

FUTURE™ FUELS

Advancing Efficiency and Environment

APRIL 2022 | PRIVATE CIRCULATION ONLY

WEBINAR

DECARBONISING SHIPPING: ISSUES AND CHALLENGES

At this Future Fuels webinar, industry experts raised concerns of the stakeholders while the tectonic shift to greener shipping becomes inevitable.





**VISHWA
SAMUDRA**
CHALLENGE IT. CHANGE IT.

STABILIZATION / FULL DEPTH RECYCLING TECHNOLOGY with stabilroad – AN APPROACH TO GREEN ENVIRONMENT



STABILIZATION / FULL DEPTH RECYCLING WITH STABILROAD

Fully Mechanized Full Depth Recycling on an average can achieve 1km per day can be complete in and the road can be made operational in 12hrs post completion of work.

Depending upon the existing base composition, need for new Aggregates can be completely avoided

Major saving in transport and environmental costs

Stabilised base can accept lower CBR and hence subbase compaction is seldom required

Mechanised controls and Minimal testing for acceptance criteria

Life cycle cost is reduced. Minimum maintenance costs

Port infra for green transition

International ports will become key points for attracting investments in clean energy infrastructure. On path to transition to new alternative and environment-friendly fuels in maritime sector, ports will become essential hubs for production and onward supply of non-fossil fuels.



Recently, a study conducted by Arup, The Resilience Shift, and Lloyd's Register together, has found that ports are critical in driving and supporting the case for investment in energy infrastructure. Their research has highlighted the risks and opportunities connected with developing infrastructure for alternative fuels and how ports can unlock investment for the production and supply of these. The study has evaluated land-side infrastructure for fuels derived from blue hydrogen and green hydrogen.

Notwithstanding the fuel of choice, the study showed that demand for alternative fuels is fundamentally linked with the concept of green corridors – where the transition can start through a multi-stakeholder initiative. In order to get investment at ports bringing co-benefits in local social, environmental, financial and economic value is necessary.

In a similar study conducted by WindEurope, a European advocacy body, has warned that without sufficient investment on infrastructure at ports, the strategy to decarbonise shipping would fail.

It imperative to scale up infrastructure at ports to prop up new decarbonisation initiatives in maritime sector. Therefore, ports need large scale investments to create new infrastructure to cater to the future fuel bunkering needs of the ships. Of late, green shipping corridors has attained greater significance and all ports are now moving towards building infrastructure to facilitate green corridors in shipping.

The ports are very crucial part in decarbonisation of maritime industry, as they can act as the linking piece between shipping and the energy systems. Therefore, its high time for the governments, industry, and all the stakeholders to ramp up infrastructure at ports to realise the decarbonisation goals.

R Ramprasad
 Editor and Publisher
 ramprasad@gatewaymedia.in

Editor and Publisher
 R Ramprasad
 ramprasad@gatewaymedia.in

General Manager - Operations
 Ravi Teja
 raviteja@gatewaymedia.in

Associate Editors
 Omer Ahmed Siddiqui
 omer@gatewaymedia.in

ASL Narasimha Rao
 narasimharao@gatewaymedia.in

Design Consultant
 Nagaraju N S, Designzone

Manager Marketing & Sales
 Satish Shetti
 satish@gatewaymedia.in
 +91 99207 05534

Administration
 Kishore P, Chief Manager
 Madhukar, Manager
 prmadhukar@gatewaymedia.in

Digital Media
 Vinay M

Finance
 Rakesh U

Future Fuels is printed and published by **R Ramprasad** on behalf of Gateway Media Pvt Ltd, 5th Floor, Navayuga Vizva, Gachibowli - Miyapur Road, Gachibowli, Hyderabad – 500 032, Telangana, India.

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Mr Indra Nath Bose
 Advisor, The Great Eastern Shipping Company Limited, has over 50 years of experience in maritime industry. He has served Indian Registrar of Shipping (IRS) for over 22 years in various capacities.



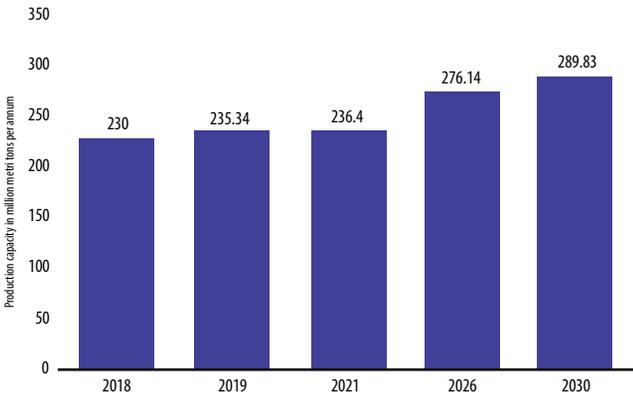
Mr Vijay Arora
 MD, Indian Register of Shipping (IRClass) is a qualified engineer with a professional experience of more than two decades. During his long tenure at IRClass Mr Arora has worked in various survey stations in India and abroad.



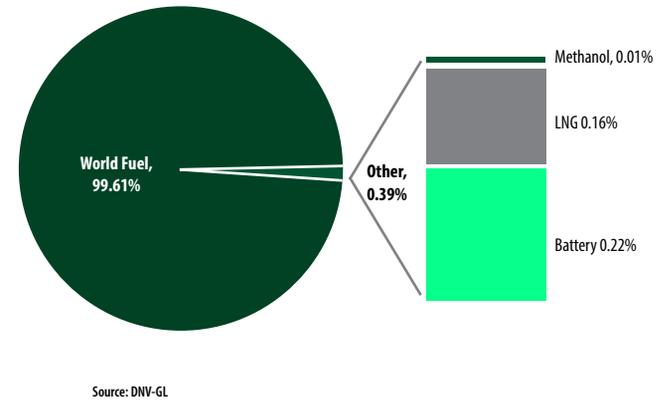
Capt Rahul Chodhuri
 MD, for Asia, Middle East and Africa based in Singapore, Veritas Petroleum Services. He has been involved in the management of fuel quality & quantity business for more than 30 years.

NUMBERS & GRAPHS

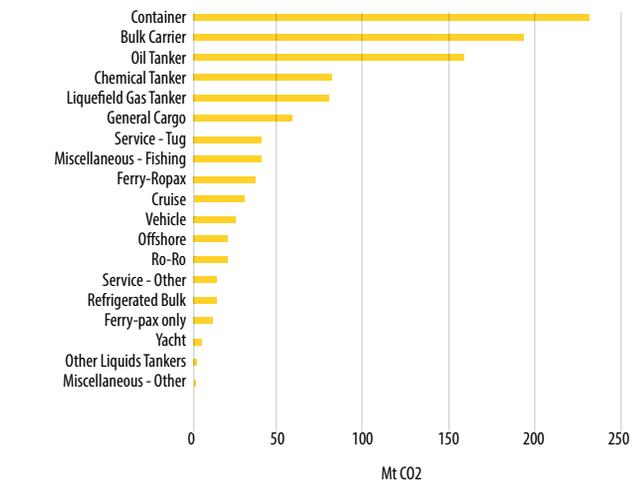
PRODUCTION CAPACITY OF AMMONIA WORLDWIDE FROM 2018 TO 2021, WITH A FORECAST FOR 2026 AND 2030



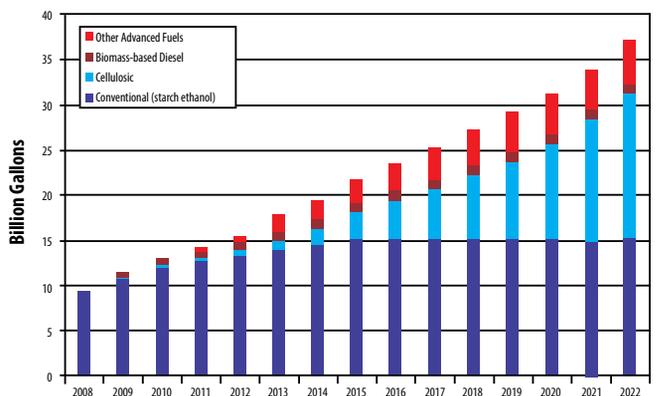
ALTERNATIVE FUEL UPTAKES - SHIPS IN OPERATION



