

BALANCING GROWTH WITH SUSTAINABILITY

Responsible consumption and reimagining product lifecycles key to circular economy for plastics

Cheap, flexible and multipurpose plastic has become the ubiquitous material of today's fast-moving economy. The linear 'take-make-dispose' model of consumption means that products get manufactured, bought, used once or twice for the purpose they were made, and then thrown away. According to Dr. Prasad Modak, Founder, Environmental Management Centre LLP, the concept of circular economy represents a shift from this "throw away culture" to "responsible behaviour". "There is no question that plastics is a boon but we need to consume responsibly," he said while delivering the keynote address at a symposium on 'Circular economy for plastics' organised at the Indian Institute of Technology-Bombay (IIT-Bombay) recently. The event was jointly organised by IIT-Bombay, The Ohio State University and Techstain Technologies Pvt. Ltd.

The circular economy represents an alternative, more sustainable model to the traditional linear economy and is restorative and regenerative by design. "In a circular economy, we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of their service life. This also improves competitiveness and resource efficiency," Dr. Modak pointed out.

He described the gradual evolution of the concept of circular economy from the 1990s to the present day. Circular economy practices have important direct and indirect contributions to the UN Sustainability Development Goals (SDGs), he said.

He noted that apart from the fami-



Dr. Prasad Modak

liar three 'R's of reduce, reuse and recycle, the concept of circular economy involves additional 'R's like 'Repair', 'Refurbish' and 'Remanufacture'.

Explaining the concepts with respect to plastics, he said, "We have to look at ways of avoiding or refusing to use plastics or even if we use it, we have to reduce consumption. In some cases, we may have to redesign or rethink in terms of the products & services being used. And after using the products and before throwing it away, we need to look at options to repair or refurbish. Extending the product life should be the intent at the design stage itself. And after finishing its beneficial use, the aim should be to reuse the product or to recycle, remanufacture or recover components."

"These new 'R's' introduces significant components like social (employment), investment and innovation. Once material flows become circular, compli-

ance becomes of interest to every stakeholder in this complex web of community, business, government, financing institutions, etc. Many companies have begun to realise that innovation comes about through circular economy practices," Dr. Modak observed.

Speaking about circular economy in India, he said that India was the first to set up an Indian Resource Panel (InRP) with an aim to promote sustainable development by utilising secondary resources to meet developmental needs.

A report by the Ellen MacArthur Foundation on India shows that a circular economy path to development could bring India annual benefits of \$624-bn in 2050 compared with the current development path – a benefit equivalent to 30% of India's current GDP.

Unfair to blame industry

Dr. Vijay Habbu, Senior Vice President at Reliance Industries Ltd. opined that the government tended to look at the industry as the "villain in the plastic pollution issue". "If you want to have food security, it is essential that it is packaged well. There is no other versatile material such as plastic. So, it does not make sense to complain about the industry for having brought you the good product in a good package that ensured its goodness," he pointed out.

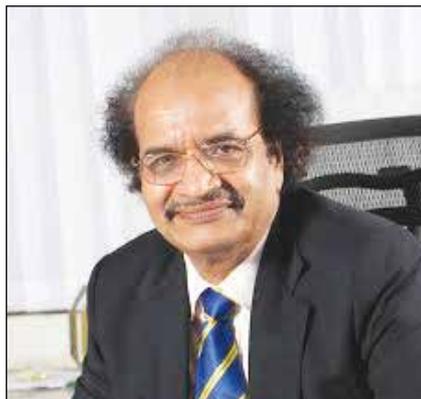
In case of plastics, consumers tend to form opinions only on what they see at the end of its life cycle because of the ubiquitous litter. They wouldn't see what happened during the beginning of its life cycle and its usage when it is compared with other alternative mate-



Dr. Vijay Habbu

rials, lamented Dr. Habbu. “Plastics is not a monolithic group and to an extent the industry is to be blamed for not making the consumers and key stakeholders aware about the different kinds of plastics in use,” he noted. “Depending on the complexity of the packaging material and whether it is rigid or flexible, it would get reflected in its litterability, retrievability and recyclability. If it is a rigid material, inherently the litterability will be very low – because it is easy to pick up – and therefore retrievability is very high. Being a single polymer, its recyclability is very easy, which is why PET materials get recycled in excess of 85%. As one goes up in complexity, the recyclability goes down. Also depending on the size and shape, the retrievability gets affected as seen particularly in flexible polymers like carry bags,” he explained.

