & Contract Management	<ul style="list-style-type: none"> <li>▪ 4D/5D planning &amp; monitoring</li> <li>▪ Automated period-end/close-out</li> </ul>
Construction & handover to operations	<ul style="list-style-type: none"> <li>▪ Drone reality capture/automated progress detection</li> <li>▪ Material track &amp; trace</li> </ul>

supply chain. This may improve once the technologies are available in India. With respect to the anticipated changes in the project intricacies, every EPC project is complex, involving a tight-rope functioning of different stakeholders. Limitation of manufacturing capacity since there are few OEMs with specific large-scale orientation in emerging technologies, increasing competitive pricing for upcoming energy value chains, and additionally bringing agility in construction with stringent time schedules are challenges to be overcome. So, moving towards sustainable processes would increase the inherent complexity of the project.

## Driving change via Adoption of integrated sustainable value chain

The EPC companies will also need to be tackle their internal or organisational challenges such as upskilling, talent retention & adoption of technology. The construction industry has made impressive investments in digital programs—particularly among owner-operators and global engineering, procurement, and construction companies or EPCs. With global trend towards adoption of integrated sustainable value chains drives the need towards upskilling. Therefore, it will be critical to keep employees engaged with global teams through on-the-job trainings and skill enhancement from global technology experts and specialists.

<b>Top 2 advanced DIGITAL CAPABILITIES deployed for executing capital projects by outperforming OWNER-OPERATORS</b>	
<b>Project Phase</b>	<b>Top two digital capabilities deployed across project stages</b>
Business Planning	<ul style="list-style-type: none"> <li>▪ Levelized Cost of Energy (LCOE) optimisation</li> <li>▪ Intelligent estimating &amp; estimation analytics</li> </ul>
Engineering & procurement	<ul style="list-style-type: none"> <li>▪ Supplier intelligence</li> <li>▪ Software verification of design</li> </ul>
Project & Contract Management	<ul style="list-style-type: none"> <li>▪ Prescriptive Project analysis (e.g., next best action)</li> <li>▪ Smart Contracts</li> </ul>
Construction & handover to operations	<ul style="list-style-type: none"> <li>▪ Reality Capture &amp; Augmented Reality</li> <li>▪ Dynamic next basic action scheduling</li> </ul>

The EPCs will need to enhance the global R&D efforts by engaging key specialist of local employees in new simulations. Engineering designs will need to be executed on upgraded software unlocking new potential to adapt to the new thinking and optimization. Furthermore, based on the evolving customer requirements, EPCs must select the right Digitalization opportunities, and implement appropriate solutions e.g., connected ecosystem and use of IoT, advance analytics to transform problem solving approach & be Industry 4.0 compliant.

Based upon Accenture analysis, such data-driven digital transformation on the ROCE for owner-operators can be upto +6.5% as well as an impact of + 5.8% on operating margin for EPCs. On the flip side, typical EPCs demonstrate little appetite to make such bold technology investments. For instance, only less than half of the EPC invested over US\$10 million in design automation during the period 2015 to 2019, leaving most EPCs scrambling with managing design changes across the project supply chain. Similarly, only a third of the EPCs invested in IIoT technology (compared with 60% among the EPC Outperformers), severely restricting their ability to monitor site activity and therefore manage project timelines and costs.

## Conclusion

Considering the growth trajectory due to the emerging technologies and the phase of energy transition, there is dire need to have manufacturing set-ups in India by global companies. India requires focus on improving capabilities in R&D of emerging technologies and ramping up domestic manufacturing. From a standpoint of Global Technology licensor & OEMs, a middle ground needs to be attained to understand whether the manufacturing set up needs to be put up after a sustained demand is established or the manufacturing setup needs to be put up to create the sustained demand. We expect that the existing demand shall rise sooner in India and Government's policy framework of self-reliant India would pave the way. ■

# Compressed Bio Gas



**Rajeev Mathur**

Director, HCG Group

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**B**io-gas is produced naturally (through a process of anaerobic decomposition) from waste / bio-mass sources like agriculture residue, cattle dung, sugarcane press mud, municipal solid waste, sewage treatment plant waste, etc. After purification, it is compressed and called CBG, which has high methane content. Further, Compressed Bio-Gas is exactly similar to the commercially available natural gas in its composition and energy potential. With similar calorific value and other properties similar to CNG, Compressed Bio-Gas can be used as an alternative,

renewable automotive fuel. Given the abundance of biomass in the country, Compressed Bio-Gas has the potential to replace CNG in automotive, industrial and commercial uses in the coming years.

Waste/Bio-mass sources like agricultural residue, cattle dung, sugarcane press mud, municipal solid waste, sewage treatment plant waste, etc. produce Bio-Gas through the process of anaerobic decomposition. The Bio-Gas is purified to remove hydrogen sulphide (H<sub>2</sub>S), carbon dioxide (CO<sub>2</sub>), water vapour and compressed as Compressed Bio-Gas (CBG), which has methane (CH<sub>4</sub>) content



of more than 90%. CBG has calorific value and other properties similar to CNG and hence can be utilized as a green renewable automotive fuel. Thus it can be an alternative to or blended with CNG in automotive, industrial and commercial areas, given the abundance of biomass availability within the country.

The estimated CBG potential from various sources in India is nearly 62 MMT with bio manure generation capacity of 370 MMT. CBG is envisaged to be produced from various bio-mass / waste sources including agricultural residue, municipal solid waste, sugarcane press mud, distillery spent wash, cattle dung and sewage treatment plant waste.

The other waste streams viz. rotten potatoes from cold storage, rotten

vegetables, dairy plants, chicken/ poultry litter, food waste, horticulture waste, forestry residues and industrial Effluent Treatment Plants (ETPs) treating organic waste can be used in the generation of biogas.

## Government Support Schemes

Government of India has published the National Policy on Bio Fuels -2018 with effect from 16th May 2018. The Policy aims to increase the usage of biofuels in the energy and transportation sectors of the country during the coming decade.

### The Policy aims to derive the following benefits

- Reduction in Crude and gas imports thereby huge savings in forex
- Utilization, development and promotion of domestic feedstock and its utilization for production of biofuels thereby increasingly substitute fossil fuels while contributing to National Energy Security
- Climate Change mitigation and control in pollution,
- Creation of new employment opportunities in a sustainable way
- Encouragement in the application of advanced technologies for the generation of biofuels

This Policy emphasises active promotion of advanced bio-fuels, including CBG.

### Benefits of Compressed Bio-Gas (CBG)

- Responsible waste management, reduction in carbon emissions and pollution
- Additional revenue source for farmers
- Boost to entrepreneurship, rural economy, and employment
- Support to national commitments in achieving climate change goals
- Reduction in import of natural gas and crude oil
- Buffer against crude oil/gas price fluctuations

The Ministry of New and Renewable Energy has notified Central Financial Assistance (CFA) of Rs. 4 crore per 4,800 kg of CBG per day generated from 12,000 cubic meters of biogas per day, with a maximum of Rs.10 crore per project.

To assist financing to CBG projects, Reserve Bank of India has categorized CBG plants in "priority sector" for lending and State Bank of India, Bank of Baroda and other scheduled banks have come out with a specific policy to finance CBG projects.

To ensure promotion of organic farming in India and enhance revenue from sale of bi-products of CBG plants such as "Fermented Organic Manure", Ministry of Agriculture has included them in Fertilizer control Order, thus facilitating marketing of Organic manure throughout India.

In addition to Govt. of India's efforts, Individual states have also come forward to promote CBG initiatives, in this direction several states such as Haryana, Punjab, Uttar Pradesh and several other States have formed State Level Committee for implementation and monitoring of SATAT Scheme.

### Global Initiatives

Countries such as Germany, Italy, UK, France and Switzerland are promoting bio-gas usage promoted by supporting legal frameworks, education schemes

and the availability of technology. Biogas produced in European countries is mostly fed into local natural gas grids and used for power generation. Grid injection is most common in European states followed by vehicles fuelled with biogas (either pure or in blend with natural gas) and biogas is also used for heating purposes either directly or blended to natural gas. The number of bio-gas plants in Germany has doubled to nearly 9,000 plants from 4,136 plants in 2010. The total bio-gas production capacity of the plants is 8.98 Billion Cubic Meter (BCM) equivalent to 6.6 Million Metric Ton (MMT). They are primarily operated by farmer co-operatives, and utilize crops like maize or turnips as feedstock in their plants

### Production & Marketing of CBG in India

Compressed Bio-Gas plants are proposed to be set up mainly through independent entrepreneurs. CBG produced at these plants will be transported through cascades or through pipelines to the fuel station networks for marketing as a green transport fuel alternative. The 4,500-strong CNG stations network in the country currently serves about 35 lakh gas-based vehicles.