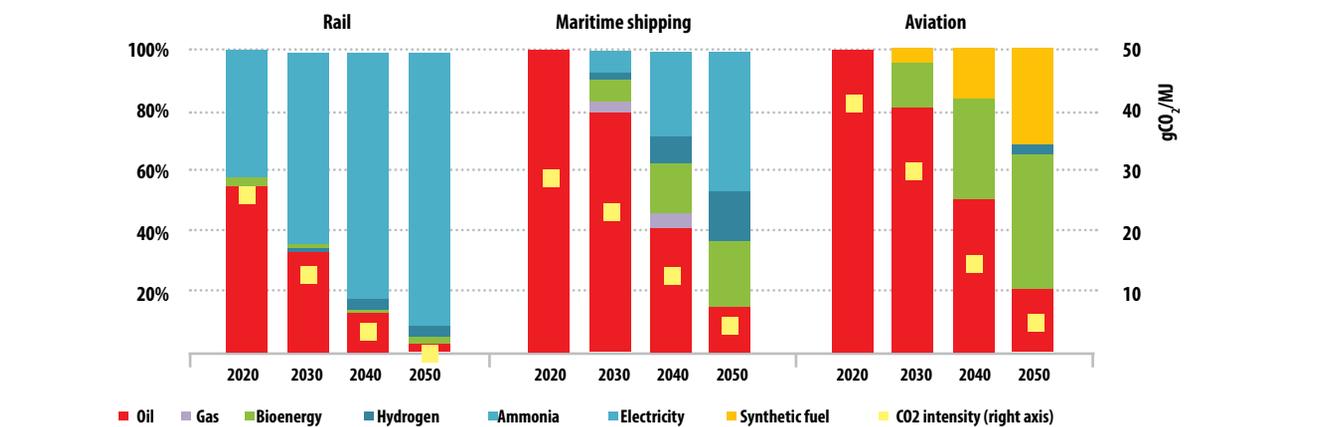
CO2 EMISSIONS BY VESSEL TYPE



RENEWABLE FUEL STANDARD VOLUMES BY YEAR

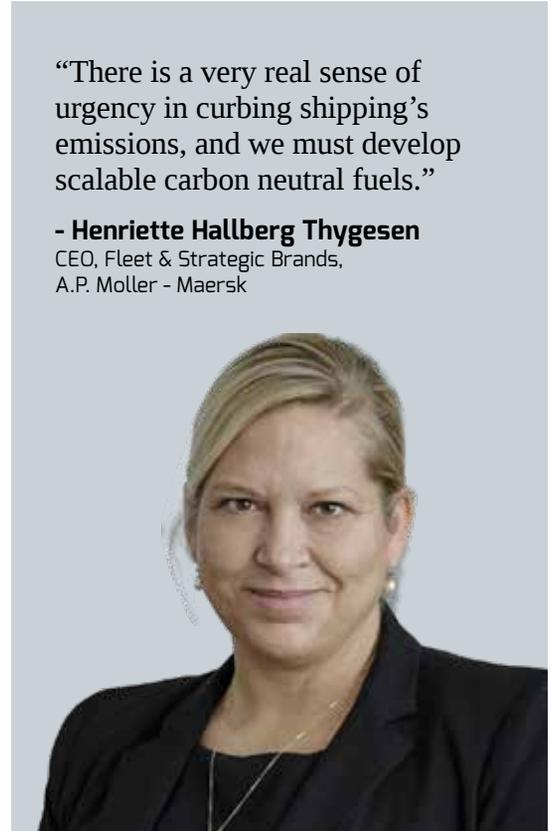
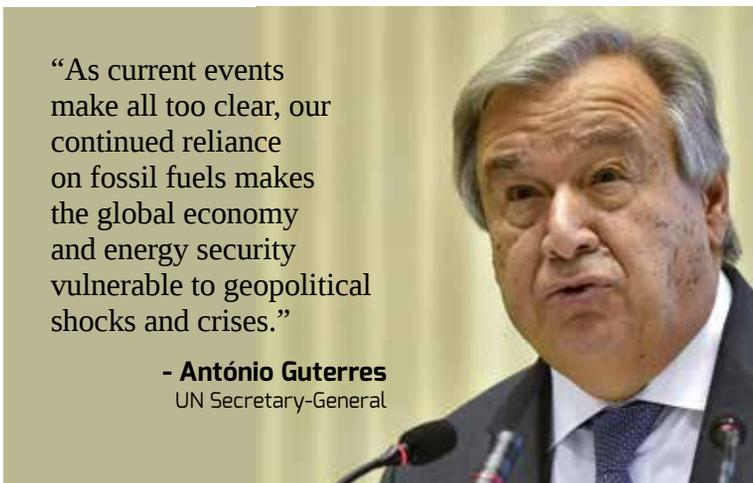
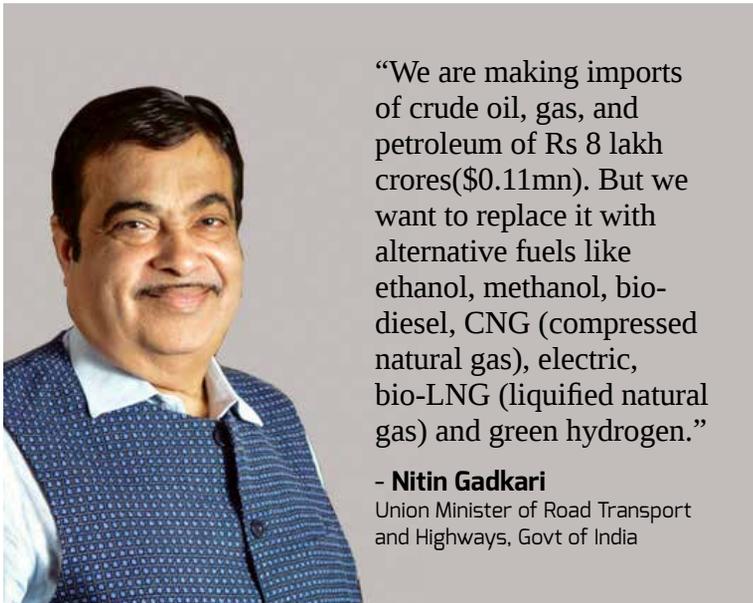


GLOBAL ENERGY CONSUMPTION BY FUEL AND CO2 INTENSITY IN NON-ROAD SECTORS



Source: IEA

QUOTES



MARINE

ME-GI Engines to power liquid-CO₂ carriers

Dalian Shipbuilding Industry Co. Ltd. has ordered 2 × MAN B&W 7S35ME-GI dual-fuel engines in connection with the construction of two 7,500 cubic-metre, liquid CO₂ carriers for Northern Lights, the joint venture between Equinor, Shell and TotalEnergies. Each ME-GI engine will feature MAN Energy Solutions' proprietary EcoEGR (Exhaust Gas Recirculation) system. Delivery of the 130-metre carriers has been set for mid-2024. Northern Lights is responsible for developing and operating CO₂ transport and storage facilities as part of 'Longship', the Norwegian Government's full-scale, carbon-capture-and-storage (CCS) project. Northern Lights will create the first ever, cross-border, open-source, CO₂ transport-and-storage infrastructure network, offering European companies the opportunity to store their CO₂ safely and permanently underground. The newbuilding carriers will be used in the first phase of Northern Lights' transport-and-storage-infrastructure development and are designed to transport liquid CO₂ in purpose-built, pressurised cargo tanks. The dual-fuel ME-GI engines will mainly run on LNG, while other innovative technologies – such as wind-assisted propulsion system and air lubrication – will be installed to reduce carbon intensity by around 34%, compared to conventional systems. The ships are the first of their

kind and have the potential to set a new standard for CO₂ shipping on coastal trading routes.

PIL awards contract to build 14,000 TEU LNG container vessels



Pacific International Lines (PIL) has announced the award of a contract to Jiangnan Shipyard (Group) for the construction of four 14,000 TEU container vessels. The vessels will be equipped with dual-fuel engines and auxiliaries which can run on both Liquefied Natural Gas (LNG) and low sulphur fuel oil. The four vessels will be delivered progressively from 2H2024 through to 1H2025. When delivered, the vessels will become the largest container vessels in PIL's fleet and the first vessels in the fleet to run on LNG.

The four vessels will be equipped with an ammonia intermediate ready fuel tank which makes it possible to retrofit the vessels to run on ammonia when the technology is commercially available. This is the latest investment the shipping industry has made into LNG-powered container vessels. In September last year shipping line ZIM exercised the option to charter five 7,000 LNG-powered vessels.

R&D for green fuel fund gets new thrust from maritime groups

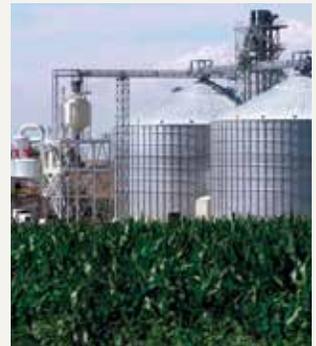
Maritime groups hope progress to establish a research and development (R&D) fund meant to find the green fuel of the future can accelerate now that they have addressed concerns about the fund raised by some nations. The organizations – including the International Chamber of Shipping (ICS), BIMCO, Intertanko, and the World Shipping Council (WSC) – submitted a joint proposal to the International Maritime Organization's (IMO's) Marine and Environmental Protection Committee (MEPC) 78.

In the submission, the maritime groups tackled concerns expressed by some member nations at last year's MEPC 77 meeting over the creation of a \$5 billion R&D fund to be managed by the International Maritime Research and Development Board (IMRB) and the International Maritime Research and Development Fund (IMRF). The member states were concerned about the equitable use of funds, as well as fair and equal access to patents and technologies globally, issues that have delayed progress in establishing the fund.

Key proposals from maritime organizations aimed at addressing matters raised at MEPC 77 include devoting \$50 million annually to support technical assistance efforts in small island states and developing countries via the IMO's greenhouse gas (GHG) trust fund; expanding the IMRB board by 10 members to be more geographically representative.

REFINERIES

World's first Ethanol production refinery from bamboo to be built in India



An agreement signed between a Hyderabad-based company and a farmers' company in Maharashtra's Latur, for building world's first ethanol production refinery project from bamboo with a daily capacity of 30,000 litres. The agreement was signed in Hyderabad between Nagarjuna Group, Hyderabad and Lodga Bamboo Industries in Latur district between Dr Banibrata Pande for Nagarjuna Group and Pasha Patel on behalf of the Lodga Bamboo Industries. This will not just offer ethanol at competitive prices but also provide livelihood opportunities to farmers who can grow bamboo for the plant. Also, at present, the Centre has committed to blend 20 per cent ethanol with petrol by 2025. This creates a huge opportunity for using bamboo-based ethanol. The project is the realisation of efforts over the last four years to promote bamboo as the key resource for livelihood security for farmers and global climate resilience.

Russian refineries feel the heat of buyers not taking oil products

Rosneft's 240,000 b/d Tuapse on the Black Sea halted crude uptake in March because it cannot ship its production, while the company's 342,000 b/d Ryazan refinery in central Russia has reduced the volume it is accepting. While there are no sanctions on exports of Russian crude or refined oil products, limited access to credit for Russian-related deals and the fear of energy sanctions being imposed have resulted in typical buyers avoiding Russian cargoes where possible, sources said. Thus, while Russian refineries have maintained normal processing rates, concerns have been rising that they would be forced to cut runs as storages become full on declining exports. Tuapse produces feedstock such as fuel oil, naphtha and vacuum gasoil for export, rather than finished-grade products. Recently, Galp said it will suspend all imports of Russian oil products, in particular VGO, in response to the invasion of Ukraine. Others are following and feedstock traders have started searching for alternative supply, with refineries in the Persian Gulf and Asia seen as potential source of material. Meanwhile, fuel oil, which despite years of upgrades in Russia, remains a significant part of refinery yields and oil product exports, has also seen typical buyers reluctant to take cargoes.

MINING

Energy-related CO2 emissions touched record highs in 2021

Energy-related carbon dioxide emissions rose to their highest level in history last year, according to the International Energy Agency (IEA), as economies rebounded from the coronavirus pandemic with a heavy reliance on coal. The IEA found energy-related global CO2 emissions increased by 6% in 2021 to reach a record high of 36.3 billion metric tons. In an analysis published recently, the Paris-based organization pinpointed coal use as being the main driver behind the growth. The energy agency said its estimate was based on fuel-by-fuel and region-by-region analysis. Breaking its findings down, it said coal was responsible for more than 40% of overall growth in worldwide CO2 emissions last year, hitting a record of 15.3 billion metric tons. The IEA's findings point to the Herculean task of achieving the goals laid out in the 2015 Paris Agreement and more recent Glasgow Climate Pact. While major economies are attempting to ramp up renewable energy capacity, the world remains heavily reliant on fossil fuels.

India must act on mining and exploration of critical minerals

The COP26 meeting held in Glasgow on climate change issues discussed accelerating action and strategies toward achieving objectives outlined in the Paris Agreement.

Consequently, India has committed to increasing its non-fossil fuel energy capacity to 500 GW by 2030, reducing the economy's carbon intensity to less than 45% in 2030 compared to 2005 levels, and achieving the target of net-zero emissions by 2070. Additionally, in 2015, India announced its Nationally Determined Contributions, including reducing its Gross Domestic Product (GDP) emission intensity by 33-35% in 2030 from 2005 levels. This commitment has been revised to a 45% reduction during COP26. Critical minerals shall play an important role to achieve these goals. Critical minerals refer to mineral resources, both primary and processed, which are essential inputs in the production process of an economy, and whose supplies are likely to be disrupted on account of non-availability or risks of unaffordable price spikes. These minerals tend to lack substitutability and recycling processes. In addition, the global concentration of extraction and processing activities, the governance regimes, and environmental footprints in resource-abundant countries adversely impact their availability risks. A recent study by CSEP assesses the criticality of 23 select non-fuel minerals for India's manufacturing sector and projects their needs for manufacturing green technologies equipment required for climate change mitigation. The study evaluated the criticality of each mineral along two dimensions: economic importance and supply risk. It projected India's mineral needs for renewable electricity generation and EV manufacturing.