In the existing system of waste collection and sorting, a lot of material remains uncollected because of its low value or due to its retrievability. “So, there should be some mechanism where brand-owners come together to fulfil the viability gap which essentially is part of the ‘extended producer responsibility’ mechanism. We have to realise that addressing the plastic pollution issue is not the responsibility of one single industry but a collective responsibility,” he emphasised.



Prof. G. D. Yadav

In his address, Prof. G. D. Yadav, Vice Chancellor, ICT, Mumbai, stressed the fact that banning of plastics would not serve any purpose and the correct approach should to focus on issues like material optimisation, recycling, reprocessing, energy recovery, etc. “If technology has created a problem, technology alone can offer the solution. Banning will never be an optimal solution for this problem,” he added. Dr. Yadav also spoke about how biotechnology would play a significant role in opening up new opportunities in polymers and gave various examples of how biology can play a vital role in areas like polymer synthesis and applications leading to a circular economy for plastics.

Challenges for circularity

The challenges in achieving true circularity were highlighted by Dr. R. Rajagopal, Founder of KnowGenix and Consulting Editor, *Chemical Weekly*, in his presentation.

“Circular economy’s restorative and regenerative design is meant to keep products, components and materials at the highest utility. But value is the issue and also at all times the major issue. A grassroots level personnel or an engineer working in a plant or a salesperson will understand the limits of this concept,” he pointed out.



Dr. R. Rajagopal

A circular economy club which tracks over 3,000 circular economy activities all over the world, found that only 9% of the reported ones could be termed as truly circular. “We have a long way to go in understanding and achieving true circularity,” stressed Dr. Rajagopal.

Claiming circularity is easy but measurement is an issue, he noted. The development of metrics and tools for enabling, monitoring and evaluation of circular economy outcomes is an evolving process. “With heterocyclic moieties coming into monomer development we need to measure multiple metrics for every process and these metrics also evolve with respect to the kind of monomers or polymers that are being generated and the kind of functionalities that they possess,” he said.

Underlining the challenging nature of the business, Dr. Rajagopal noted that many companies in the field of

biobased industries have filed for bankruptcy in the past 18 months because of a lack of understanding of technology challenges and not because of regulatory or pricing troubles. He also quoted the example of chemicals giant, BASF, recently exiting Avantium – the furandicarboxylic acid venture – because they weren't able to deliver results even after 11 years of trying with the best of human resources at their command.

He noted that 'Green Chemistry' principles provide an excellent framework to create systems consistent with circular economy. The evolution of green chemistry products to commercially sustainable products is recognised as a significant landmark in the sustainable product design movement, he said.



Dr. Rajagopal pointed out that product design is extremely critical in the whole journey of defining circular economy for any industry and not just for plastics. "It is critical to evaluate and optimise design principles and then make improvements continuously," he

added. "The crux of the whole issue is how to integrate circularity into materials and businesses. We are far away from it today. Unless we get our resource efficient models right how are we going to achieve circularity," he remarked.

RECOGNITION

Ultra's Sant Sanganeria felicitated by Hindu College

Mr. Sant Sanganeria, President & Managing Director of leading fragrances & flavours firm, Ultra International, was felicitated by the Hindu College, University of Delhi, during the occasion of its 120th Founder's Day recently.

Mr. Sanganeria was bestowed with the 'Sarthak Samman' – a newly instituted honour by the Hindu College for outstanding philanthropic gestures.