The entrepreneurs would be able to separately market the other by-products from these plants, including bio-manure, carbon-dioxide, etc., to enhance returns

on investment. It is planned to roll out 5,000 Compressed Bio-Gas plants across India in a phased manner in the next 4-5 years.

Several Oil and Gas marketing companies have undertaken various biofuel projects in the country including Compressed Biogas (CBG) Projects under SATAT (Sustainable Alternative towards Affordable Transportation) initiative of Govt. of India which envisages target production of 15 Million Metric Ton (MMT) of CBG by 2023-24, from 5000 CBG Plants. Under the above scheme EOIs (Expression of Interest) have been invited from eligible entrepreneurs for setting up CBG plants, produce and supply CBG to OMCs. CBG produced at the CBG plants will be transported through cascades (or through pipelines, if feasible) to the retail outlet (fuel station) for marketing as a green transport fuel alternative.

## Recent initiatives

According to the Ministry of Petroleum and Natural gas, Compressed Bio Gas (CBG) is the need of the hour, and the Government is taking all steps to promote ecosystem around it. CBG plants are a huge leap forward in arriving at a win-win situation for farmers and environment.

Asia's largest Compressed Biogas plant has recently been commissioned in Sangrur (Punjab). This plant will consume 100,000 tons of paddy straw, which will be procured from 6-8 satellite locations within a 10 km radius of the plant. The CBG Plant's present production is about 6 TPD CBG, but soon this plant will process 300 Tons Per Day of paddy straw at max. Capacity to produce 33 TPD of CBG using 8 digesters of 10,000 cubic meters there shall be daily production of about 600-650 Tons of FOM (Fermented Organic Manure), which can be used for

<b>CBG Plant at Sangrur</b>	
<b>Asia's largest Compressed Bio-Gas (CBG) Plant</b>	
<b>Key Facts</b>	
Feed	Paddy Straw
Input (max)	300 Tons per Day (TPD)
Present Production	6 TPD CBG
Capacity (max)	33 TPD CBG
Digestors (required)	8 Digestors of 10,000 cubic meter each
Fermented Organic Matter / day	600 to 650 Tons
Reduction of Stubble burning Area	40,000 to 45,000 acres of fields
Annual Reduction of CO <sub>2</sub> emissions	1,50,000 tons

organic farming. The Sangrur CBG Plant shall reduce stubble burning of 40,000 – 45,000 acres of fields, translating into an annual reduction of 150,000 tons of CO<sub>2</sub> emissions. This plant is just the beginning of India's master plan for a CBG-based rural economy and steps are being taken to promote the ecosystem around it. The Plant has been commissioned with an FDI investment of Rs. 220 crores (approx.) by Verbio AG, one of Germany's leading Bio-energy companies.

The SATAT scheme aims to empower and unleash the rural economy by supporting farmers, increase India's domestic energy production and self-sufficiency and also reduce the air pollution, and help India lead the world toward a clean energy transition. Apart from this plant, 38 CBG / Biogas Plants have been commissioned recently under the SATAT initiative.

### Future Potential

Compressed Bio-Gas can be produced from various bio-mass/waste sources, including agricultural residue, municipal solid waste, sugarcane press mud, distillery spent wash, cattle dung and sewage treatment plant waste. The other waste streams that is, rotten potatoes from cold storages, rotten vegetables, dairy plants, chicken/poultry litter, food waste, horticulture waste, forestry residues and treated organic waste from industrial effluent treatment plants (ETPs) can be used to generate biogas.

Going forward, Compressed Bio-Gas networks can be integrated with city gas distribution (CGD) networks to boost supplies to domestic and retail users in existing and upcoming markets. Besides retailing from retail fuel stations, Compressed Bio-Gas can at a later date be injected into CGD pipelines too for efficient distribution and optimised access of a cleaner and more affordable fuel.

### Conclusion

What is considered as waste today can be transformed into energy in the near future! Every bit of biomass can be used to produce bio-gas and bio-manure. This will go a long way in making India energy self-reliant, help combat global warming and mitigate climate change. Compressed bio gas has a bright future. ■

# Building Techno Commercially Feasible Facilities: From Waste to Energy



**Ajay Popat**

President, Ion Exchange (India) Ltd

India is one of the world's fastest-growing economies, with rising urbanization and an expanding middle class. India's energy profile continues to be heavily dominated by fossil fuel-based sources: by 2040, 42% of the new demand will be met by coal compared to 60% as on date and the country is projected to be among the largest oil consumers. Thus, India contributed 2.48 billion tons of carbon dioxide (CO<sub>2</sub>) in 2019, which amounted to 7% of global CO<sub>2</sub> emissions. The Paris Agreement aimed to tackle this problem by keeping

the global temperature below 2-degree Celsius relative to pre-industrial levels. To meet this goal, India has set a target of producing 175 gigawatts (GW) of renewable energy by 2022, with 100 GW coming from solar, 60 GW from wind, 10 GW from biomass energy, and 5 GW from small hydropower.

As of date, waste to energy accounts for nearly 495 MW of the total energy mix. India has significant potential to expand its renewable energy production from waste by using the vast quantities of organic waste generated by the

agricultural sector as well as a growing amount of municipal solid waste, used cooking oil and wastewater.

## Ion Exchange Experience & Expertise

Ion Exchange has installed the INDION Integrated Waste to Energy – Resource Recovery System (ANDICOS) at Akshaya Patra Foundation's Kitchen in Hyderabad, Telangana, which provides meals to underprivileged students under the Midday Meal Scheme and is one of the largest fully automated kitchens in India.

- 54 Using state-of-the-art Advanced Bio-methanation process, the INDION Integrated Waste to Energy – Resource Recovery System (ANDICOS) is an innovation which provides the perfect solution to address the crucial problem of disposal of large quantities of organic kitchen waste produced by Akshaya Patra's kitchen.

The plant treats organic kitchen waste to

produce Renewable Green Energy and Rich Organic Fertilizer thus reducing the burden of waste management and recovering valuable by products in the process.

The system has been integrated with a Biological Odour Control Unit which eliminates foul odour. The biofiltration process which does not use energy, is practically maintenance-free and results in complete decomposition of the pollutants without creation of hazardous byproducts. The odour control system which is integrated with the Waste to Energy plant is a significant innovation as the Waste to Energy plant sits next to the centralised kitchen of Akshaya Patra.

It can easily be replicated in converting biomass, agro residues and complex industrial organic waste into energy. In the case of the latter, Ion Exchange has already deployed this technology successfully and commercially in industries like – paper, brewery, FMCG

W2E Integration with INDION IPC MBR technology	
▪ Use case	▪ Treat Liquid waste (Sewage/Sullage)
▪ Water Recovery	▪ 90%
▪ Capacity	▪ 950 kg/day (organic kitchen waste)
	▪ 2 – 6 m <sup>3</sup> of sewage sludge /day
▪ Energy Output	▪ 20 kW/h per day
▪ Byproduct	▪ 1.35 tonnes of rich organic fertilizer

and is implementing one of the biggest projects in a petrochemical complex.

## **International success story/ ies - business model that may be emulated in our country**

India can adapt advanced waste to energy models from developed economies. Apart from technology adoption, we can also adopt their framework to commercialize them on vast scale in India.

- The European Waste to Energy Plants reported that in the year 2018, Germany converted 31% of their total MSW generated into Waste to Energy, while during the same year in Sweden, Finland, Norway, and Denmark, the conversion reached more than 50%
- In the USA, for example, modern regulated landfills collect approximately 2.6 million tons of methane-producing heat and electricity with a capacity of up to 50 MW turbine generator
- China, the largest developing country globally, has also attained massive progress in waste to energy development in the past decade. 259 waste to energy mass-burn plants have been built in China as of 2016

with a total capacity of 280,000 TPD

- In the UK, there are now 661 digesters in use (Foster et al., 2021). It provides biomethane (102 plants) and electricity (583 plants) to the national grid as well as local heating (42 plants). Between 2008 and 2017, 255 new anaerobic digesters with a total capacity of 193,354 kW were erected in the UK.