HEAVY OILS

Reliance acquires battery maker Lithium's assets for \$61mn



Indian refining giant Reliance Industries makes a bigger push towards clean energy and transport, and has acquired the assets of battery maker Lithium Werks for \$61 million. Reliance's investment in Lithium Werks, which manufactures lithium iron phosphate batteries that are mainly used in electric vehicles (EVs), includes funding for future growth, the company said. The assets, acquired through its subsidiary Reliance New Energy, include Lithium Werks' portfolio of about 219 patents, a manufacturing facility in China, key business contracts and existing employees, it said. The deal comes as Reliance looks to cut dependence on its mainstay oil-to-chemicals business, with plans to invest \$10 billion in clean energy projects to boost its green credentials and meet its goal of net zero carbon by 2035. Reliance agreed in December to buy Faradion, a UK-based sodium-ion battery company, for an enterprise value of 100 million pounds (\$130 million).

Tech Mahindra signs 'the climate pledge'



Tech Mahindra now joins a group of companies like SAP, Maersk and Harman in the 'The Climate Pledge', the commitment to reach the Paris Agreement 10 years early and be net-zero carbon by 2040. It is one of the 95 new signatories for the cause. This is nearly a 600 per cent growth in signatories over the past year. Co-founded by Amazon and Global Optimism in 2019, 312 organisations have signed The Climate Pledge to date. Pledge signatories in total generate over \$3.5 trillion in global annual revenues and have more than 8 million employees across 51 industries in 29 countries. Signing 'The Climate Pledge' means the business/organisation has agreed to measure and report greenhouse gas emissions on a regular basis. They will also implement decarbonisation strategies in line with the Paris Agreement through real business changes and innovations, including efficiency improvements, renewable energy, materials reductions, and other carbon emission elimination strategies. Lastly, they would also neutralise any remaining emissions with additional, quantifiable, real, permanent, and socially beneficial offsets to achieve net-zero annual carbon emissions by 2040.

LNG

Rising LNG prices expected to increase India's fertilizer subsidy bill



India's heavy reliance on imported liquified natural gas (LNG) as a fertilizer feedstock exposes the nation's balance sheet to ongoing global gas price hikes, increasing the government's fertilizer subsidy bill, according to a new report by the Institute for Energy Economics and Financial Analysis (IEEFA). By shifting away from expensive LNG imports for fertilizer production and using domestic supplies instead, India could reduce its vulnerability to high and volatile global gas prices and ease the subsidy burden, the report says. Natural gas is the main input (70%) for urea production, and even as global gas prices increased 200% from US\$8.21/million Btu in January 2021 to US\$24.71/million Btu in January 2022, urea continued to be provided to the agriculture sector at a uniform statutory notified price, which led to an increased subsidy. As an interim measure, the report suggests allocating the limited domestic gas supplies to fertilizer manufacturing instead of to the CGD network.

The first green hydrogen FCEV in India launched by Gadkari

Union Minister for Road, Transport and Highways, Nitin Gadkari, launched the world's most advanced technology – developed green hydrogen Fuel Cell Electric Vehicle (FCEV), Toyota Mirai in New Delhi. Toyota Kirloskar Motor Pvt Ltd and International Center for Automotive Technology (ICAT) are conducting a Pilot Project to study and evaluate the world's most advanced Fuel Cell Electric Vehicle (FCEV) Toyota Mirai which runs on hydrogen, on Indian roads and climatic conditions. This is a first of its kind project in India which aims to create a Green Hydrogen based ecosystem in the country by creating awareness about the unique utility of Green Hydrogen and FCEV technology. It is an important initiative which will promote clean energy and environmental protection by reducing dependence on fossil fuels and thereby make India 'Energy Self-reliant' by 2047, Fuel Cell Electric Vehicle (FCEV), powered by Hydrogen, is one of the best Zero Emission solutions. It is completely environmentally friendly with no tailpipe emissions other than water.

First green hydrogen fuel plant in HP to come up soon

Chamba district in the state of Himachal Pradesh will soon have a green hydrogen fuel generation plant. The hydrogen plant will be set up by the National Hydroelectric

Power Corporation (NHPC). The decision was taken in a meeting of Chamba district administration with NHPC Ltd held recently which was presided over by Chamba Deputy Commissioner DC Rana and attended by NHPC's General Manager (Project), Chamera-II and Chamera-III SK Sandhu. Chamba deputy commissioner DC Rana said that it would be the first hydrogen mobility-based project in the district. The plant will produce hydrogen through a 250KW photovoltaic solar plant. He said that apart from setting up the hydrogen fuel plant the NHPC will also provide the district administration a 33-seater hydrogen fuel cell bus on pilot bases. The bus will be operated by the Himachal Pradesh Road Transport Corporation in the important tourist places of the district. The range of the hydrogen fuel-powered bus would be 200 km. After the hydrogen is produced from the solar plant, the remaining electricity supply will be sent to the local grid, he said. Rana said that during the meeting it was also decided that a hydrogen fuel plant will be set up on the land already available with the NHPC. The deputy commissioner was also directed to constitute a committee of officers of various departments under the chairmanship of the SDM concerned to identify the suitable site for the project. He also directed that the committee constituted would inspect the land available with the NHPC in different areas of the district on March 15. The deputy commissioner also asked all the departments concerned to meet the departmental parameters required for setting up the project.

BUNKER

Higher bunker prices to weigh on demand in Fujairah



Bunker suppliers in the world's third largest bunkering hub Fujairah in the UAE are concerned rising oil prices are weighing on marine fuels demand at the port. A number of bunker suppliers in Fujairah said they were concerned that demand at the hub is declining as they see buyers considering taking smaller volumes of bunker fuels. The price of very low-sulphur fuel oil (VLSFO) in Fujairah exceeded \$1,000/t yesterday, according to Argus assessments. "The price is so high that many will start buying the fuel only for one journey, rather than filling their tanks affecting the liquidity," a Fujairah supplier said. Sellers of marine fuels, especially smaller suppliers, may be forced to ease credit terms, because it could become more difficult for traders and shipowners to obtain short-term credits for large amounts to finance their purchases, according to market participants. "Buyers will start asking for longer credit terms — 30 days or more, while suppliers themselves buy their cargoes from wholesalers on much

shorter credit terms or even pay cash in advance," a Fujairah based trader said. Fujairah traders are not worried about a possible VLSFO supply shortage at the port, in the case of sanctions on Russian oil exports. This is because only 260,000t of Russian-origin low-sulphur fuel oil arrived in Fujairah in 2021.

SIPG, CMA CGM complete first LNG bunkering

Shipping and logistics firm CMA CGM Group and terminal operator Shanghai International Port (Group) Co., Ltd. (SIPG) on 15 March successfully conducted a liquefied natural gas (LNG) bunkering operation for CMA CGM SYMI at Yangshan Port. The 15,000 TEU LNG-powered containership received LNG bunker fuel from the new 20,000 m³ LNG bunkering vessel Haigang Weilai, the largest LNG bunkering vessel in the world. The bunkering operation was the first ship-to-ship LNG simultaneous operation (SIMOPS) bunkering operation in China, which meant the containership carried out cargo operations at the terminal while receiving marine fuel simultaneously. The development builds upon an earlier 10-year LNG bunkering and joint project agreement formed between both entities in January where SIPG will provide SIMOPS LNG bunkering service for CMA CGM's vessels sailing from China to the United-States at Yangshan Port. The Shanghai Port's bonded LNG bunkering project has been highly valued by the Shanghai Municipal Government, according to Gu Jinshan, Chairman of SIPG.

METHANOL

Maersk needs 730,000t of methanol per annum by 2025



A.P. Moller-Maersk A/S, one of the world's largest oil consumers, has partnered with six energy companies to jump-start the green methanol market and help the shipping giant ditch fossil fuels. Maersk will be able to buy at least 730,000 tons of methanol per year by the end 2025, the Copenhagen-based company said on Thursday. That's equal to roughly 3.5% of its current oil use and vastly higher than the world's current global methanol production of about 30,000 tons. The partnership will help address what Maersk has described as the "chicken-and-egg problem" plaguing the green fuel market now: few energy companies produce green methanol because there's presently little demand, while ship owners are reluctant to build green vessels because the fuel market is so small.

"To transition towards de-carbonization, we need a significant and timely acceleration in the production of green fuels," Henriette Hallberg Thygesen, head of Maersk's fleet, said in a statement. The partnerships represent an "important milestone."

ADNOC, Proman to develop methanol facility

ADNOC, Abu Dhabi National Oil Company signed an agreement with Proman, world's leading producers of methanol, to develop the UAE's first world-scale methanol production facility at the TA'ZIZ Industrial Chemicals Zone in Ruwais. Under the terms of the agreement, Abu Dhabi Chemicals Derivatives Company RSC Ltd. ("TA'ZIZ") and Proman will construct a natural gas to methanol facility with an anticipated annual capacity of up to 1.8 million tonnes per annum. The facility will meet growing domestic and international demand for this clean and versatile chemical commodity which is gaining momentum as a lower-emission fuel alongside existing uses spanning industrial products. The project is subject to relevant regulatory approvals. TA'ZIZ is a joint venture between Abu Dhabi National Oil Company (ADNOC) and ADQ, an Abu Dhabi-based investment and holding company. The proposed partnership will capitalize upon ADNOC's attractive value proposition for downstream petrochemicals, ADQ's diversified portfolio, and Proman's extensive construction and operational expertise as the world's second-largest methanol producer. This world-scale plant advances the TA'ZIZ mission to diversify the UAE's economy and accelerate industrial development, by enabling local supply chains through the production of new chemicals in the UAE.

BIOFUELS

Indian refiners planning to ramp up ethanol storage



The state-run fuel retailers in India are considering increasing ethanol storage capacity by 51 per cent, as the country is targeting to double the biofuel's blending with gasoline to 20 per cent by 2025 according to a director at Indian Oil Corp refinery. India is one of the largest importers of oil which relies on foreign suppliers to meet more than 80 percent of its demand. Prime Minister Narendra Modi in the COP26 climate summit held at Glasgow has pledged to achieve net-zero carbon emission by 2070. In order to fulfil that target govt is now encouraging industries to switch to go for cleaner options including renewable and biofuels to cut carbon footprint. According to some sources, India is close to achieving its target of 10 percent ethanol blended gasoline in this fiscal year ending March 31. Last year, India brought forward its target of selling 20 percent ethanol blended fuel across the country by five years to 2025, with sales beginning in some parts of the country from April 2023.

Three firms join together to launch whisky into biofuel technology



Three Scottish companies have joined forces to accelerate the launch of new biofuel technology. The companies are Ardnamurchan Distillery, Woodlands Renewables and Scotland's first bio refinery, Celtic Renewables, based in Grangemnorth. Celtic Renewables has already attracted £43million (\$56.47 million) of investment and the new biorefinery will be able to produce one million litres of sustainable biochemicals annually and five large-scale refineries are planned worldwide in the next five years. The plant will use Celtic Renewables' patented technology to convert 50,000 tonnes of biological material into renewable chemicals, sustainable biofuel, and other commercially and environmentally valuable commodities. The catalyst for the cooperation by the three companies is serial Scottish investor Donald Houston of Ardnamurchan Estates who has substantial stakes in all three companies. Houston said: "Celtic Renewables needs a byproduct of whisky distilling called pot ale to assist in its testing process before starting full production of its biochemicals and biofuel.