"With growing student strength, the existing infrastructure at the college was proving to be severely inadequate both in terms of space as well as quality of equipment. In this very short but immensely meaningful period of Mr. Sanganeria's association, the College has seen a rapid upscaling of the infrastructure facilities for the students. The addition of state-of-the-art laboratories for Physics, Chemistry, Botany and Zoology shall open up new vistas of learn-



Dr. Satyapal Singh, Minister of State for Human Resource Development, conferring 'Sarthak Samman' on Mr. Sant Sanganeria (Third Right)

ing and give the students an edge over their peers elsewhere. Mr. Sanganeria has shown by this most benevolent gesture, how one individual can make all the difference," said Dr. Anju Srivastava, Principal, Hindu College.

She added that Mr. Sanganeria's contributions have been recognised by the Trust of Hindu Educational Society by nominating him as a member of the Governing Body of the Hindu College.

NETWORKING BENEFITS

Embracing digitalisation set to unlock new growth opportunities for chemical process industry

‘Industry 4.0’ – also referred to as the fourth industrial revolution – encompasses a wide gamut of technologies that are enabling automation and data exchange in the manufacturing sector. These new-age technologies include artificial intelligence, machine learning, cyber-physical systems, robotics, the Internet of Things, cloud computing and cognitive computing amongst others.

While the chemical process industries (CPI) may have been slower to adopt some of these technologies as compared to consumer markets or other manufacturing sectors, the CPI is very familiar with the use of sensors and automation since a number of years and is well poised to take advantage of these technologies.

This was the view expressed by most experts who spoke at a one-day seminar on ‘Digital Solutions in the Process Industries’ held in IIT-Bombay recently. The event was organised by the Indian Institute of Chemical Engineers, Mumbai Regional Centre (IICHe-MRC) in association with Chemical Engineering Association (ChEA) of IIT-Bombay.

Rapid transforming

According to Mr. R. G. Rajan, Chairman, IICHe-MRC, the digitalisation of process industries is rapidly transforming the operations of companies and opening up lot of opportunities for companies to improve and increase efficiencies, product quality and to customise their processes to an unprecedented degree. “It is clear that companies which can quickly and successfully implement a digital transformation strategy throughout their entire plant lifecycle, will have a definite



Mr. R. G. Rajan, Chairman, IICHe-MRC speaking at the seminar as other dignitaries look on

competitive edge over others,” he declared. Mr. Rajan quoted reports which estimated that companies around the world are already spending about \$1 trillion every year to upgrading systems to be suitable for ‘Industry 4.0’.

Even as digitalisation becomes important for process industries to dramatically accelerate change in resource management, process control and in design and development of new destructive business models, the transformation will throw up challenges for companies in terms of security of systems, data protection and employee training, noted Mr. Rajan.

Embracing digitalisation

The concepts of digitisation, digitalisation and digital transformation were lucidly explained by Mr. Anand Vishnubhotla, General Manager-Asia Pacific, Honeywell Process Solutions, in his presentation.

“Digitisation as simply converting

the data or information into some digital format. Digitalisation is taking it even further and making sure that the information is being used to optimise or improve operations or business processes. Digital transformation is very similar to digitalisation and involves using the digital tools to fundamentally change business models or create new revenue streams,” he remarked.

He listed the following factors as driving the digital transformation in the process industry:

- The cost of sensors has come down dramatically in the last couple of years. A manufacturing plant now features a plethora of sensors and instrumentation, and tons of data gets generated.
- In the last 5-6 years, the computing power and costs have also come down and the ability to store and process has increased manifold.
- The rate of innovation in new digital technologies like augmented reality, virtual reality, advanced analytics,

artificial intelligence, machine learning, robotics, etc. has been very dramatic in the last few years.

- The changing workforce system with infusion of young people who are attuned to a digital world.

Mr. Vishnubhotla noted that these changes and disruptions are a great opportunity for the process industry to upgrade to the next level. He, however, underlined the difficulties in adopting digital technologies in process industries given that huge capex is involved in setting up chemical plants and it would not be feasible to have short term technology solutions that become redundant in a year or two.

“The challenge would be to properly implement the various digitalisation tools & technologies and extract real value. There is a lot of excitement about all these technologies, but the applications, which are giving true benefits, are still evolving,” he concluded.