Ion Exchange has successfully deployed these technologies with select industries like breweries, paper, food & beverage, chemicals etc. to convert complex effluents into energy. Further, it has invested in commercial scale plants (Akshaya Patra) to demonstrate a model concept to convert municipal waste into resources (clean water, green energy, and rich organic fertilizer).

## **Investment scenario**

Central Financial Assistance (CFA) in the form of back-ended subsidy is provided for installation of Waste to Energy projects for recovery of energy in the form of Biogas or Bio-CNG or Power from Urban, Industrial, Agricultural Waste / Residues and Municipal Solid Waste.

Despite large government investments, India's energy sector relies on the private

sector more than ever as public-sector resources are more directed toward public health and sustaining livelihoods. Therefore, to attract private investment, the government has encouraged the participation of nonfinancial banking companies, launched a new investment fund, initiated the rationalization of tariffs, released subsidies, and improved the bankability of power purchase agreements in Indian Renewable Energy Market.

### Challenges for EPC industry to build techno commercially feasible facilities to produce waste to energy

The waste to energy concept is at a very nascent stage, particularly for converting Municipal solid waste to energy. EPC's, particularly in municipal sector (municipal waste) face several challenges like:

- **Highly fragmented market** with near majority of participants from unorganized and startup sectors
- **Cost Competitiveness:** Waste to energy plants must be cost competitive which means the price of energy produced by the waste to energy facility must be competitive in energy market. In India, the electricity produced from WTE plant needs to

be competitive vis-à-vis that coming from other renewable sources / traditional thermal sources in order to compete for Merit Order Dispatch (MOD)

- **Limited Technology Players** with a bandwidth-scale to promote the concept with technology, design, quality of components with optimum levels of control and automation plus odour control / VOC abatement technology integration in the design of the waste to energy plant.
- **Off taker risk:** Off takers are primarily state-owned public-sector distribution companies or Urban Local Bodies. Given the poor financial health of both, there is a risk of lagged or incomplete payments
- **Lack of infrastructure:** Inefficiencies from the lack of infrastructure to collect, segregate, technological solutions for MSWs and then generate and distribute electricity are a key barrier to foreign investment.
- **Waste to energy lies outside traditional investments** and potential investors are often wary because of their limited understanding of the sector in India. Domestic institutional investors typically invest in less risky



securities and prefer more liquid assets with good credit ratings, which are not available in Waste to Energy projects.

## Building the ecosystem to accelerate adaptation by industries & integration in energy ecosystem

- **Demand side reforms** such as reducing goods and services taxes on WTE Plants and promoting different WTE Technologies like Bio methanation, CBG, Torrefaction will encourage industry / consumers to opt for these concepts / technologies.
- **Effective implementation of RECs and RPOs** (which complement each other) could be a major factor in driving WTE market segment. Incentivizing power generated from WTE sources through subsidies or rate cuts, while simultaneously disincentivizing fossil fuels, will also be important.
- **Tapping financial resources** through financial intermediaries and instruments for the renewable energy sector is also important. Following the Covid-19 pandemic, green bonds may be attractive to investors as countries prioritize a green recovery from the recession.
- **Reducing energy intensity** will be important for managing demand. India can look to China for successful areas for improvement. China has reduced energy intensity and CO2 emissions by renovating old coal-burning facilities and incorporating ultra-low emissions technology into 80% of its coal-fired energy capacity as of 2019
- **Developing reliable vendor base** for different upcoming WTE Technologies like Bio methanation / Torrefaction etc.
- **Demonstrating the concept** as Ion Exchange has done, by setting up reference plants that can then be multiplied or scaled up. ■

## Role of Green Ammonia in Energy Mix



### Atul Bhalerao

Sr General Manager and Head of Market Development  
Thyssenkrupp Industrial Solutions India

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**G**lobally, India is the third largest producer of ammonia which is traditionally produced from natural gas. Since India lacks the availability of natural gas resources, the feedstock for Ammonia is imported into India; making it import-dependent. However, this process of Ammonia production from natural gas generates carbon emissions. Moreover, the volatility of natural gas prices impacted by the Ukraine war has pushed the conventional Ammonia prices to a record high approx. more than 1,000 USD per ton earlier this year. Unless there is a solution to detach prices from natural Gas, the

Indian agriculture sector is expected to suffer from subsidies and import bills. Some fertilizer companies within India also import conventional Ammonia for further utilization in other downstream phosphate fertilizers.

The food crisis is one of the major issues the world has been facing over the past decades for which it is essential that food production is ramped up. To accelerate the crop yield, ammonia-based fertilizers are used which catalyze the nitrogen in Ammonia and improve the soil nutrients. In the present scenario, the world is also struggling with climate crisis to keep

greenhouse gas emissions within specified limits.

With rising demand to curb carbon emissions, the industry is now exploring various options for producing Ammonia either free from carbon dioxide or keeping the emissions possibly at the lowest level using Green Ammonia.

In addition to Ammonia being utilized as fertilizer, the industry is seeking new avenues for utilization of Ammonia for burning as a fuel in coal-fired power plants, running ships/ vessels on Ammonia fueled marine engines, generation of electricity using Ammonia fired turbines and many others. Although these are not exclusively novel applications, the scale and utilization of such ammonia applications are being developed large-scale usage worldwide. Therefore, it is definitely a matter of time before such applications will become a reality.

With recent introduction of new incentives announced by Governments of developed nations such as USA, EU, and Japan;

### **New Avenues for Ammonia Utilization**

- Fuel in coal-fired power plants
- Running ships/ vessels on Ammonia fueled marine engines
- Generation of electricity using Ammonia fired turbines

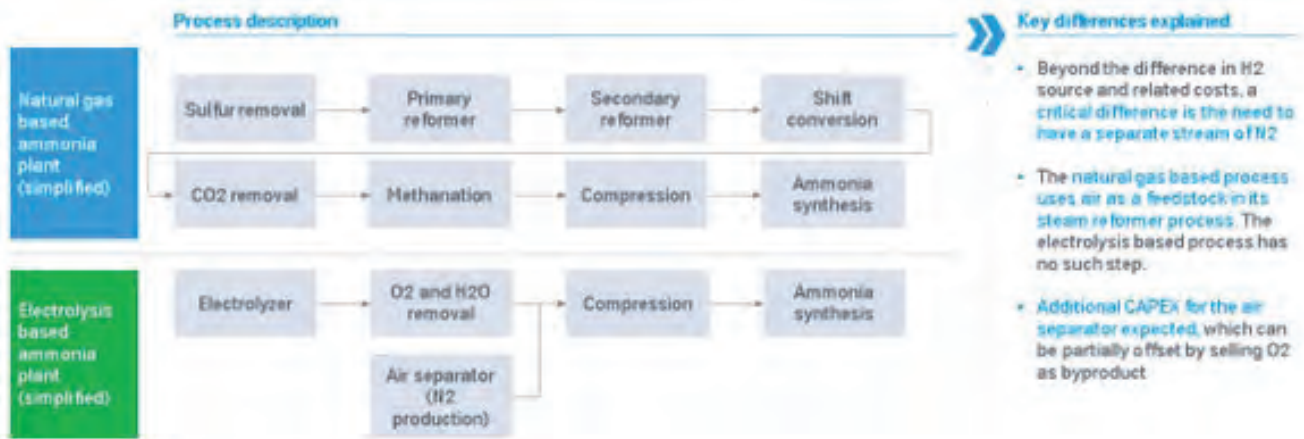
the Green Hydrogen and Green or Blue Ammonia are gaining sustained focus for the decarbonization of economies. It is also seen that the extraction of hydrogen from Green Ammonia provides another possible solution by cracking Ammonia at the site of consumption.

Overall market dynamics in Ammonia, provides a unique opportunity for India to move from import dependent Ammonia for Fertilizer in the agricultural sector and move towards export-oriented Green Ammonia ecosystem with the upcoming trade applications of ammonia as a fuel. Considering India's consumption of Ammonia, it is certain that Ammonia will play a vital role in India's journey towards energy transition.