Sugar mills in Maharashtra file bids to supply ethanol

Sugar mills in Maharashtra have submitted bids to supply 111 crore litres of ethanol to oil marketing companies (OMC) for the ethanol supply year 2021-22. This is expected to divert over 12 lakh tonne of sugar in the state with most of the ethanol being produced either from B heavy, C heavy molasses or directly from cane syrup. According to officials at the Maharashtra State Cooperative Sugar Factories Federation (MSCSFF), 84 units including 34 cooperative sugar mills, 33 private sugar mills, 12 independent ethanol plants and five stand-alone molasses distilleries will be participating in the production and supply of ethanol in the 2021-22 marketing season. Maharashtra had supplied around 79.04 crore litres of ethanol in the 2020-21 marketing season. For the ethanol supply year 2021-22, OMCs have floated national tenders for supply of 465 crore litres. Till February-end, the OMCs have finalised supplies of 416 crore litres and letters of intent (LOIs) for 401 crore litres have been issued. In Maharashtra, 84 units including 67 sugar mills have started producing ethanol and in line with the national trend, majority of the mills are producing the fuel additive from B heavy molasses. At present, Maharashtra has around 127 plants with a production capacity of 303.27 crore litres of ethanol. Officials said that applications have been placed for 336 projects.

TECHNOLOGY

Wild castor oil can be converted into biodiesel



The seeds of the wild castor oil plant, *Ricinus communis*, can be converted into biodiesel according to a new study in the International Journal of Oil, Gas and Coal Technology. The Mexican research team shows how the requisite transesterification reaction of oil from the seeds using methanol in the presence of sodium hydroxide as a catalyst can produce a fuel product that meets the standards set out by the American Society for Testing and Materials and the European Organization Standardization. A ratio of oil to methanol of 1 to 9 is the most efficient. The team explains how in the search for sustainable alternatives to fossil fuels, techniques for biodiesel production using a transesterification reaction of a biological product have been used for many years. The process involves transforming esters in the plant-derived oil into another fuel-type ester and glycerol as a byproduct. The different densities of ester and glycerol means they can be readily separated by gravity and the glycerol removed. The alcohol reagent can then be removed from this biodiesel by distillation and recycled for use in the next batch.

Scientists develop an energy-efficient method for hydrogen production

Hydrogen can store and deliver usable energy, but it doesn't typically exist by itself in nature and must be produced from compounds that contain it. And on similar lines, Scientists at the International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI) have developed an energy-efficient method for hydrogen production with less carbon footprint. The world is searching for alternative fuels that can help humankind fight climate change. Among the sustainable fuels, Hydrogen has great potential to cater world's ever-expanding need for fuel. Hydrogen is the simplest element on earth - it consists of only one proton and one electron - and it is an energy carrier. Scientists from ARCI have developed a method to produce hydrogen with high purity (99.99%) from a methanol-water mixture at ambient pressure and temperature that uses only one-third of the electrical energy required in water electrolysis. With near-zero or zero end-use emissions and continually replenished fossil fuel resources, hydrogen can be an ideal sustainable energy carrier and would play an immense role in the near future. Scientists at the International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI) have developed a method that combines both the processes of

electrolysis and reformation to produce hydrogen from methanol-water mixture by electrochemical methanol reformation (ECMR) at ambient pressure and temperature. The main advantage of this process is that the electrical energy needed to produce hydrogen is 1/3rd of water electrolysis (Practical water electrolysis requires 55-65 kWh/kg of hydrogen). This technology has been patented by ARCI.

The simple technology that will bring an end to fossil fuels

The world is turning its back on fossil fuels to save the planet and, in recent times, to hurt Putin and his horrific plans. But, there is a massive problem. Renewable energy, like solar and wind are erratic, and the mega batteries we use to overcome this issue are costly and massively impact the environment. However, a simple, little-used technology is set to solve this problem and enable an energy revolution. Welcome to the brilliant world of gravity batteries. The advantages of switching to solar and wind are apparent. They are some of the lowest carbon forms of energy, have practically no dependency on fossil fuels and are by far the cheapest form of energy per kWh. As climate armageddon looms and oil and gas prices rocket, due to Russian sanctions, these factors make solar and wind very appealing. But there is a huge problem. The Sun doesn't always shine and the wind doesn't always blow. To turn the sporadic nature

of solar and wind power into a useable, on-tap source we need to use massive batteries like the 100 MWh pack Tesla built in Australia. These mega-batteries store surplus energy for later use so we can get 24/7 power. So, in theory, these packs solve the problem and allow a country to run themselves entirely on solar and wind power. But there is a terrible problem. The process of building, replacing and recycling these mega batteries is prohibitively expensive and catastrophic for the environment. This means that solar and wind technologies can't out-compete fossil fuels at the moment. Building a battery with over 100 MWh's capacity takes a colossal amount of rare-earth metals, refining and shipping. All of which release toxic metals into waterways, pollute the atmosphere and destroy wildlife. Even worse, these batteries don't last forever. They are being constantly charged and discharged at a frightful pace. Even our best batteries can only take a few years of this punishment before they start to degrade, lose capacity and breakdown. So, we will need to build another mega battery to replace it in the not too distant future, costing a fortune and doing even more environmental damage. Also, the old battery needs to be disposed of properly. Yet again this process can pollute the air and damage the environment. Despite all of this, a lithium-ion battery supported solar farm or wind farm is still much better for the environment than fossil fuels. But, our planet is at stake. We can't just be better. We need to be perfect.

POLICY

Highways in Kerala to have more electric charging stations



The Departments of Power and Transport in Kerala are establishing electric vehicle charging stations for every 50 km along national highways and the MC Road. In this regard, the Transport Department has transferred (\$0.12mn) to the Power Department for the first phase of the project, Transport Minister Antony Raju and Electricity Minister K. Krishnankutty said, addressing the 65th foundation day celebrations of the Kerala State Electricity Board (KSEB). Mr. Krishnankutty, who inaugurated the event, flagged off 65 electric cars inducted by the KSEB into its fleet to mark Earth Drive, the foundation day celebrations of the KSEB. Mr. Raju said that the Kerala State Road Transport Corporation (KSRTC) will begin inducting the electric buses for the city service in Thiruvananthapuram by April. Fifty buses will be on the roads by May. "In due course, the entire city service fleet in the State capital will have electric buses," he said.

WEBINAR

DECARBONISING SHIPPING: ISSUES AND CHALLENGES

At this Future Fuels webinar, industry experts raised concerns of the stakeholders while the tectonic shift to greener shipping becomes inevitable.



The webinar with the participation of eminent speakers from key stakeholders in the shipping industry including Indian Register of Shipping, The Indian National Shipowners' Association (INSA), The Maritime Association of Shipowners Shipmanagers and Agents (MASSA), The Indian Coastal Conference (ICC) Shipping Association, The Company of Master Mariners of India (CMMI), Foreign Owners Representatives and Ship Managers Association (FOSMA), Institute of Marine Engineers of India, Wärtsilä, and MAN Engines and Solutions has thrown light on several issues related to decarbonisation in maritime industry with some appropriate solutions in sight.

Setting the tone for the first webinar, **Mr Ramprasad Ravi, Editor-in-chief, Maritime Gateway and Future Fuels** has introduced the initiatives of the Gateway Media through its

leading publications and digital platforms in connecting governments, trade associations, industry players through the content, research and various discussion forums. He has also elaborated how 'Future Fuels' brings out a reader focused content that doles out the most up-to-date information on the latest happenings in the fuels and fuel additives sectors. He has also explained the need for conducting such a webinar and its objective to clear the apprehensions about decarbonisation in maritime industry, with the inputs shared by eminent panellists.

Mr Anil Devli, Chief Executive Officer (CEO), Indian National Shipowners' Association (INSA), acted as moderator for the first session of the webinar. The panellists in the first session have focused on 'Becoming Carbon Neutral: Regulations, Options and Technology - Solutions for Sustainability and Efficiency'.

In his initial remarks to the



discussion, **Mr Indra Nath Bose, Advisor, The Great Eastern Shipping Company Limited**, said that the decarbonisation in shipping is necessitated by the IPCC, and IMO regulations which mandate shipping to reach NetZero by 2050.

“Ship owners today are facing a huge amount of risk because of the change in IMO regulations on emissions in shipping. As they have invested huge amounts of money on ship building and suddenly now with change in regulations, decarbonisation is required for the fleet of 30,000 of large mercantile ships, and 100,000 vessels around the world, and they have a mammoth task before them to convert the vessels to low carbon or zero carbon fuels, or to go for retrofitting the vessels in future, which have a more life span. Moreover, there are no readily available zero carbon fuels in the market to replace fossil fuels, and a lot research is required,” he said.

Mr Vijay Arora, Managing Director, Indian Register of Shipping (IRClass), has elaborated the IMO strategy of 2018 on reducing the Greenhouse Gas (GHG) emissions in his introductory remarks. Mr Vijay Arora through a presentation explained the short-, mid-, and long-term emission reduction measures like carbon intensity indicators (CII), and energy efficiency Existing ship Index (EEXI) measures starting from 2018 and lasting till 2050. “IRS can assist ship owners with the help of a newly developed web-based electronic toll for EEXI calculation and development of EEXI technical file, and other technical assistance through workshops,” he said.

While advocating strongly for the digitisation in shipping industry, **Capt Mahendra Bhasin, Chairman, Maritime Association of Shipowners Shipmanagers and Agents (MASSA)**, said “We are moving more towards digitally smart and a carbon neutral future through decarbonisation”. Further elaborating the importance of technology, he said that the process is



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Maritime decarbonization will become a major issue for ship owners especially for medium and small size players, if not for the large size vessel owners. Here is need for shipping community to sit and assess what needs to be done to address the cost factor.

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MR ANIL DEVL
Chief Executive Officer,
Indian National Shipowners'
Association (INSA),



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MR INDRA NATH BOSE
Advisor, The Great Eastern
Shipping Company Limited

transformational not just transitioning and the impact on the ship operations can be huge. “It is always crucial to keep the crew and ship in mind. It is important to touch safety aspects, and how robust is this transformation in this safety critical industry? While transforming it is imperative to see proper risk management systems and to ensure resilience. The digitalisation and

decarbonisation go hand in hand and ultimately the success of the systems will depend on seafarers,” he said.

Capt Bhasin stressed on the need to form coalitions in the industry to find practical solutions for decarbonisation. Through a slide presentation on CO2 emission reduction potential of individual measures, he elaborated on how some simple measures like hull design, operation, and power and propulsion system, along with alternate fuels can play a major role in reduction of emissions.