Industrial Internet of Things

Mr. Sanjeev Katti, Director General, ONGC Energy Centre, reiterated that the growing interconnectedness of industrial operations, better known as Industrial Internet of Things (IIoT), is transforming industry in day-to-day operations.

“Digitalisation connects streams of machine data to powerful analytics and



people, providing industrial firms with valuable insights to manage assets and operations more efficiently,” he said.

Speaking from a user perspective, he noted that chemical plants can use predictive analytics to detect corrosion in a pipeline or monitor catalyst activity. It can also provide real time data to uncover any additional capacity in the plant and accelerate new product development by feeding operations and service data back into the product design cycle.

“Remote monitoring and asset control were already been made possible by Distributed Control System (DCS) and Supervisory Control And Data Acquisition (SCADA). While a DCS is more integrated and can do more higher-end stuff,

SCADA systems are more flexible. The benefits of IIoT are in device interoperability, system ownership cost, data insight and scalability. IIoT technologies will certainly supplement DCS and SCADA but not replace them,” he explained.

According to Mr. Sunil Shah of Modelicon Infotech, IIoT is an enabler to induce intelligence into existing systems. This usually involves upgrading the basic control systems in an existing setup with monitoring, diagnostic and advanced process controls and making it smarter by providing additional internet-connected sensors and leveraging digital tools to facilitate optimisation, prognostic and diagnostic capabilities with multimodal visualisation.

Speaking about the buzzwords of artificial intelligence (AI) and machine learning (ML) as applied in the process industry, Mr. Deepak Seth of Equinox Software Services noted that AI-ML is mainly focused on rotating machinery like the pumps, compressors, etc.

Even though process models have delivered great value to engineers, he noted that there are limitations in its application and relevance in rotating equipment as there are many dimensions which cannot be easily represented only by the process models. “The process industry is applying technologies like AI-ML to predict the anomalous behaviour of an equipment. With early alerts about the anomalies, the user gets extra lead time to frame a better response and thus save on costs by preventing scheduled and unscheduled plant shutdowns,” he explained.



EXPANSION

Evonik raises activated metal catalysts production at Dombivli site

German speciality chemicals major, Evonik, has announced the commissioning of a new plant at its catalyst manufacturing site in Dombivli, near Mumbai. The plant will initially produce Evonik's *Kalcat* brand of nickel-based activated metal catalysts while in the long term also produce *Metalyst* brand of activated base metal catalysts which are heterogeneous powder catalysts with no support (bulk catalysts) for slurry type reactions carried out in batch or semi-batch mode.

Evonik said the new facility will allow it to fully utilise its capacities in Dombivli while establishing significant synergies with the activated metal catalyst (AMC) production site in Germany.

AMCs are used in the food industry for the production of sorbitol, the manufacture of active pharmaceutical ingredients (APIs) and in the production of fine and industrial chemicals, for example in the polyurethane value chain. "The growth rate for India and the rest of Asia in the catalyst market, is forecasted to be significantly higher than in other regions of the world. Therefore, this expansion and upgrade of operations will safeguard the supply of the established product range as well as allowing Evonik to expand the portfolio targeting new markets and applications," a company statement said.

"With this new production facility, we will be able to increase our ability to supply our customers with technologically advanced products in India and abroad," said Dr. Thomas Tacke, Managing Director Evonik Catalysts India. "It is one more step towards the



(L to R) – Mr. Sanjeev Taneja, President and Managing Director India, Evonik; Dr. Steffen Hasenzahl, General Manager & Senior Vice President Business Line Catalysts, Evonik; Mr. Peter Meinshausen, Regional President Asia Pacific South, Evonik; Mr. Marja Einig, Deputy Consul General, German Consulate; Dr. Hans-Jürgen Höne, Vice President Production and Technology Business Line Catalysts, Evonik; Mr. H. S. Karangle, Director General, Indian Chemical Council; Dr. Thomas Tacke, Managing Director, Evonik Catalysts India



company's commitment to increase our footprint in the growth region" added Mr. Sanjeev Taneja, President, and Managing Director, Evonik India.