### **Ammonia Synthesis**

The difference between conventional vis-à-vis green ammonia is the elimination of process steps such as the primary & secondary reforming. The conventional process of producing ammonia from natural Gas releases approx. 2 tons of CO<sub>2</sub> for every ton of ammonia produced. Primarily, these reforming processes of hydrogen production through Steam Methane Reforming are now replaced by producing green Hydrogen from Water Electrolysis. Depending on the downstream use, Deoxo (Oxygen removal) & Hydrogen compression need to be considered. The Nitrogen required will typically be sourced from an Air

## Conventional vs Electricity-based ammonia production



60 Separation Unit. The Ammonia synthesis process that follows is then similar compared with the conventional process.

To sum it up, we see that Green Ammonia is essentially produced from air, water, and from renewable energy sources like the sun & wind.

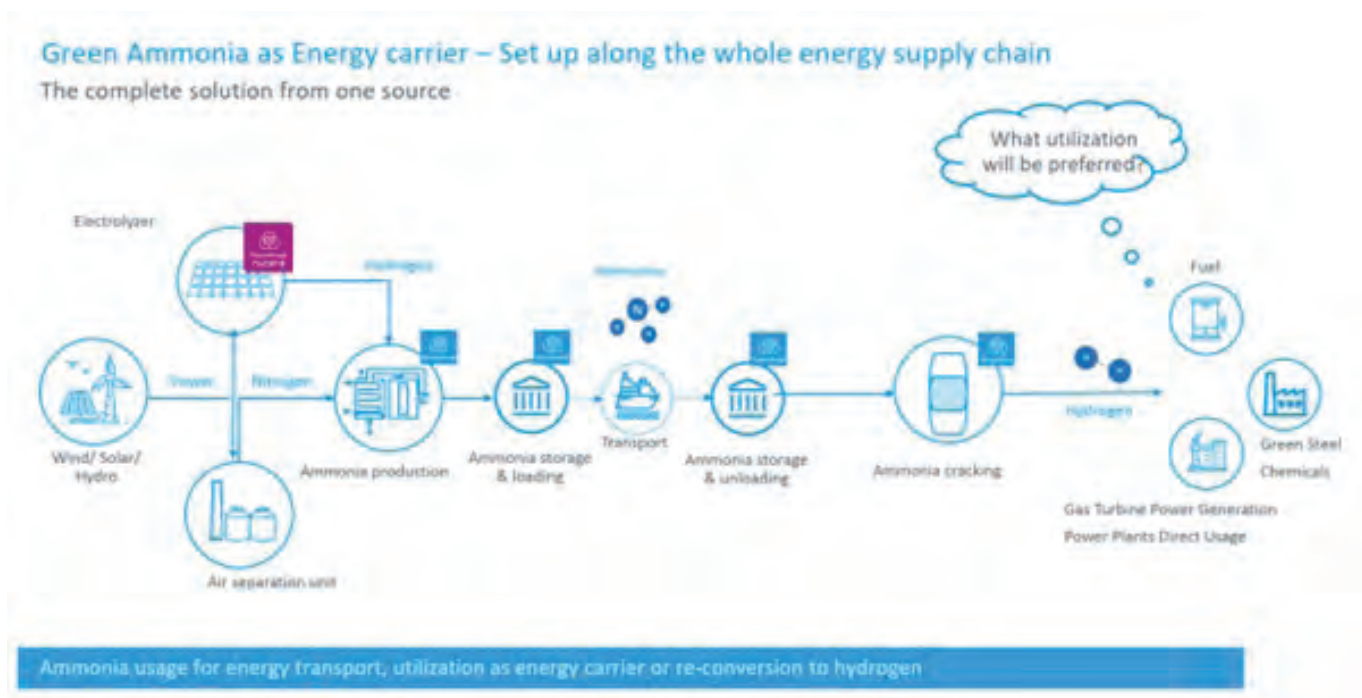
### thyssenkrupp offerings in Ammonia

thyssenkrupp offers a variety of solutions across the value chain of Ammonia production - starting from Green Hydrogen up to Ammonia Synthesis followed by Ammonia storage, and Ammonia cracking.

The difference between conventional and green ammonia plants is load management. While a conventional ammonia plant is usually operated near

its maximum capacity most of the time, the renewables-based production has to basically follow the ups and downs of the available power. thyssenkrupp Uhde has specifically developed a holistic performance modelling (RHAMFS©) across the entire Green Hydrogen / Green Ammonia value chain, right from power feed characterization to product dispatch. Based on decades of technical and economic data, dynamic and multivariable modelling can be performed to determine the most practical and cost-economic concept for any power-to-X application, be it greenfield or brownfield.

thyssenkrupp nucera offers Water Electrolysis technology and has more than five decades of experience in Electrolysis technology. thyssenkrupp has built more than 600 Chlor-Alkali electrochemical plants equivalent to 10 GW of Green



Hydrogen. All these Chlor-Alkali plants produce Hydrogen from the electrolysis process, as a by-product.

thyssenkrupp Uhde has more than 100 years of experience in implementing various Fertilizer projects around the globe. It is also the only company that has the experience in building more than 3,500 tpd Single Train Ammonia plants, which have been running successfully for more than 15 years. This expertise has been demonstrated at various plants worldwide.

thyssenkrupp Uhde can offer varied capacities of Green Ammonia plants from 300 TPD up to 5,000 TPD as required. It also offers carbon capture technology which can be utilized in conventional ammonia plants to limit carbon emissions; thereby such ammonia plants integrated with the carbon capture can also qualify for Blue Ammonia.

## International Success Stories

Globally, developed countries have started taking steps towards investing in Green Ammonia plants. Green Ammonia is also one of the critical vectors for carrying green hydrogen over long distances since the required infrastructure and supply chain for carrying ammonia has been in place for decades.

In the existing scenario, to achieve price parity with conventional Ammonia, the industry is ensuring the focus on economies of scale. Therefore, global projects such as NEOM in Saudi Arabia with 2GW of Water electrolyzers coupled with Green Ammonia production in the downstream are being set up at the industrial scale. In addition, the upcoming projects in developed nations such as EU / USA are also looking at larger-scale

ammonia plants.

thyssenkrupp is presently executing world scale Green Hydrogen project in Neom, Saudi Arabia and Clean Ammonia projects in Qatar & USA, which are expected to be on stream in the years to come.

### **Investments Scenario & Building the ecosystem to accelerate adaptation**

In the coming years, many analysts estimate multiple investments in the clean (either Green or Blue) ammonia capacities. The feasibilities of utilizing ammonia for applications other than in the fertilizers industry are being looked and studied at. One of the largest US fertilizer companies hinted that they will be adding ammonia capacity for exploring the upcoming potential market of ammonia for the marine shipping industry, and within the power plants. EU and Japan are exploring the import of Green Ammonia for this purpose.

Therefore, the Indian government is on the path of attaining self-reliance in Green Hydrogen & Green Ammonia. The ministries are promoting their bit to re-align their expectations towards the export of Green Ammonia at better prices. In order to make Green Hydrogen & Green Ammonia competitive, certain policy incentives from the supply side are announced for waiver of central transmission charges, banking up to 30 days and open access policy. In the

next phase, it is anticipated that the government will release policy incentives to encourage consumption and issue certain production linked schemes. A few months ago, the Energy Conservation (Amendment) Bill was introduced which sought to mandate the use of Green Hydrogen, Green Ammonia for energy & feedstock to combat the over-reliance on fossil fuels and move towards a self-reliant India in the future. Such an environment will ensure the pace of investments in Green Ammonia in India.

### **Conclusion**

thyssenkrupp can offer a wide range of solutions from concept to commissioning within the Green Ammonia value chain. This is at a time when India is making new strides in Green Ammonia sector as the energy transition takes place. To achieve a sustainable scenario while moving towards a net-zero economy, India is poised to grow with Green Ammonia investments. Many project developers and financial institutions are re-assessing their feasibilities based on ever-evolving scenarios from developed nations and seeking incentives from the government to make investments more sustainable. ■

# Agile Gas Infrastructure to Transport Hydrogen & Gas Mix



**Akhil Mehrotra**

MD & CEO, Pipeline Infrastructure Limited

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**M**uch of the talk today around hydrogen (H<sub>2</sub>) focuses on the need to upscale production to meet Net-zero targets and the vast demand that will be soon required, but a major factor to achieving this is how will we provide access of H<sub>2</sub> to the end users. The most promising approach is using existing natural gas pipelines for transporting hydrogen. It is technically possible as studies suggest that about 20% hydrogen can be blended into natural gas for transportation via gas pipelines, without any major investments.