Mr Sachin Kulkarni, Head - Marine Power Sales (South Asia), Wärtsilä, while joining the discussion said that fuel transition in shipping is filled with many challenges as at this point of time there are many options available, but there is no consensus on commercial availability of the future fuels, which of course, will depend on a lot of factors like geographical location the national interest and legislation and the availability of the stock.

“Investing in flexible future fuel solutions will mitigate business risks associated with future fuels. The business impact of future conversion can be reduced further by preparing the fuel storage tanks,” he said. He described that continuous development of technology is Wärtsilä’s future fuel roadmap which is very clear. “Our new fuel compliment engines can run on bio or synthetic methane, methanol, ammonia, and hydrogen, and LNG,” he added.

“Commercial development of the new fuels will depend on operational considerations like sustainability of the fuel, its availability, price, required vessel endurance, tank size and location, emission, output, efficiency requirements, and exhaust gas abatement,” Mr Sachin explained. He opines that there will be no single future fuel, but whole variety of them will come in to use, and investing in fuel flexibility will mitigate compliance business risks, but Wartsila will continue to offer complete systems including multi fuel engines and viable

upgrades to engines to introduce future fuels.

Taking the discussion forward, **Mr Jithendra Nimmagadda, CEO – Maritime - Vishwa Samudra Group**, said that the global maritime industry emits about 940 million tonnes of CO₂ every year, which accounts for 2-5% of the total GHG emissions globally. So, the focus is mainly on the reduction of CO₂ emissions, but future fuels like ammonia, hydrogen, methanol, and biofuels are currently not available and it may take a while for them to be available in the market. Then, what is the option for reduction of emission now for at least 1/3rd of the vessels that have a lifespan of about 15 years and more.

“Here is a product from Vishwa Samudra Group called FuelSpec®, a combustion catalyst, which when combined with fossil fuels offers emission reduction as well as efficiency. The product comes with a host of combustion benefits,” he explained.

Mr Mukesh Kumar, Fleet Personnel Manager, Bernhard Schulte Ship Management (I) Pvt. Ltd (BSSM), stressed on the need to have dual fuel engines in the transition phase, and taking care of the air lubrication system, and marine battery system, Exhaust Gas Cleaning System (EGCS), and checking the efficiency of propeller for the existing vessels. “Measures like applying coating for vessels will improve the carbon emissions before fully transitioning into future fuels.” he added.

Bringing the cost factor in the decarbonisation as point for discussion, Mr Anil Devli, said “It will become a major issue for ship owners especially for medium and small size players if not for the large size vessel owners. Here is need for shipping community to sit and assess what needs to done to address the cost factor”. Taking the discussion forward he asked Mr Indra Nath Bose whether IMO has touched this issue.

While replying to the question Mr Bose said that the IMO under GHG



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CAPT MAHENDRA BHASIN
Chairman, Maritime Association of Shipowners Shipmanagers and Agents (MASSA)

emission reduction strategy and its impact assessment of the states, has clearly discussed about the cost impact of decarbonisation. He has quoted an example of methanol which is produced using biological sources like feedstock or renewable sources costs about \$2,000 a tonne for VLSFO. According to him there

needs to be a level playing field to balance and IMO is thinking of levying additional taxes on fossil fuel to bring the parity. He has also cited report given by Ricardo, a consultancy firm that worked on behalf of industry association, and has presented about 120 challenges faced by ship owners on the path to decarbonisation.

Responding to the discussion, Mr Vijay Arora has explained how ship owners can obtain energy efficiency certifications by fitting in some simple energy saving devices.

The first session of the webinar at the end has addressed the questions raised by the delegates.

When calculating EEXI for a vessel. If the vessel is using LNG as fuel, are methane slips addressed?

Replying to the question Mr Vijay Arora said that currently it is not being addressed.

How is the use of biofuel taken into account when calculating attained EEXI? In case if a vessel is unable to bunker biofuel due to its non-availability, how does it affect its compliance with EEXI?

While answering the question Mr Indra Nath Bose said, currently carbon footprint of fuels is taken into account only when it is taken into a vessel it doesn't take its full life cycle from its production, processing etc. Burning a biofuel, there is carbon and there is GHG emission, so you don't get a benefit of it being a sustainable product. That is why IMO has now framed a full lifecycle assessment guideline for fuels to take into account the carbon footprint. There may be a marginal benefit when using biofuels.

Considering methane slip effect in LNG-fuelled engines and that methane has massively higher Global warming potential (GWP) compared CO₂, Will LNG continue to be a viable alternative to reduce GHG emissions?

Answering the question Mr Sachin Kulkarni said that there are currently technologies available in the market to address this issue, where the methane

slip is just less than 1% per kilowatt. He further added that we have technologies available today to address the methane slip issue.

How benefit of technology like PBCL can be qualified by class/RO when used in conjunction with EPL to arrive at EEXI value for the technical file, what if such changes are made post January 1, 2023 during scheduled docking?

Mr Vijay Arora said that post January 1, 2023 whatever impact they want to do in that case they definitely have to ensure EPL has resulted in obtaining the attained EEXI less than EEXI. Impact of the technology is that we can do CFD analysis, which will help us know to what extent impact is there to reduce the resistance of the ship so that it helps us to calculate V reference without going for sea trials.

I would like hear comments and views of ship owners/stakeholders on how to deal with emissions when vessels actually doing no cargo transportation, when it is in balanced leg of voyage, doing tank cleaning, or it is at bulk?

“We have discussed this issue at our correspondence group at IMO. Some of these issues have already been taken into account and some issues will be finalised in the next MEPC 78 meeting scheduled this year. Anchorage stays and bad weather are some of the aspects, which are not taken into account for consumption for calculating CII reduction, but for other aspects we’ll get clarity only in the next MEPC session” Mr Indra Nath Bose replied.

Is there any substantial data available that makes sure these alternative fuels are not having any negative impact on atmosphere, or any study shows that this fuel also has some footprint, for the time being this solution looks like the best, but in near future they may turn negative, so what would be the impact of using alternative fuels as solution for future?

Answering the question Mr Sachin



Commercial development of the new fuels will depend on operational considerations like sustainability of the fuel, its availability, price, required vessel endurance, tank size and location, emission, output, efficiency requirements, and exhaust gas abatement.



MR SACHIN KULKARNI
Head - Marine Power Sales
(South Asia), Wärtsilä



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MR JITHENDRA NIMMAGADDA
CEO – Maritime
Vishwa Samudra Group

Kulkarni said, “Fuel gas storage and supply is a very important aspect as each fuel will have its own parameters for this. So, today the tanks that we use for ammonia cannot be used for LNG, similarly for hydrogen also we need to prepare different tanks. It’s very important which fuel we are using and depending on that what kind of characteristics we need to address and therefore, it will vary depending on the fuel.”

How does the fuel purification for

the fuels affect the fuel components with respect FuelSpec® product? What is the effectiveness of FuelSpec® on Biofuels? Are there any Health, Safety, and Environment (HSE) related risks in using the product? Will FuelSpec® give us credit in CII, and EEXI?

While replying to these questions, Mr Jithendra Nimmagadda said that FuelSpec® doesn’t neither interact with the fuel nor react with any other fuel additive. It is basically a combustion catalyst that transfers the heat energy in a much more efficient manner so that the unburnt hydrocarbons are completely reduced. So, to that extent absolutely there would be no impact on any other additives including purifiers.

FuelSpec® can be used with wide range of fuels starting from VLSFO, HFO, MGO, and biofuels also. The impact of FuelSpec® is more or less same on biofuels as it ensures complete combustion of the hydrocarbons including the biofuels. On the HSE point of view the product is noncorrosive and nonreactive high flash compound, hence it is absolutely safe in terms of usage storage and transportation. But of course, good practises have to be followed like any other compound, like for example, we should take good measures like avoiding spillages, etc. otherwise of course the product is absolutely safe in handling.

FuelSpec® reduces the amount of GHG emissions including NOX, SOX, soot, CO2, and unburnt hydrocarbons. So, there is a definite reduction in emissions and improvement in terms of rating, he added.

With respect to CII and EEXI ratings on FuelSpec® Mr Jithendra Nimmagadda asked Mr Vijay Arora to give his views.

Mr Vijay Arora said, “In the use of FuelSpec® as what you said it is going to improve the combustion efficiency and from that point of view it may not impact EEXI part but it is definitely going to impact CII part. Because once the efficiency is better using FuelSpec®

and with less fuel burning that means we are getting indirect advantage in improving the CII rating but not in terms of EEXI rating.”

Mr Anil Devli moderator for the first session has thanked all the panellists for their valuable inputs. In his concluding remarks he said that the webinar would be helpful in disseminating awareness about the fuel transition among the stakeholders and the policy makers will consider the points raised in the discussions while framing policies for the transition.

The second session of the webinar has focused on ‘Solutions for sustainability and efficiency’. Mr Indra Nath Bose has acted as moderator for the session.

While mooted the discussion for second session, **Capt Rahul Chodhuri, Managing Director - AMEA, Veritas Petroleum Services**, said “International shipping uses more than 300 million tonnes of the existing fossil fuels every year, and therefore the dominance of these fuels is going to be there for some time. As these fuels power more than 55 vessels across the world in shipping and replacing this will be a huge task”. He further said that existing bunker fuel hubs play an important role in the transition of green corridors or decarbonisation. In this context, the Indian bunker marine fuel share position vis-à-vis global bunkering is relatively very less, he said. He further said that all future fuels come with pros and cons and there is no panacea for future. The future fuels may reduce CO2 emissions up to 95 to 100%, but they also come with limiting considerations like safety, ammonia is highly corrosive and methanol has a very low flash point and requires large storage point. “One area of interest that we see is in biofuels, which can be used with the existing engines without retrofitting. But there is a talk about sustainable biofuels, but this is changing with second and third generation biofuels which are not crop-based. For decarbonisation in shipping to succeed creative collaboration,



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Measures like applying coating for vessels will improve the carbon emissions before fully transitioning into future fuels.

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MR MUKESH KUMAR
Fleet Personnel Manager,
Bernhard Schulte Ship
Management



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CAPT RAHUL CHODHURI
Managing Director - AMEA,
Veritas Petroleum Services



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Unfortunately, there are no regulators to control emissions at ports, which are equally responsible for GHG emissions like ships.

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MR P JAIRAJ KUMAR
Chairman and Managing Director,
Ocean Sparkle Limited

robust R&D work and regulatory framework are required – Singapore has all of these three in one,” he added.

Advocating the need for initiating efforts of decarbonisation in ports, **Mr P Jairaj Kumar, Chairman and Managing Director, Ocean Sparkle Limited**, said, “Unfortunately there are no regulators to control emissions at ports, which are equally responsible for GHG emissions like ships.” He recalled that the member states have signed IMO MEPC 74 resolution that talks about cooperation between ports sector and ships to reduce emissions from ships but not at ports. The four areas identified in the resolution include developing offshore power facilities at ports preferably from renewable sources, provision of safe bunkering facilities, promotion of port incentives for ships for low carbon emissions, and optimisation of port calls.