JOINT DEVELOPMENT

High Energy to partner CECRI for electric-vehicle batteries

Tiruchi-based High Energy Batteries Ltd will join hands with the Central Electrochemical Research Institute (CECRI) to produce battery for electric vehicles (EVs). The BSE-listed company will be the joint venture partner and bring in funds for a pilot project to make batteries for EVs.

CECRI, a CSIR institute focusing on electro-chemistry, has developed battery chemistries and is seeking to try them out in a pilot project. It was NITI-Aayog Member and former DRDO Chief Dr. V. K. Saraswat, who pitched the idea of roping in a private sector player for the pilot project since CECRI is a scientific research body with little expertise or funds to set up manufacturing.

At a recent meeting in Chennai, attended by Dr. Saraswat, CECRI scientists and High Energy Batteries' Managing Director Mr. G. A. Patanjali, among others, Dr. Saraswat mooted the idea of the pilot project in which



High Energy Batteries would invest. The company indicated that an investment of up to Rs. 5-crore was possible. A non-profit company will be set up for this purpose.

While batteries can be made with different chemical compounds, the pilot plant would make them those with a combination of lithium, nickel, manganese and cobalt – for use in electric vehicles.

Pooling expertise

An electrochemical battery has four major elements – cathode, anode, electrolyte and separator. Cathode, the

heart of the battery, is the domain of CECRI. Dr. Saraswat has roped in three other institutes of CSIR – Indian Institute of Chemical Technology, Hyderabad; Central Glass and Ceramic Research Institute, Kolkata, and National Physical Laboratories, Delhi, for lending their expertise for the other three components. ITI Ltd. has also agreed to participate.

Dr. A. S. Prakash, Principal Scientist, CECRI, has been named the 'Mission Director' for the pilot project.

Meanwhile, two other entities have come forward to take CECRI's technology for setting up battery plants – Tunga Services and ITI Ltd. Two memorandam of understanding were signed between CECRI and the companies for initial agreement of technology transfer. Raasi Green Earth had earlier signed an agreement with CECRI for battery technology.

RENEWABLE ENERGY

Tamil Nadu set to regain top slot in clean energy with fresh capacity addition

Tamil Nadu may regain the top slot in total installed capacity in renewable energy as the state has bright prospects for capacity addition in wind and solar sectors in the coming year, according to a report in the *Hindu Business Line* newspaper. Last year, Karnataka had toppled Tamil Nadu.

Karnataka is the top State with a total installed capacity of 13,042-MW



as of January, 2019, while the same for Tamil Nadu is 12,125-MW.

Tamil Nadu, however, is the leader

in wind capacity, while Karnataka occupies the top position in the solar segment. Helped by faster installations in the solar sector and significant improvement in wind capacity, Karnataka has risen to the top position from the fifth rank about four years ago.

According to the Ministry of New and Renewable Energy (MNRE), in September 2015, Tamil Nadu was the

leader in renewable energy with a total capacity of 8,466-MW, while Karnataka's capacity was 4,606-MW. Of the total renewable capacity of 13,042-MW of Karnataka, solar segment accounted 5,323-MW (which includes 5,175-MW in ground-mounted capacity and 154-MW in rooftop category), followed by wind power at 4,683-MW. Small hydro, co-gen power and bio-power accounted for the rest.

For Tamil Nadu, wind remains the

major segment with a total installed capacity of 8,764-MW, while in the solar segment the state's installed capacity is 2,233-MW (includes 2,098-MW of ground-mounted and 135-MW of rooftop capacity). Bio-power and bagasse co-gen capacity contributed 1,004-MW and 941-MW, respectively, and small hydro 123-MW of capacity.

A renewable energy consulting firm Bridge to India expects a total capacity addition of 15,860-MW in the renewable sector in India in 2019. In solar, 1,872-MW of

new solar capacity is expected to come in Tamil Nadu, while Karnataka is expected to add 1,555-MW.