As the world moves towards Energy Transition, the possibility of repurposing existing fossil fuel infrastructure to distribute “clean” energy is attracting a lot of attention. Hydrogen being one of the prominent candidate as a clean energy source a lot of talk has been going on about upscaling it’s production. However, after scaling up, we need to transport it to end users and this part has added challenges towards provisioning of H<sub>2</sub> gas across end users due to inherent properties of H<sub>2</sub> gas towards metals.

Transportation of hydrogen can be

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

- **Pipelines** tend to be the cheapest way to move hydrogen over longer distances. Constructing pipelines usually requires volume and demand certainty to justify investment. Additionally, existing natural gas pipelines can be repurposed provided they meet the technical criteria to reduce the risk of embrittlement. Repurposing of existing pipelines also enables blending of hydrogen within the existing natural gas networks for end uses where blended hydrogen can accelerate demand creation.
- **Trucks** are used to transport hydrogen in smaller volumes, both in gaseous and liquid form, for local distribution and longer distances.
- **Ships** are beginning to be used for larger volume, longer distance transport, mainly moving liquid hydrogen (LH<sub>2</sub>), LHOCs, and ammonia. Shipping of hydrogen is currently expensive due to added conversion costs (liquefaction or chemical conversion) in addition to the necessary structural design to reduce risk of embrittlement.

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

To establish the H<sub>2</sub> economy, hydrogen producers need to be connected to the users, and an optimum transport solution is via the existing gas infrastructure. There are many global projects investigating this scenario, one of them being the European Hydrogen Backbone (EHB) which is a collaborative effort with an estimated total investment of \$50-100 billion involving the major transmission operators across Europe which envisages expanding the network to appx. 39,700 Km of hydrogen pipelines by 2040. This will be achieved by adding 12,300 Km of new H<sub>2</sub> pipelines, with the remaining



27,400 Km (i.e., 69%) of the network being made up of repurposed natural gas pipelines. The requirement to design and repurpose pipelines for H<sub>2</sub> service is of global importance for the safe and efficient transportation of hydrogen from producers to users.

Gas infrastructure provides the backbone for the economy, as without this key energy infrastructure, cities, homes, and industry wouldn't be able to function. But how does this relate to H<sub>2</sub>. The complex infrastructure required to move H<sub>2</sub> to end users requires many critical components. These components range from pipelines, compression stations and valves, through to metering stations and city gate stations that enable transportation of gas to the end user. In all of this, pipelines make up most of the infrastructure and are designed and operated under a series of codes to ensure safety and efficiency of delivery.

## Blending of hydrogen in Natural Gas Pipeline network

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

Depending on the share of hydrogen to be injected, the gas network might need concrete retrofitting actions. The extent to which modifications are required depends on multiple aspects related to technical characteristics of the gas

European Hydrogen Backbone (EHB)			
Capital Investment	50 - 100 billion USD		
Project competition	2040		
Network coverage	39,700 km	New H <sub>2</sub> pipeline construction	12,300 km
		Repurposed Natural Gas pipeline	27,400 km

network. The retrofitting of the networks brings challenges that can be technically solved in an affordable way for hydrogen shares up to a certain limit. Few studies have revealed that at relatively low hydrogen concentrations (up to 10% H<sub>2</sub> in volume), the gas system may not require major investment or modifications, while higher shares of hydrogen concentration may require significant investment - depending on the topology of the gas grid, distance of transport, equipment in the gas system and acceptance of H<sub>2</sub> and natural gas mixtures by the end user.

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Repurposing natural gas pipelines for hydrogen is 10-30% of the cost of building new pure hydrogen networks. Blending hydrogen with natural gas in existing infrastructure will facilitate the use of a cleaner gas by end consumers. The possibility of blending H<sub>2</sub> to the Natural Gas network also comes with huge opportunities and additional challenges. This would require a detailed understanding of blending threshold during normal and transient operations in to eliminate the potential material, integrity, and operational issues as well the pipeline design implications.

Pipeline Infrastructure Limited (PIL) has proactively undertaken a key initiative to be ready for future energy transition

by assessing the blending of Hydrogen in pipeline. Strategic projects are in progress to evaluate possibility of hydrogen blending/ transportation or readiness of PIL pipeline. This is one of the first hydrogen blend related projects in the transmission space in India. PIL has partnered with DNV for assessing the technical impacts on gas pipelines of using hydrogen at different blending ratios (5%, 10%, 15%, 50% and 100%) covering assessment of pipeline integrity, pipeline safety and network operations with blended hydrogen. PIL has also signed a Memorandum of Understanding (MoU) with GAIL (India) for cooperation and collaboration towards development and strengthening of the hydrogen-based ecosystem in India.

### Key Challenges

- On the technical side, modifications in some parts of compressors as well as installation of new and more turbines or motors and more powerful compressors to deliver the three-times higher volume flow of hydrogen compared to natural gas will be required. This will totally depend on the admixture of hydrogen.
- Hydrogen and natural gas have slightly different densities. This is a key factor in pipeline management as

fuels in transit must be pressurized to optimal levels that balance volume with commercial viability. The fuels are also different in calorific heating value as well as corrosive propensities (which matters for the longevity of pipelines).

## Conclusion

Hydrogen is expected to play a critical role in the future energy transition and cost-effective transportation is a key driver to expand the footprint of hydrogen. To move H<sub>2</sub> over distances, users either must ship it, build new pipeline infrastructure, or repurpose existing gas networks. Every time hydrogen is converted between energy vectors along the chain from production, through transportation and on to storage and use, this would result in efficiency losses. The selection of H<sub>2</sub> transportation method and vector is multi-faceted and requires early evaluation to ensure the process is optimised. ■

# CHEMICAL ENGINEERING WORLD

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**“Implementing Projects on new technologies is the new normal, EPC players need to adapt to a robust digital infrastructure, mitigating primarily the cyber risks.”**



**Mr. Rajiv Menon**

President - Energy & Industrial, Tata Projects Ltd

*Taking cognizance of the global geopolitical scenario, **Rajiv Menon, President - Energy & Industrial, Tata Projects Ltd** articulates how the Indian EPC industry is moving quickly on its green hydrogen agenda to advance both its economic and environmental standing as well as its position as a world leader in EPC Sector via leveraging industry's talent and seasoned knowledge.*

**What is your outlook for the Indian vis-à-vis Global EPC Industry owing to the paradigm shifts due to energy transition?**

India is moving quickly on its green hydrogen agenda to advance both its economic and environmental standing as well as its position as a world leader. The energy crisis last year and ongoing challenges in the face of rising oil prices have served as wake-up calls regarding our continuous reliance on fossil fuels and the distance we still need to travel. After China, US, and EU, India produces the fourth-highest amount of carbon dioxide globally.

The hydrogen economy effort and the energy production required for it will both require the Indian EPC industry to be a key partner. India now has a significant home advantage thanks to the worldwide competitiveness of the Indian EPC industry during the past ten years.

The industry's talent and seasoned knowledge enable seamless integration of the design and construction phases for shorter lead times and reduced costs. The lower capital cost of constructing the plant will be crucial in achieving the lowest cost hydrogen generation. Given the government's goal of becoming the Global Hub of Green Hydrogen by 2030, this becomes of greater significance.

**What do the project owners / operators are now expecting from the EPC industry?**

Project owners and operators expect timely project completion without any cost overruns. At the same time, quality & safety must be maintained. Today, there is an increasing trend of owners and operators also enquiring about sustainability when discussing about projects.

**What are the major risks that need to be factored both by the project owners / investors and the EPC players since there is lot of talk about implementing projects based on new technologies?**

Implementing Projects on new technologies is the new normal, EPC players need to adapt to a robust digital infrastructure, mitigating primarily the cyber risks. For example, when implemented appropriately - wearable technology can enhance the calibre of work and increase worker safety on construction sites. But there are additional risks to consider if a company is looking into wearable technology. However, the risks of using wearables on the job site are still largely unknown.