He said, “India has taken few action plans in this direction including India maritime vision 2030, the national action plan and key interventions and green initiatives and commitment made at COP26 summit. India has already initiated national action plans like achieving just-in-time arrivals at ports by 2023, and port-based incentives for low emission ships.” In the infrastructure segment, he said, India has identified battery charging stations at ports, bunkering stations for LNG, ammonia, and hydrogen. In the technology and solutions segment, shore power for all by 2023, however, very little is achieved so far in meeting these measures due to not having a regulator at ports, he added.

Joining the discussion, **Mr Pawan Kapoor, Chairman and Managing Director, ISF Group**, said that limited perspectives on GHG emissions cannot find us right solutions. He quoted IPCC 6 report that says GHG emission may even affect our existence in the world. “So, regulations are to be there as we are working towards new fuels, but the awareness about the seriousness of the situation needs to be really brought

down to all the levels of our society in general. Unless we do that probably we will not find solutions,” he observed.

He has stressed on the need to have an authentic data on green house emissions, to find right solutions. He has emphasised importance of having robust systems to measure the emissions precisely and spread awareness about the emissions and it should be beyond the regulations for sustainability all forms of life on Earth.

Mr Girish Sreeraman, Area Manager, Maritime - India, Sri Lanka, Bangladesh and Thailand, DNV-GL, in his initial remarks said that we don't have the luxury of discussing the measures for decarbonisation and for 20 to 30 years and then arrive at a decision. He said that the situation has come where steep targets are set for decarbonisation of shipping. It's the time for all stakeholders in the maritime industry to come together and collaborate to work for achieving decarbonisation goals. Technical aspects have to be taken into account before transitioning to future fuels.

Stressing the need for decarbonisation, **Mr Kristian Mogensen, Two-Stroke Promotion & Customer Support, MAN-Energy Solutions (ES)** said that MAN engines are responsible for about 1.5% of the global CO2 emissions, and therefore, have a significant impact on the global maritime sustainability agenda. He has elaborated on the development of engines for all future fuels including LNG, Methanol, LPG, ammonia, and ethane. “The journey for carbon free and less carbon industry for us started much earlier in 2011, but the market for dual fuel engines has picked up pace only after 2017,” explained Mr Kristian.

“MAN has developed engines to suit all types of fuels including methanol and it is currently developing Ammonia based engines which is expected to be completed by 2024,” he has added. On the subject of which will be the fuel of the future Mr Kristian



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So, regulations are to be there as we are working towards new fuels, but the awareness about the seriousness of the situation needs to be really brought down to all the levels of our society in general. Unless we do that probably we will not find solutions.

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Chairman and Managing Director,
ISF Group



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MR GIRISH SREERAMAN
Area Manager, Maritime - India,
Sri Lanka, Bangladesh and
Thailand, DNV-GL

said that a lot factors like area of operations like Asia and Europe will determine the fuel of the future. He cited DNV-GL's prediction that new ships will be fuelled by green ammonia by the 2030s. But he agreed that there is still a lot of uncertainty over the fuel of the future as there is no bunkering infrastructure for methanol. “MAN has the capability to offer future-proof engine technology as it offers MAN B&W ME-C engines, which can be retrofitted to use LNG, LPG, Ethane, Methanol, and Ammonia as fuel” Mr

Kristian said.

Joining the discussion, **Ms Vinita Venkatesh, (Managing Director), Ocean 2 Door Pvt Ltd**, said, “We are the global marketing partners for FuelSpec®, a combustion catalyst meant for bringing fuel efficiency and emissions reduction”.

She said, “Most of the decarbonisation solutions available today are expensive involving high investment, the only solution that is there short term right away ready for the shipping lines is to optimise speed. But in today's global supply chain situation slowing down the vessel is tragedy, both for the shipping lines and for the customers.”

In this context, Ms Vinita has presented the test trials conducted on the product which have shown great results in bringing fuel efficiency, emission reduction and fuel saving also. She has presented the trials conducted by the manufacturer in the US on different engine-built vessels using FuelSpec® product which have given impressive results in terms of emission reduction and fuel cost saving, and at the same time the catalyst is safe as it has not interfered with engine. “More such trials were conducted on other vessels on Indian coast also which have also given similar results proving the potential of the FuelSpec® in reducing the emissions and efficiency,” she added.

While speaking on the tests conducted on biofuels Capt Rahul Chodhuri said that the amount tests done on biofuels has increased some 5 to 10% last year. As many big ship owners and operator who have already completed number of trials. He cited the recent update of CMA CGM announcing that they're going to trial biofuels on 32 of their large container ships, and they would burn biofuel called B-24 and mentioned that they would get about 21% reduction in CO2 emissions. So, Biofuel is an easy fuel to use and complies with sulphur regulations and has got good energy value which is close to a pure

fossil fuel and also has good ignition and combustion characteristics. He cautioned that biofuel is not going to solve all the problems as one needs to be careful about the oxidation of the fuel, and needs to be careful that we cannot store the fuel for too long. But of course, there is a lot activity is happening in this area, he added.

Responding to the question on how port sector is preparing for the energy transition phase, Mr P Jairaj Kumar said, "Until and unless there is a pressure nobody will act, and in the case of ports there is no compulsion from any regulatory bodies or the government to go for the transition, rather it is the private equity investors and financial institution like IIFC and ADB who have clearly spelt it out that until we show progress in going green, they are not going to fund us."

The second session was also followed by Q&As from delegates.

What is the opinion of the panellists with regard to changing the rules of construction to ensure net zero vessels will be built post 2030?

Mr Girish Sreeraman responding to the question said, "IMO has moved towards a goal-based approach, they have left it to the industry, and the ship owners to come up with solutions. We are moving from a prescriptive approach to a goal-based approach. As we come up with solutions and the spirit of what is required to be achieved is fulfilled then rules are getting framed."

Would you please elaborate on storage material requirement for tank construction and also pressure and storage condition for ammonia as a fuel?

For ammonia we expect to store at temperature of -25 degrees which is a safety margin. In terms of tanks and tanks capabilities then ammonia fuel is corrosive material and this sets some requirements. However, it is a big advantage as it is already widely used in process industry. So, what we can do is actually we can adopt the same regulations and the guidelines from the



MAN has the capability to offer future-proof engine technology as it offers MAN B&W ME-C engines, which can be retrofitted to use LNG, LPG, Ethane, Methanol, and Ammonia as fuel

MR KRISTIAN MOGENSEN
Two-Stroke Promotion & Customer Support,
MAN-Energy Solutions (ES)



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MS VINITA VENKATESH
Managing Director,
Ocean 2 Door Pvt Ltd



process industry to the marine sector. We will be using 316L stainless steel as well as we will adopt a mixture of fuels and 5% water that is in order to avoid corrosion. In general ammonia is a new fuel for the marine sector, but it has been handled well by the process industry for long, Mr Kristian Mogensen replied.

Has Veritas tested different sources of biofuel, am aware that testing to C14 bio content

can be measured, as done for 8217 parameters will this in your opinion be required to be verified notwithstanding bdn, etc?

Capt Rahul Choudhuri responded to the question and said, "Since biofuels is an addition to existing fossil fuels 8217 is existing standard, and it would be smart of owners and operators to follow that. If you are a first user of biofuel it would be good for you to go for additional tests such as Fatty Acid Methyl Esters (FAME), which is what biofuel is made of, and you need to do carbon corrosion test and you also need to make sure ignition qualities are good. In the initial phase of using a biofuel, especially during trial phase, it is important to add on to existing test methodologies to ensure that you have a good feel of what this product is."

Will the Calorific value of Biofuel B100 be similar to that of B24?

Capt Rahul Choudhuri replied to the question and said that the calorific value of Biofuel B100 will be lower than B24 since the fossil fuel component would not be down to zero.

Has the FuelSpec® trial done for the engines with respect to the carbon deposits in the combustion chamber and the combustion equipment i.e., initial inspection before using and intermittent inspection till the next overhaul period?

"We have three trial reports, which are very extensive and detailed, we are happy to share those reports with whoever has an enquiry and to dialogue on them," Ms Vinita Venkatesh replied.

While concluding the webinar Mr Indra Nath Bose thanked all the panellists and participants, for being part of such an informative event. Mr Ramprasad Ravi thanked the speakers on behalf of Maritime Gateway and Future Fuels. He also thanked supporting sponsors, INSA, MASSA, CMMI, FOSMA, ICCSA and Institute of Marine Engineers of India, and webinar presenting sponsor FuelSpec®, for their active participation.



'TRANSITION TO NET-ZERO SHIPPING IS A COMPLEX CHALLENGE'

Mr. Vijay Arora, Managing Director, Indian Register of Shipping, in an exclusive interview with *Future Fuels* shares how IRS is helping ship owners to face the existing vessel certification challenges and elaborates on the short-, mid-, and long-term measures on path to decarbonisation.

Q. What are initiatives taken by IRClass to help Indian ship owners in the decarbonisation efforts?

IMO's initial strategy on GHG reduction sets a pathway in terms of short-term, mid-term and long-term measures.

Regarding the recent short-term measures adopted by IMO towards GHG reduction from existing ships namely EEXI and CII, IRS is assisting the industry for complying with this new requirement. IRS has prepared a web based electronic tool which will enable the industry for easy calculation and preparation of required technical file/documents.

Also, to develop the understanding on EEXI and CII compliance among Indian ship owners, IRS delivered presentations on EEXI and CII compliance and possible solutions through dedicated training sessions as well as through forums organised by

various industry organisations.

IRS has also initiated efforts towards mid-term and long-term measures, particularly in the field of alternative fuels. In addition to our existing rules and classification notes for LNG fuelled ships, IRS has also prepared Guidelines for Methanol Fuelled ships, Guidelines on "Vessels with Fuel cell power installations" with emphasis on hydrogen fuel cells and Guidelines on Battery Powered Vessels.

IRS has also been involved in the trials conducted on two coastal vessels of Ambuja Cement using 20% Biofuel blend, wherein measurements of emissions, vibration as well as full examination of engines after a trial period of 3 months was completed satisfactorily. No significant impact observed on NOx & Sox whereas CO2 emission was found to be reduced by approximately 7%. Based on experience gained in the use of bio-fuel, IRS is

preparing Guidelines on the use of Bio Fuel which is expected to be completed by Dec 2022. Discussions are also on with another ship owner for conducting trials on seagoing vessels using biofuel.

IRS in collaboration with CSL and KPIT, is working on fuel cell powered technology demonstration project. It will comprise end to end solutions, system / component compliance in marine certification, approval in principle, rule development and validation in new technology areas.

IRS is involved in certification of vessels with Hybrid propulsion (Li-ion Batteries and Diesel Engines) on a series of 23 vessels for Kochi Metro Rail Limited (KMRL) and First Vessel of the series was recently delivered in Jan 2022.

Q. Recently IMO's MEPC 77 session has set target of 2023 for the ships to comply with Carbon Intensity Indicator (CII) and Energy

Efficiency Existing Ship Index (EEXI) certifications. What will be its impact on Indian coastal vessels?

Indian Administration, vide M. S. Notice No. 07 of 2021 has mandated the requirements on EEXI (for ships of 400 GT & above) and CII (for ships of 5000 GT & above) for all Indian Flag ships registered under MS ACT irrespective of whether the ship has coastal or worldwide trading license.