Wind power sector

The overall capacity addition in the wind sector is expected at 2,300-MW in 2019 and almost all this new capacity is expected to come up in Tamil Nadu and Gujarat. With a favourable outlook, Tamil Nadu may add much higher capacity than Karnataka and regain the top position among the States, the report noted.

BALANCING BILATERAL TRADE

India gives China list of items, including chemicals, with potential for increased exports

India has given China a list of 380 items which have the potential to increase exports, provided China lowers non-tariff restrictions. The list includes items from chemicals, pharmaceuticals, textiles, agriculture and horticulture sectors besides tobacco and some engineering products.

The Commerce & Industry Ministry has reportedly asked various export promotion councils, including the ones for spices, agriculture, engineering goods, pharmaceuticals, IT and organic chemicals, to prepare China-specific export strategy so that pointed action could be taken.

“The Chinese leadership has already acknowledged that the growing imbalance in bilateral trade can be bridged mainly through increased exports from India. A beginning has been made with export protocols being signed between General Administration of Customs of China (GACC) and the Indian government for items such as fish, fish oil, rice and tobacco. But a lot more targeted efforts have to be made,” a government official was quoted as saying in a *Hindu Business Line* report.



“The Chinese Vice-Minister for GACC is scheduled to visit New Delhi next month and finalise some more protocols for India's exports. The Indian Embassy in China is also in constant touch with Chinese officials to expedite action in the area,” the official said.

India's trade deficit with China widened to \$63-bn in 2017-18 which comprised more than a third of the country's total trade deficit of \$156-bn. However, in 2018-19 the trade deficit

is likely to lower a bit as India's imports from China have declined while exports have continued to increase. In April-February 2018-19, India's exports to China increased 28.61 per cent to \$15-bn; while imports declined 6 per cent to \$65-bn resulting in a trade gap of \$50-bn.

The top items of exports to China from India in 2018-19 were petroleum products, organic chemicals, cotton yarn, plastic raw materials and iron ore.

FUEL BLENDING

Average ethanol blending from December to March increases by 8%

The average ethanol blending in the country during the first four months of the current marketing year (December 2018-November 2019) from December 2018 to March 2019 has been more than 8 per cent in 10 states.

With the decision to start supplying 10 per cent ethanol blended petrol in North Eastern states and Jammu & Kashmir, more ethanol production capacity will get set up in newer regions, according to a statement issued by the Indian Sugar Mills Association (ISMA).

Against a requirement of 330 crore litres of ethanol for 10 per cent blending in the country, excluding J&K, North Eastern States and island territories, ethanol supply contracts have been signed for 237 crore litres for the ethanol supply period 2018-19 (December–November). This is the highest ethanol supply contracts ever, ISMA said.

“The best ever achieved was last year when contracts for 160 crore litres were signed and 150 crore litres of ethanol were supplied in 2017-18 ethanol supply period. Average all-India ethanol blending with petrol achieved last year in 2017-18 was 4.22 per cent,” the statement added.

“If all the 237 crore litre of ethanol is successfully blended in the country in the current year, about 7.2 per cent of fuel consumption will get substituted by this environment-friendly bio-ethanol,” ISMA said.

Moving away from sugar

Out of total contracted ethanol



supplies of 237 crore litres, 45 crore litres of ethanol have been contracted to be manufactured and supplied from ‘B’ heavy molasses and sugarcane juice, amounting to reduction of around 5 lakh tonnes of sugar production. Similarly, 16.5 crore litres of ethanol have been contracted to be manufactured and supplied from damaged foodgrains, unfit for human consumption.

In the first four months of the contracted supply period, December to November 2019, ethanol manufacturers have successfully supplied 75 crore litres to various depots of the oil companies across the country, it said, adding that for the first time, “21 crore litres out of the total supply of 75 crore litres have been manufactured from ‘B’ heavy molasses/sugarcane juice/damaged foodgrains”.

According to the new bio-fuel policy, the government aims to achieve a target of 20 per cent ethanol blending

with petrol by 2030, and to have 10 per cent blending with petrol by 2022. The policy allows use of feedstock other than molasses to manufacture ethanol in the country. This includes sugarcane juice, damaged foodgrains, rotten potato, corn, surplus foodgrains, if any etc.