**How have the risks changed for the EPC players in the emerging scenario?**

Yes, it is true that the fast-evolving

<b>TATA Projects Ltd Order Book- FY 22</b>		
<b>Project Owner</b>	<b>Location</b>	<b>Project</b>
<b>Indian Arena</b>		
HPCL Rajasthan Refinery Limited	Barmer, Rajasthan	CDU/VDU With HWOOG Treatment Unit, LPG Treating Unit & Fuel Gas Treating Unit; Delayed Coker Unit; and VGO Hydrotreater Unit
ONGC Limited	Kakinada	Onshore terminal for KG DWN 98/2 Development
ISRO	Trivandrum	Semi-Cryogenic Engine & Cryogenic Engine Test Facility
IOCL Gujarat Refinery	Vadodara, Gujarat	MS Block and Octmax Unit
NTPC Limited	Ramagundam	Construction of Power Plants
<b>International Arena</b>		
ADNOC Refining	Abu Dhabi	Improvement of Mussafah Terminal Firefighting Facilities
	Bangladesh, Thailand, Nepal & African countries	Transmission lines
<b>Marquee Projects in Indian Arena</b>		
	New Delhi	New Parliament building
	Mumbai	Mumbai Trans Harbour Sea Link
	Pune, Mumbai & Chennai	Metro Rail projects

scenario poses many risks to EPC players, however, if proper planning and implementation is undertaken then the situation can be managed better. For example, sustainability and green evolution is both a risk and an opportunity – it is a risk if one does not adapt properly but an opportunity for those that embrace these evolving concepts. Another risk to

EPC players could be disruption of supply chains due to geopolitical scenarios such as the current conflict in Ukraine. However, if alternate supply chain options are planned and kept on stand-by then this risk can also be managed to a large extent. Likewise, is the case with fluctuating commodity prices within a fixed price contract.

**What kind of supply chain disruptions do you anticipate in the volatile geopolitical scenario. How is TATA Projects securing the supply chain for timely execution of projects? To what extent do you rely on indigenous sourcing.**

The global supply chain is more interlinked and connected today than ever before and therefore a volatile situation in any part of the globe affects everyone. There are logistics constraints due to volatile geopolitical scenario, however, these need to get properly managed through proper planning around alternate supply channels and vendor management programs. As an Indian multinational, our approach has always been to maximize indigenous supply, while having a robust global sourcing strategy for items not available locally. Our long-standing relationships with suppliers across the world via our JVs and subsidiaries are also being leveraged to navigate through this situation.

**What is the current status of order book for TATA Projects? Tell us about some of the key projects at various stages of implementation and pipeline.**

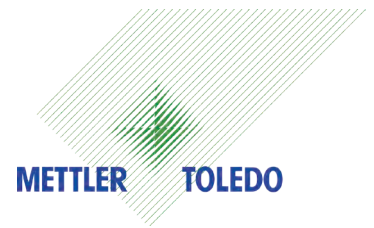
In FY22, the company witnessed a healthy double-digit growth in order booking vis-à-vis the same period earlier. And we remain confident about our future prospects because India needs

infrastructure to support its developmental objectives. We are doing marquee projects for HPCL Rajasthan Refinery Limited in Barmer (Rajasthan) such as CDU/VDU with HWOG Treatment Unit, LPG Treating Unit & Fuel Gas Treating Unit; Delayed Coker Unit; and VGO Hydrotreater Unit. For ONGC Limited in Kakinada – we are doing onshore terminal for KG DWN 98/2 Development Project. While we are building Semi-Cryogenic Engine and Testing Facility & Cryogenic Engine Test Facility for ISRO in Trivandrum. For IOCL Gujarat Refinery, we are setting-up MS Block and Octmax Unit in Vadodara, Gujarat.

On the international arena, we are undertaking EPC works which includes Improvement of Mussafah Terminal Firefighting Facilities Project for ADNOC Refining in Abu Dhabi. We have also undertaken transmission lines in Bangladesh, Thailand, Nepal, and African countries.

Our other marquee projects include New Parliament building, and the Mumbai Trans Harbour Sea Link that will be the longest sea bridge built in India. We are also doing a lot of work around Metro Rail projects in Pune, Mumbai, and Chennai. Also, substantial work has been undertaken in the Power sector for NTPC by constructing large power plants in Ramagundam. ■

## Enabling QA & QC excellence via Digitalized Analytical instruments



**Mr. Sanjoy Mallik**

Managing Director - Mettler -Toledo India

*Mr. Sanjoy Mallik - Managing Director - Mettler -Toledo India, articulates the commitment of Mettler Toledo towards creating high precision analytical instruments enabled with digital technologies & Industry 4.0 Ready features through dedicated R & D and decades long experience-based innovation. The instruments developed via such methods with the user industry at the center of development process, have substantially raised standards of the product output of the industry users of Mettler Toledo's precision measurement systems.*



### **How is Mettler Toledo poised in India's precision measuring tools market and internationally?**

METTLER TOLEDO is a leading global manufacturer of precision instruments. The Company is the world's largest manufacturer and marketer of weighing instruments for use in laboratory, industrial and food retail applications. The Company also holds the top-three market positions for several related analytical instruments and is a leading provider of automated chemistry systems used in drug and chemical compound discovery and development. In addition, the Company is the world's largest manufacturer and marketer of metal detection systems used in production and packaging. We also offer precision instruments and services for many applications in R&D, quality control, production, and logistics and these are the areas where India is looking forward as growth drivers.

### **What are the major challenges of the changing and evolving field of precision instruments and how have you addressed them?**

The major challenge experienced around precision instruments is consistent performance as any deviation can impact productivity. To address this challenge, Mettler Toledo sensors are integrated into an automation environment in tough industrial areas and used in quality- or safety-critical processes. For example, they are used to produce vaccines or lithium-ion batteries that rely on

repeatable production quality. Therefore, our customers require monitoring that not only provides a weight value but also assurance that the weight value can be trusted. For example, many traditional weighing systems do not have the functionality to indicate whether a measuring device remains in good condition and is not damaged by external factors which leads to inaccurate measurements. We notify the customers that the system is running and if a significant event occurs, an alarm is sent to the automation network, as well as the operator and to any enabled alarm annunciator. This prompts the customer to act and fix the root cause before a mistake leads to out of spec products.

### **What are some of Mettler Toledo's latest technological breakthroughs and trends that help maintain the highest industry standards?**

METTLER TOLEDO has long been a leader in innovation and quality, it starts with traditional research and development but goes beyond technology to include a full understanding of customer needs. Simply said, we are committed to ensuring our innovations translate into real value for our customers. A selection of our innovations is highlighted here:

- a. **METTLER TOLEDO** has substantially increased the possibilities of tunable diode laser (TDL) applications using the folded optical path principle in our GPro500 series. TDL spectroscopy is rapidly becoming the gas analysis

technology of choice in industrial processes.

- b. Our **XPE Analytical Balances** are equipped with the unique StaticDetect™ technology which automatically detects electrostatically charged samples as soon as these are placed on the weighing pan. A warning signal alerts the user when the sample material is carrying a charge. Coupled with static elimination technology and an improved SmartGrid weighing pan, our solution provides trusted and precise results.
- c. **Quantos** replaces the tedious work of dosing minute sample quantities. With automation and the protection of a closed system, Quantos delivers precise powder dosing of samples and accuracy to weigh to 0.005 mg. The intelligent dosing head includes a storage container for dispensing highly potent or hazardous powders and has built-in radio frequency identification (RFID) to immediately save all data.
- d. **STARe** thermal analysis software provides comprehensive data integrity. Protect your records from unauthorized modification and link original records with the operator, method, conditions, and calibration data. STARe software also meets stringent FDA 21 CFR Part 11 requirements.
- e. **ISM (Intelligent sensor management)** features the world's first learning sensors for process

analytics. Advanced algorithms allow sensors to learn process conditions within one day. This ability accelerates the rate at which accurate diagnostics are provided and enhances the consistency of information over a sensor's lifetime.

**'Rise of automation results in intensified demand for advanced precision measuring tools, how have you been leveraging Automation to stay competitive in the business?'**

We have made our sensors faster, more deterministic, as well as low latency (i.e., fast-reacting) and enable them to be connected to the leading automation networks like EtherNet/IP, PROFINET and Ether CAT. Customers benefit because they can operate quicker and more efficiently than in the past. Moreover, in early 2023, we will introduce server and connectivity to our state-of-the-art compact automation weight indicator. This will allow simultaneous connection to the factory floor and the Cloud. Cloud connectivity is desired to monitor and analyze data for improvement. With our compact automation indicator almost every type of gravimetric weight device, legacy or modern is easily connected to a control system or the cloud. We also help customers to support and automate manual workflows like recipe weighing. Surprisingly many customers still work with fully or partially paper-based processes. With our networked formulation software solutions like Form+ we help customers to digitalize workflows

and achieve higher efficiency, avoid operator errors and simplify traceability in production.