Upon compliance to EEXI requirement, International Energy Efficiency Certificate is to be issued to specified ship types of 400 GT and above certified for international voyage. Upon compliance to CII requirement, Statement of Compliance for Fuel Oil Consumption Reporting and Operational Carbon Intensity Rating for specified ship types of 5000 GT and above certified for international voyage.

Moreover, in order to ensure that vessels registered under RSV and ICV notification also are as energy efficient as international going vessels, Indian Administration vide the above-mentioned M.S. Notice has mandated all EEXI requirements except for the requirement of issuance of IEEC for such vessels (i.e. they will be required to calculate Attained EEXI, comply with Required EEXI and submit EEXI Technical File). Similarly, such vessels will be required to report same data as required by IMO DCS, calculate Attained CII, comply with Required CII and CII rating, except for the requirement of issuance Statement of Compliance for Fuel Oil Consumption Reporting and Operational Carbon Intensity Rating.

Further, in order to have a national emissions inventory from Indian ships, Indian Administration has also mandated collection of fuel consumption data from smaller size ships i.e. below the size to which the said MARPOL requirements of IMO DCS and CII are applicable. However, SOC is not required to be issued to such vessels and the data is reported to Indian Administration and not to IMO GISIS platform.

The above requirements

demonstrate India's commitment to energy efficiency domestic shipping as well as enabling a national maritime emissions inventory which can provide input to future policy development.

Q. Considering the ongoing initiatives for developing eco-friendly fuels, do you think the IMO's CO2 emissions target of 2050 is attainable?

The transition to net-zero shipping is a complex challenge that requires collaboration from all sectors, commitment from industry leaders, and a willingness to share the results of trials and tests. The transition to net zero will have to tackle

- The issues of availability of fuels
- The cost of infrastructure on land
- Scalability of successful pilot projects.

IMO has taken three step approach to deal with decarbonisation. Fuel consumption data is being collected since 2019. Technical and operational energy efficiency measures have been planned to be implemented for all existing ships wherein the reduction targets have to match with the phase 2 of EEDI ships. Also phase 3 of EEDI for new ships has been advanced for certain ship types of higher deadweight. All these measures have been adopted considering that CO2 emissions per transport work will be reduced by at least 40% by 2030 compared to 2008. Further, work is under progress in respect of midterm measures which includes, implementation programme for Alternative Fuels & Technologies & New/innovative emission reduction mechanism(s) possibly including Market-based Measures (MBMs) and review of the measures already taken and analysis of collected data which will be carried out in 2026, based on which future policy decisions will be made to achieve 2050 targets i.e reduction of 70% CO2 emissions per transport work and to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008 levels.

Q. Where do you think Indian flag ships are placed in terms of CO2 emissions vis-à-vis foreign flag ships?

CO2 emissions from Indian Flag

ships was approximately 4.62 million tonnes in 2020. In comparison the overall CO2 emissions based on data submitted to IMO Ship Fuel Oil Consumption Database in GISIS for the year 2020 was approximately 630 million tonnes (MEPC 77/6/1 submitted by Secretariat). Considering the average age of the Indian fleet is over 17 years, it is understandable that compliance to EEXI and CII will be a challenging task for Indian Ship Owners. Based on our preliminary assessment, it has been observed that 90% of bulk carriers and tankers in our Classed fleet will have to adopt Engine Power Limitation or other technical measure to meet the Required EEXI value. Regarding CII, it is observed that around 55% of vessels in our classed fleet (considering all ship types) would be falling in D & E rating by 2023. As far as Containerships in our fleet, although a small sample size, are better placed with 50 % of containerships having A rating in 2023.

Q. What policy measures can we expect from Government to support ship owners for switching over to green fuels?

Government is taking various initiatives for switching to green fuels. The acceptance to try biofuels onboard ships is a recent example as briefed above in Question 1. Various themes for Green Initiatives have been identified with participation from major stakeholders, and these will form inputs to the National Action Plan for green initiatives in marine sector. These themes include as Fuel Cell, Battery propulsion, Solar power, Bio-fuels/ Methanol, Storage and Dispensing of Hydrogen from Ports, Potential of usage of wind energy for Propulsion, Voyage optimization, Energy Mix for future emission free ships (hybridisation of above technologies).

Understandably government will have to play a major role in encouraging Indian ship owners to adopt green fuel friendly ships in their fleet and in setting up the infrastructure facilities to enable deploying alternative fuels and technologies on ships. **EF**

‘WE ARE MAKING THIS TRANSITION FOR A BETTER WORLD’

Dr Sanjay C Kuttan, Chief Technology Officer, Global Centre for Maritime Decarbonisation (GCMD) in an exclusive interview with *Future Fuels*, enlightens on the energy transition challenges in maritime industry and the efforts being made by GCMD for the decarbonisation.

Q. What is Global Centre for Maritime Decarbonisation (GCMD)? What does it do to help decarbonising the maritime industry?

GCMD was established on August 1, 2021, and it was born out of the recommendation made by the International advisory panel on decarbonisation that was set up by Maritime Port Authority of Singapore (MPA). This recommendation was made to the government last year at the last Singapore maritime week. Around six companies have come forward to fund for setting up this centre. The companies include BW, BHP, DNV Foundation, Eastern Pacific Shipping, Ocean Network Express (ONE) and Sembcorp Marine, and each one of them put \$10 million together with MPA putting matching \$60 million over the next five years. The mission of GCMD is really around shaping standards, deploying solutions, financing projects, and bringing the community of stakeholders in the maritime sector together to really move forward with one voice in relation to decarbonization. At the centre of everything we do is really about pilot and demonstration of technologies which are in the pre-commercial stage but looking for platform to demonstrate their value to the industry. As we are not for profit organization all the lessons will be shared with the maritime community so that every one can move



forward together.

Q. What do you think are the challenges or barriers for moving towards decarbonisation?

First thing is the maritime sector is not homogeneous but heterogeneous in nature. It not only varies in terms of vessel type but also in its use case where some are containers, some are liquid bulk, and some are dry bulk, and the routes are different from different ports. So, the first challenge a lot ship owners are asking us is which low carbon fuel should I begin to use, because not all low carbon fuels are available at all ports, and not all low carbon fuels have

reached production levels that is high enough that they can be assured of supply and not all low carbon fuels are compatible with current fuels as well. So, there are multiple challenges that a ship owner or ship operator has to consider before he makes a decision, because once you build the vessel it is going to be around for 20 or 25 years. The entire supply chain needs to move together, it's like a chicken and egg situation. Do the ports build infrastructure to cater to a vessel that comes once a month or the vessels change their entire propulsion system and look for port to refuel? We need

this collaborative nature of solving the maritime decarbonisation challenge which requires all stakeholders to move together so there is sufficient de-risking across the value chain.

Q. In the context of several alternative fuels making their way to the market, which fuel do you think will prevail in the changing scenario?

You look at the variables that one has to deal with in deploying new fuels. The first thing is the deployment infrastructure and current engines. It would be unreasonable for everyone to write off this infrastructure just to cater new cryogenic fuels. Therefore, if you look at biofuels, they can actually use current infrastructure and can be deployed quite easily to meet the near-term targets as a drop in fuel and that is the easiest path today. One of the big challenges is people say there is not enough production of biofuels, but as demand side commits to taking up supply, you will see production ramp up to meet that demand-supply imbalance. So, one of the earlier fuels we can move forward with current infrastructure and with some minor modifications is biofuel. What we don't want to do is to promote biofuels that compete with the food chain and there are new solutions in gen 2 gen 3 and gen 4 biofuels, which are very viable alternatives to what we used to know as generation 1 biofuels that come from food crops, we want to avoid that wherever possible. The other fuel that is fast coming into the space is LNG, which is cleanest of all the fossil fuels. LNG opens up the opportunity of bio-LNG in the future. Because once you build the LNG infrastructure bio-LNG can be a nice replacement. So, transition to LNG is an interesting opportunity.

Methanol can also be deployed easily today there are engines that can burn methanol in propulsion systems. But of course, the color of the methanol that makes the difference and the emerging e-methanol is slowly increasing.

As we move in to ammonia

scenario, it is an efficient molecule that carries three hydrogen atoms and therefore ammonia has to be green if it has to be used as a decarbonization factor. Ammonia today has a significant demand in the industrial sector. So, the question really is if you are making sufficient green ammonia then wouldn't you want to displace the brown ammonia that exists in the industrial sector as a priority to decarbonize the entire ecosystem as opposed to putting it through to maritime sector.

Hydrogen is not an easy molecule to handle, and to make green hydrogen is obviously a prerequisite to make green ammonia. We need to think where green hydrogen plays a role in the future.

But at least in next decade or so between biofuels, bio-LNG, and bio methanol we have an opportunity to start the process of decarbonisation with the current infrastructure.

Q. Most of the existing vessels are scrubber fitted to adopt to low emissions, from technology standpoint what changes do you see in the future engines and ships that would be coming up to comply with this decarbonisation?

One strategy we are beginning to see emerge is the dual fuel readiness strategy. The ships are being built with space and piping space that would be ready to take on the new infrastructure for this alternative fuels. So dual fuel readiness is definitely going to be one of those strategies. The other strategy of once you have a scrubber depending on the scrubber technology there is also an opportunity to use the scrubber technology to both on carbon removal systems and nitrogen removal systems. This is being actively looked and researched. The challenge of onboard carbon capture is you need to close a loop on the captured carbon. So, it is not good enough for maritime to say that I captured carbon and hand it over to land site and you decide what to do with it. There must be an entire eco system to fix the CO2 and whether it's

through sequestration in all oil fields. There must be a pathway to lock CO2 that is captured. These are different pathways people are thinking about.

Q. While the transition is happening with set targets like 2030, 2050, and 2070, Are there any fuel additives are catalysts which can offer interim solutions for reducing emissions in the meantime?

There are some fuel additives being used in the land transportation industry which offer efficiency increase from 5 to 10%. But that is not going to help the maritime sector as we need additives which can offer 50 to 100 percent reduction in emissions. Therefore, a lot of these solutions like fuel additives will not make the cut. Because their production and carbon foot print will be high. So, we really need to look at alternative fuels' scenario.

Q. We talked about fuels like hydrogen, biofuels, and LNG, do you think all these fuels will coexist in the market place? The alternative fuels would be costlier compared to conventional fuels, so what would be the business model emerging?

Yes, there will be multiple fuels and in different regions you will have more than one or the other. It's all about question of accessibility and part of the accessibility is the cost to transport the fuel and move it around. That is where the cost structures of the business model need to be optimized. The production cost today is high but there is still room for technological innovation to reduce those production costs.

We must remember why are we doing this decarbonization, we not doing this to make money or to find a cheaper fuel. We are doing this because climate change is existential threat and we need to address and slow down. What price we can put on existentialism, that's where people need to realize, if you want save the whole world and your grandchildren's life what is the price you are not willing to pay. We are making this change for a better world. 



FuelSpec® real time field trials reveal huge fuel savings

Indian Institute of Technology Hyderabad (IITH) conducted real time field trials on heavy duty vehicles, evaluating the fuel savings by impressive 8%.