In July-August 2018, the government had announced, for the first time, different prices, with a premium, for ethanol produced from ‘B’ heavy molasses and sugarcane juice as well as ethanol produced from damaged foodgrains.

“Ethanol is rich in oxygen and, therefore, is considered to be the best oxygenate in the world. The extra oxygen helps the balance petrol to burn more efficiently within the vehicle engine, thereby reducing vehicular emissions which, in turn, reduce environmental pollution. The ethanol accordingly helps in improving air quality,” ISMA said.

COLLABORATION

Praj and Gevo of US join hands to commercialise renewable isobutanol, jet fuel and isooctane in India

Pune-based Praj Industries has signed a Construction License Agreement (CLA) with US-based renewables firm, Gevo Inc, to commercialise technology for the production of isobutanol using sugar-based feedstocks, such as juice, syrup and molasses.

Pursuant to the CLA, Praj will provide Engineering Procurement and Construction (EPC) services to third parties using a process design package developed by Praj. This package uses Gevo's proprietary isobutanol biocatalyst on sugar-based feedstock. Isobutanol derived from the proprietary process is high energy renewable intermediate product that finds application in aviation and racing cars. To that effect, Praj also signed a Memorandum of Understanding (MoU) with Gevo to commercialise Gevo's renewable hydrocarbons products. This includes Gevo's renewable alcohol-to-jet fuel (ATJ) and renewable isooctane, derived from Gevo's renewable isobutanol.

Commenting on the deal, Mr. Pramod Chaudhari, Executive Chairman of Praj,

said, "The addition of isobutanol technology to Praj's diverse product portfolio is a step in our endeavour towards smart biorefineries that facilitate sustainable decarbonisation. This solution can be offered both as a 'bolt-on' to an existing ethanol plant or as a greenfield plant".

He added that Praj will also pursue development of agri-biomass-to-isobutanol route as reinforcement of circular bio economy.

"Praj is a company that shares our vision of the utilisation of renewable resources and renewable energy to decarbonise transportation fuels," said Mr. Patrick Gruber, Chief Executive Officer of Gevo. "With Gevo's technology and Praj's execution, ethanol can be substituted with isobutanol and drop-in gasoline. Gevo expects to leverage Praj's *Enfinity* technology to produce second generation drop-in hydrocarbons utilising Gevo's existing technology that has already been proven.



Mr. Pramod Chaudhari (Left) with Mr. Patrick Gruber

We expect to scale up quickly and be ready for the Indian market as early as 2020," he added.

The agreement will allow Praj to leverage its extensive customer

base to identify those interested in licensing Gevo's technology to produce isobutanol utilising the sugar-based feedstock.

In addition to the CLA, Praj and Gevo have also entered into a new joint development agreement (JDA). This agreement is aimed at continuing joint development efforts to produce isobutanol using agricultural residue such as bagasse, rice straw, wheat straw, corn stover, cotton stalk and empty fruit bunches. Both parties are nearing the completion of work to develop a process design package by using agricultural residue for production of isobutanol. These second-generation agricultural residues are the lowest cost feedstocks in some markets and have the additional benefit of having a very low carbon footprint.

UP THE LADDER

Vinodkumar Ramachandran is new leader of Industry 4.0 at KPMG

KPMG International has appointed Mr. Vinodkumar Ramachandran as Global Leader for Industry 4.0 with effect from this month. Mr. Ramachandran currently serves as the Automobile and Industrial Manufacturing Leader for KPMG in India.



expert in the automotive and industrial industries, with more than 25 years of consulting experience across key geographies. His expertise includes driving large scale topline and bottom-line transformation for clients, including turnaround, digital and post-merger integration across the automotive and industrial

industries. "Businesses today are faced with numerous challenges and disruptive technologies and clients rely on us to advise them and support them in implementing complex Industry 4.0 transformation programs. I look forward to leading the talented global network of KPMG professionals, as they continue to work and guide clients on the Industrial 4.0 journey," said Mr. Ramachandran.