### **What are your latest tools and advancement in the digital spectrum that drives productivity and quality?**

We continue to work closely with our customers to help them comply with their quality management programs. Our customers see us as a reliable and knowledgeable partner. This strength of ours is a key differentiator in our business. We invest a lot of effort in educating the industry to not only achieve compliance but also to keep improving productivity and efficiency. This is backed by our significant investments in our people, both in terms of their own competence and their availability to share their knowledge with our customers. With the increasing demand for digitalization, METTLER TOLEDO has been investing significantly in Industry 4.0. Most of our equipment is Industry 4.0-ready and can be integrated with any MES systems.

METTLER TOLEDO has been present in India for more than 20 years and has developed capabilities in pre-sales consulting, engineering, and post-sales support. We are sensitive to the need for prompt customer support. We have two state-of-the-art competence centers in Mumbai for customer training, product testing, and in-house competence enhancement of our sales and service teams, as well as a network of well-trained service engineers who are located near

most of the industrial clusters across India. The engineers are backed by an in-house technical support team. All customer service requests are managed centrally through a modern call management system. We also invest a significant effort in training our customers so that they can deploy our equipment optimally.

### **Mettler Toledo deals with many industries sectors from chemical, pharma to engineering, how have you adapted to the changes and transformations in these sectors?**

Simply said, we keep our finger on the pulse of the market and anticipate where we can add value for our customers. For example, we are closely monitoring and foresee Ethernet APL for weight data in hazardous areas. We have also introduced a revolutionary calibration method that dramatically reduces calibration time and efforts typical to the calibration of large tanks. Also, on the operational side we are adapting our sales processes to the latest market trends. We are providing a comprehensive set of technical information including CAD data, sample codes and virtual demos to integrate our products more efficiently in customers' machines or plants. We have also introduced our Customer Portal, which is a combined platform for fast online purchasing, easy collaboration and transparent after-sales services including an asset overview. ■

## Advanced Vacuum Membrane Distillation (AVMDTM ): Cost-effective and Sustainable solution for ZLD



*Increasing regulations and pressure for industries around the world to achieve ZLD (Zero Liquid Discharge) & MLD (Minimal Liquid Discharge) highlight a growing need for affordable, efficient brine management technologies. Aquatech International Corporation has developed (Advanced Vacuum Membrane Distillation- AVMD) to overcome these limitations, namely: (1) lower flux as brine TDS increases (2) pore wetting, which can result in low quality distillate (3) inability to go beyond saturation due to salt crystallization on membrane surface (4) lack of scalability. This technology works at relatively low temperatures (leading to lower energy demand) and separates water vapors from brine through hydrophobic membranes.*

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Governments on all continents are increasing pressure on industries to comply with environmental regulations as ecological conservation and environmental preservation become worldwide buzzwords. Additionally, in India, it is becoming more and more difficult for businesses to dispose of environmentally dangerous trash that comes from their facilities. Regulations governing the disposal of industrial wastewater

are also getting stricter. To lessen the environmental impact of wastewater management, zero-discharge technologies (ZLD) are being researched more and more.

ZLD can be achieved in various ways. There is no “one size fits all” solution, as the optimal system design is site specific. The wastewater composition, various streams to be treated, site specific operating costs, footprint availability and

other factors are determining factors for an optimal design.

Because of high installation and maintenance costs, conventional thermal evaporation technologies now find it difficult to provide clients with low-cost solutions. After extensive research, Aquatech's Advanced Vacuum Membrane Distillation (AVMD™) technology was developed to overcome these problems and successfully meet the requirements of small-scale thermal evaporation.

## AVMD™ Process

In the AVMD process, preheated RO reject water or brine, or wastewater is circulated in a tank where one or more AVMD™ membrane units are placed in the hot circulating liquid system. The hot circulated brine generates water vapors which are drawn through the AVMD membrane unit with the help of vacuum. These water vapors are condensed to

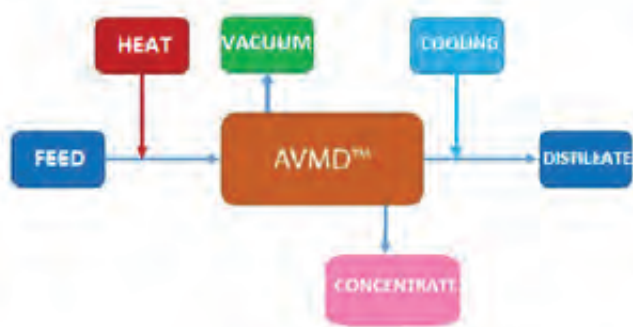


Figure 1. Schematic Diagram of AVMD™ Process

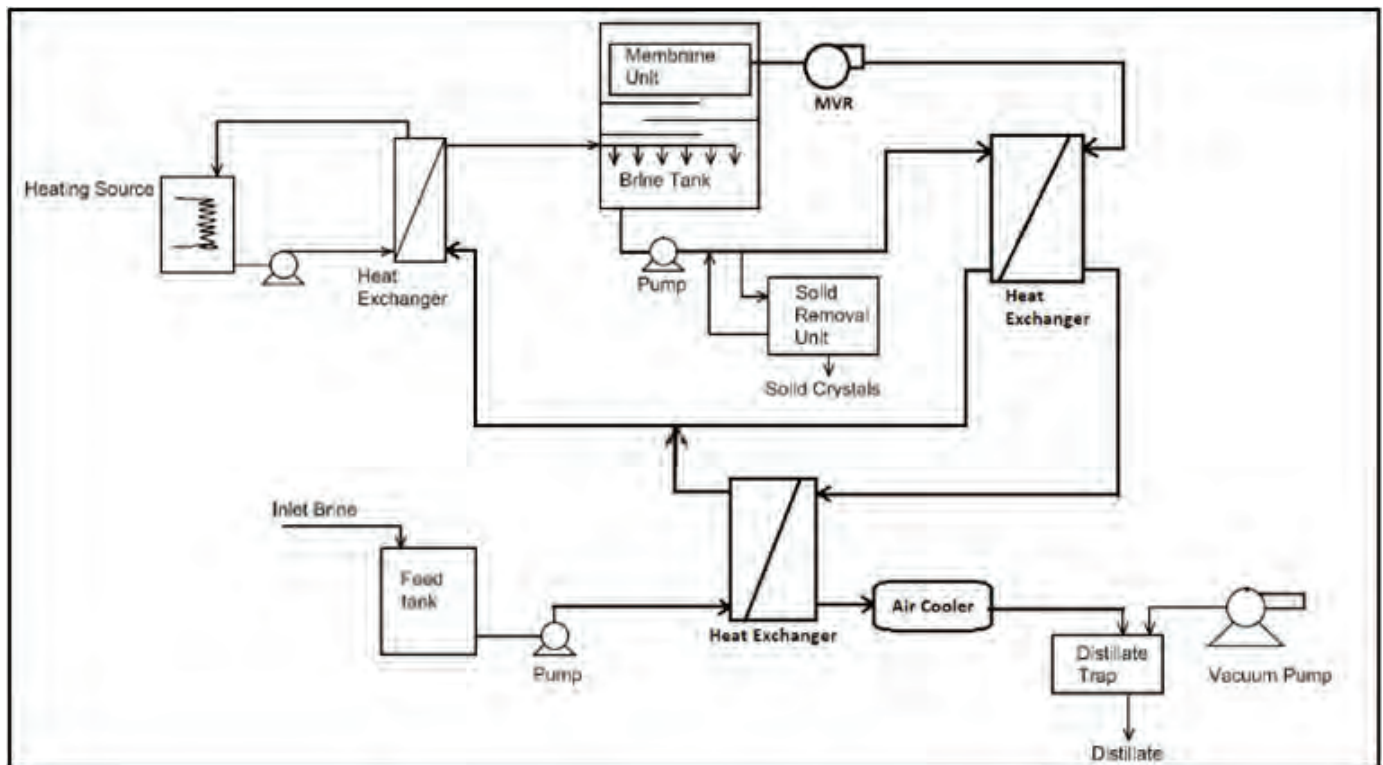
generate a pure distillate with low TDS and more than 99.9% of dissolved inorganic impurities removed. Furthermore, the technology can concentrate RO reject brine up to saturation levels, serving the same purpose as conventional brine crystallizers with much lower footprint and equipment cost. For volume reduction, the AVMD process can also reduce brine/wastewater volume by 90% or more, depending on influent water characteristics. AVMD's process schematic diagram is shown in Figure 1 and AVMD's modular system skid design is shown in Figure 2.