FuelSpec® 114-05 from Vishwa Samudra Group is a fuel combustion catalyst that improves combustion efficiency, provides fuel savings and reduces emissions. The extensive field data was collected with one of the Volvo tandem rollers from December 14th to December 23rd, 2021. During the test, the roller was subjected to various loads in both amplitude and adverse worksite conditions. The machine produces the energy required for excellent compaction by combining high centrifugal force, heavy drum weight, and dual amplitude with the option of dual amplitudes and frequencies.

The specification of the roller and its engine are given below:

They collected base case performance data with the high-speed diesel (HSD), then added the Fuel

FIELD TEST EQUIPMENT USED FOR TRIALS

Field Test equipment	Volvo Double Drum Compactor - DD90B
Engine make/model	Kirloskar 4R1040TC BS -III (CEV)
Engine type	4 cylinders, four-stroke, CI engine, Turbocharged, water-cooled
Rated power @ installed speed	55 kW @ 2,200 rpm
Maximum torque @ 1500 rpm	300 Nm
Emission certificate	BS III Compliant



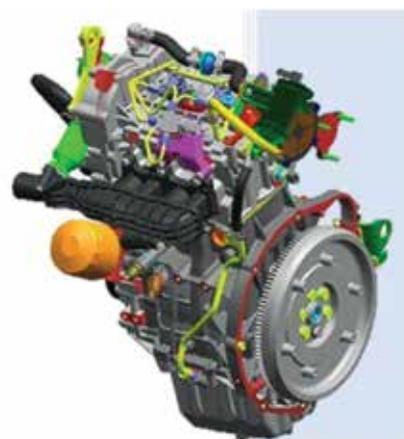
Volvo Double Drum Compactor - DD90B

THE TEST RESULTS COLLECTED FROM THE FIELD TRIAL

Fuel sample	Total running hours			Total Fuel Consumption (Liters)	Average Fuel consumption rate (Liters/hour)	Fuel savings (%)
	Low speed (880 rpm)	Medium speed (1320 rpm)	Low/High speed (880/1760 rpm)			
HSD	26.4	35.3	22.9	273.6	3.234	8.5%
HSD + Fuel Combustion Catalyst	31.9	29.5	32.8	278.8	2.959	

FUEL SAMPLE USED FOR TRIALS

Fuel sample	Engine speed(rpm)	NOx (ppm)	CO2 (%vol.)	NOx reduction
HSD	800	60	1.2	10% - 84%
	1320	19	1.5	
	1760	340	2.6	
HSD + Fuel Combustion Catalyst	800	22	1.2	
	1320	3	1.7	
	1760	303	2.6	



Twin-cylinder Turbocharged CI engine (40 HP)

Combustion Catalyst in a 1/4000 blend ratio and collected performance and emission data from the same roller again. Enough precautions are taken to ensure that the experiments are carried out under similar conditions, both with and without the Fuel Combustion Catalyst.

The roller is operated at three different engine speeds to generate data for various load conditions. The field data is collected for a few hours at each speed, as shown in Tables 1 and 2, for both fuel consumption and emission. Finally, the average fuel consumption rate from three operating conditions is calculated.

- Comparing the average fuel consumption rates of a tandem roller fueled with and without the Fuel Combustion Catalyst

They collected base case performance data with the high-speed diesel (HSD), then added the Fuel Combustion Catalyst in a 1/4000 blend ratio and collected performance and emission data from the same roller again. Enough precautions are taken to ensure that the experiments are carried out under similar conditions, both with and without the Fuel Combustion Catalyst.

- revealed that the Fuel Combustion Catalyst blended at a ratio of 1/4000 in high-speed diesel could save approximately 8.5 percent of the fuel.
- Field data also revealed that adding a Fuel Combustion Catalyst to HSD improved engine

response and smoothness.

- Compared to an engine fueled with HSD, the addition of a Fuel Combustion Catalyst reduces NOx emissions by at least 10% and up to 84 percent. This could be attributed to a better combustion process resulting from shorter premixed combustion and improved spray and fuel-air mixing characteristics. CO2 emissions are reduced when CO2 emissions are normalized by fuel input mass due to lower fuel consumption for the same power output.
- Engine vibration and noise would be reduced with the improved combustion characteristics with the Fuel Combustion Catalyst, as observed during the trial runs. **FE**



(From left) **Mr Nikeel Idnani**, Honorary Secretary IMarEST UAE Branch; **Ms Vinita Venkatesh**, Managing Director, Ocean2Door; **Mr David Pereira**, COO, TRISTAR Maritime Logistics; **Mr Gautam Lahiry**, Manager, ABS Middle East; and **Mr Jaideep Vohra**, Sr. Manager Fleet Performance, Bahri

Improving fuel efficiency - Key to sustainable shipping

At IMarEST UAE branch technical meeting the panellists stressed the need for efficient combustion technologies, which can allow shipping to burn less fossil fuel for significantly cleaner operation.

IMarEST UAE branch, an international professional body and learned society for marine engineers, scientists and technologists, has organised a technical meeting at Fairmont hotel on the iconic Palm Jumeirah Island in Dubai on February 18, 2022. The event focused on discussing the deliberations made at the IMO's goal of cutting GHG emissions from shipping by 2050 and its progress, and the need to focus on technology that is available today and to improve fuel combustion.

A panel comprising of Mr David Pereira (COO, Tristar Maritime Logistics), Mr Gautam Lahiry (Manager, ABS Middle East),

Mr Jaideep Vohra (Sr. Manager Fleet Performance, Bahri) and Ms Vinita Venkatesh provided a lively interaction with the 123 attendees at the event.

Delivering the welcome address, Nikeel Idnani, Honorary Secretary IMarEST UAE branch, highlighted that complete fuel combustion leads to reduced – emissions and engine wear. He pointed out that marine diesel engines have been optimized in their design to operate at maximum efficiency. However, the Achilles heel are external factors such as the inconsistent quality of the fuel that could affect fuel efficiency, wear to the engine and release of emissions. The end products

that remain after the process of hydrocarbon fuel combustion, are released into the atmosphere which are harmful to human health and puts the planet in jeopardy. Efficient combustion reduces the energy waste and polluting nature of these end products. Efficient combustion is achieved when there is complete combustion of the fuel in the engine thereby providing maximum power or energy output. He said, "It's all about getting the best green bang for your green buck".

In her keynote address, Ms Vinita Venkatesh, Managing Director, Ocean2Door India (Global Marketing & Distribution partner of FuelSpec® Combustion Catalyst) explained that patented FuelSpec® liquid combustion catalysts improve combustion efficiency, provide fuel savings, and reduce emissions resulting from Heavy fuel oil and Diesel fuel combustion (including ash, carbon dioxide, carbon monoxide, NOx, Sulfur dioxide, and unburned hydrocarbons). Vinita revealed that the catalysts work effectively on a range of fuels in 2-stroke and 4-stroke Diesel engines. Better combustion provides secondary benefits such as overall improved equipment performance, extended equipment life, and a reduction in operating and maintenance costs. **EF**



FUELSPEC
COMBUSTION CATALYST

Manufactured by EFS - USA, the FuelSpec combustion catalyst aims at reducing emissions across fuel-based combustion engines across the world. EFS specializes in technology driven chemical combustion products for various industries.

FuelSpec® 114-05

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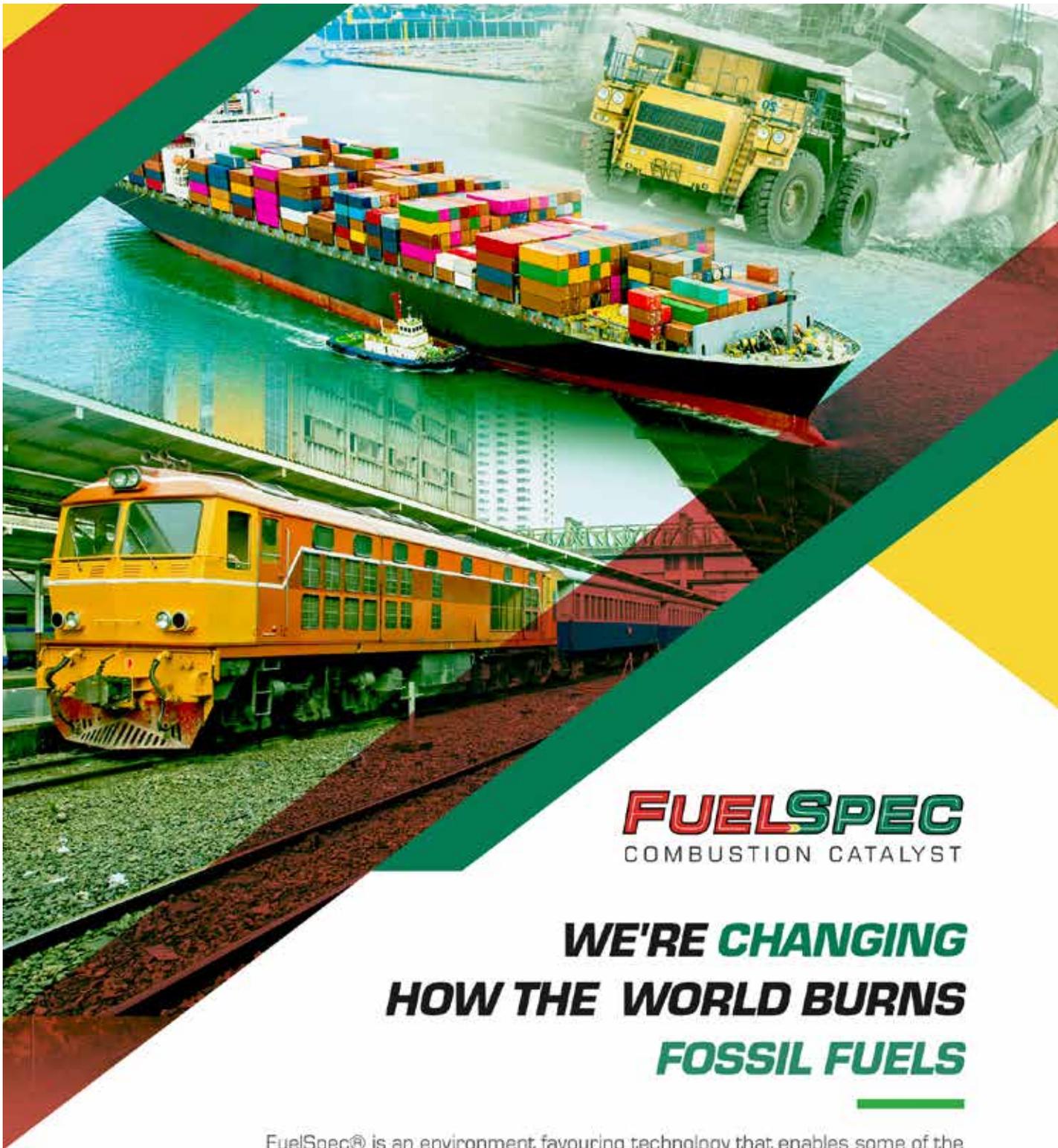
FuelSpec
Vishwa Samudra Group
4th Floor, Divine Banjara, Road Number 12,
Banjara Hills, Hyderabad – 500034, Telangana, India



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