## AVMD Process Features

AVMD can consistently produce distillate with 99.5-99.9% salt rejected regardless of feed brine concentration due to its novel configuration. The process can also be adjusted to maximize water or solute recovery where applicable. Due to its scalable design, AVMD also enables lowered capital cost in small- to mid-scale facilities.



Figure 2. Modular AVMD™ System Illustration



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Figure 3. Flow Scheme of AVMDTM Process with Energy Recovery

## Value propositions of AVMD™ Process:

Based on the various studies, AVMD's value proposition for small- to mid-scale ZLD & MLD facilities can be encapsulated as follows:

- High brine concentration and salt rejection abilities, allowing for greater than 90% recovery and low TDS distillate. The brine can also be concentrated to achieve ZLD.
- Innovative design separates the membranes from the liquid/brine solution, eliminating membrane fouling and leading to a consistent high flux and distillate quality.
- Lower capital cost than thermal evaporation systems in low-capacity applications due to its modular configuration.
- Modular design minimizes installation, commissioning, and operating costs.
- Membranes contained are highly temperature-resistant, capable of handling up to 90°C feed water, and possess mechanical durability allowing for improved operating life.
- System can operate with multiple heat sources.

- Compact footprint, with limited infrastructure construction or modification required.
- Faster delivery and installation than conventional brine management treatment systems due to standardized design.

## Conclusions

The AVMD process is optimized for direct treatment of RO reject or similar brine or high TDS streams with some preconditioning. Furthermore, AVMD is able to effectively reduce brine volume and recover high quality distillate to meet ZLD & MLD requirements. The AVMD process provides consistent distillate quality regardless of feed brine concentration with recovery > 90%. AVMD is effective in applications where a significant capital cost advantage over other thermal evaporation technologies can be applied, or where there is a recoverable product such as a solvent or valuable material which can be recycled back to an upstream industrial production process. It offers an energy efficient process with high membrane flux, eliminates membrane fouling and pore wetting limitations through an innovative design, has lower capex, trouble free and easy user-friendly operation and has a compact footprint with limited infrastructure construction or

modification required. AVMD system is modular & flexible, can be customized with and without energy recovery option as per customer needs. Thus, AVMDTM provides an innovative and low-cost solution to customers for small flow ZLD systems.

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## Arkema increases bio-based offer with a new range of mass balance acrylic materials



mass-balance certified under the International Sustainability and Carbon Certification-PLUS (ISCC+) framework. This launch would enable Arkema's customers in achieving their climate plan goals by reducing their scope 3 greenhouse gas emissions.

These novel performance bio-based segregated solutions are: Rilsan and Pebax Rnew polyamide 11 advanced polymers, Sartomer Sarbio UV-curing resins, Synaqua alkyd emulsions, Crayvallac and Coapur rheology additives, amongst many others.

<https://hpp.arkema.com/en/product-families/rilsan-polyamide-11-resins/rilsan-clear/>

In a key milestone in the transition to a more renewable and lower carbon economy Arkema launches new range of bio-attributed acrylic monomers and specialty acrylic additives and resins,

## Honeywell launches Honeywell Forge Sustainability+



**HONEYWELL FORGE**

Honeywell announced a new

sustainability solution for carbon emissions monitoring and optimization which it has launched for earlier adopters and has also been deployed at its own facility. Honeywell Forge Sustainability+ for Industrial Emissions Management and Honeywell Versatilis Signal Scout wireless Industrial IoT leak detection sensors will enable organizations to monitor and visualize emissions in near real-time by providing organizations with

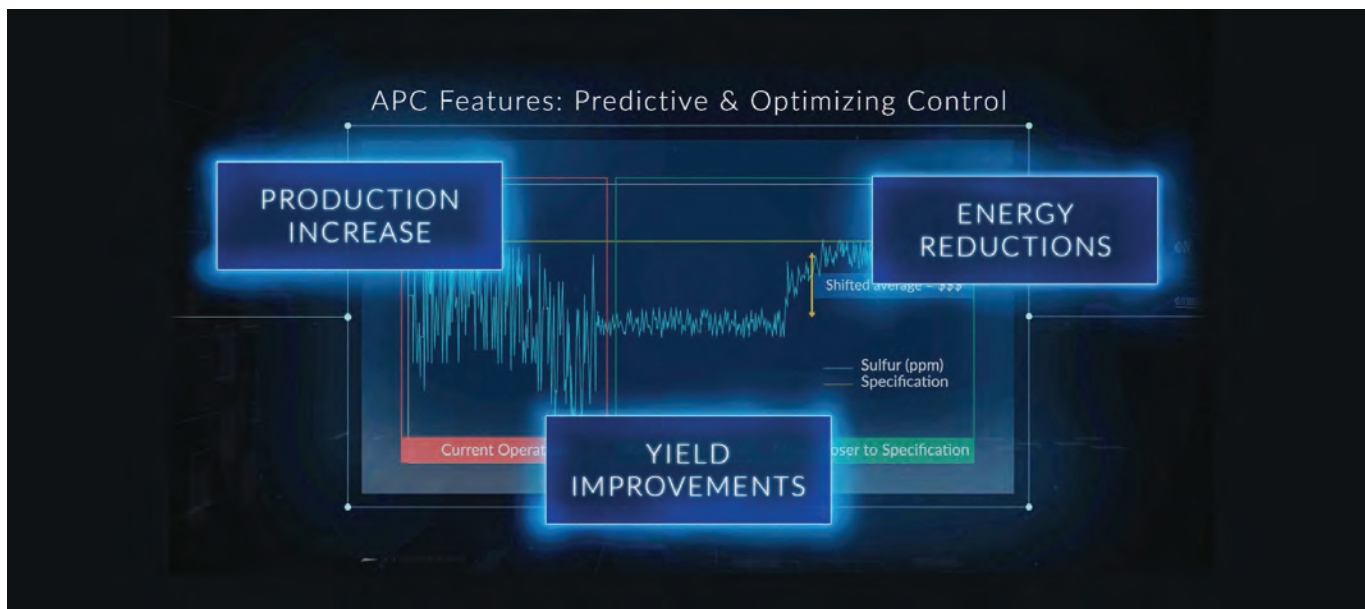
an end-to-end software solution that includes emissions monitoring, analytics, visualization, and proactive insights to assist with emissions reduction.

These novel solutions will serve as a foundation for organizations to measure, monitor, reduce and report their emissions performance of their customers in the industrials sector as they strive to reduce their greenhouse gas (GHG) emissions and meet their carbon reduction goals and against their carbon reduction goals.

<https://www.honeywellforge.ai>



## Aspen Technology Introduces New Software Release to Advance Customers' Sustainability and Operational Excellence Initiatives



Aspen Technology, Inc., a global leader in industrial software, announced the availability of its latest aspenONE® software release, V14. The new release delivers advanced intelligence and guidance capabilities that improve decision-making abilities and further boost operational excellence. In addition, V14 enables customers to accelerate sustainability projects with more than 100 sample models and to manage Scope 1 and 2 emissions for reducing carbon footprints. aspenONE V14 enables industry to jumpstart progress in the areas of emissions management, hydrogen economy, carbon capture, materials circularity, bio-based feedstocks, and renewable energy. V14 automates CO2 emissions data collection from multiple sources for decarbonization compliance/reporting and enables customers to model these emissions in operations to achieve sustainability targets.

[www.jasubhaimedia.com](http://www.jasubhaimedia.com)

“It’s a critical time for companies to optimize efficiency and sustainability across their operations,” said David Arbeitel, Senior Vice President of Products at AspenTech. “Our customers are uniquely positioned to support the dual challenge of meeting the increasing demand from a growing population in a more sustainable way. The new capabilities in V14 will help customers streamline progress toward sustainability goals and operational excellence for stronger business outcomes.”

<https://www.aspentech.com/en/products/engineering/aspen-plus>

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to  
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Direct Reach  
to  
**>200,000 Readers**  
across  
**>25 countries**



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