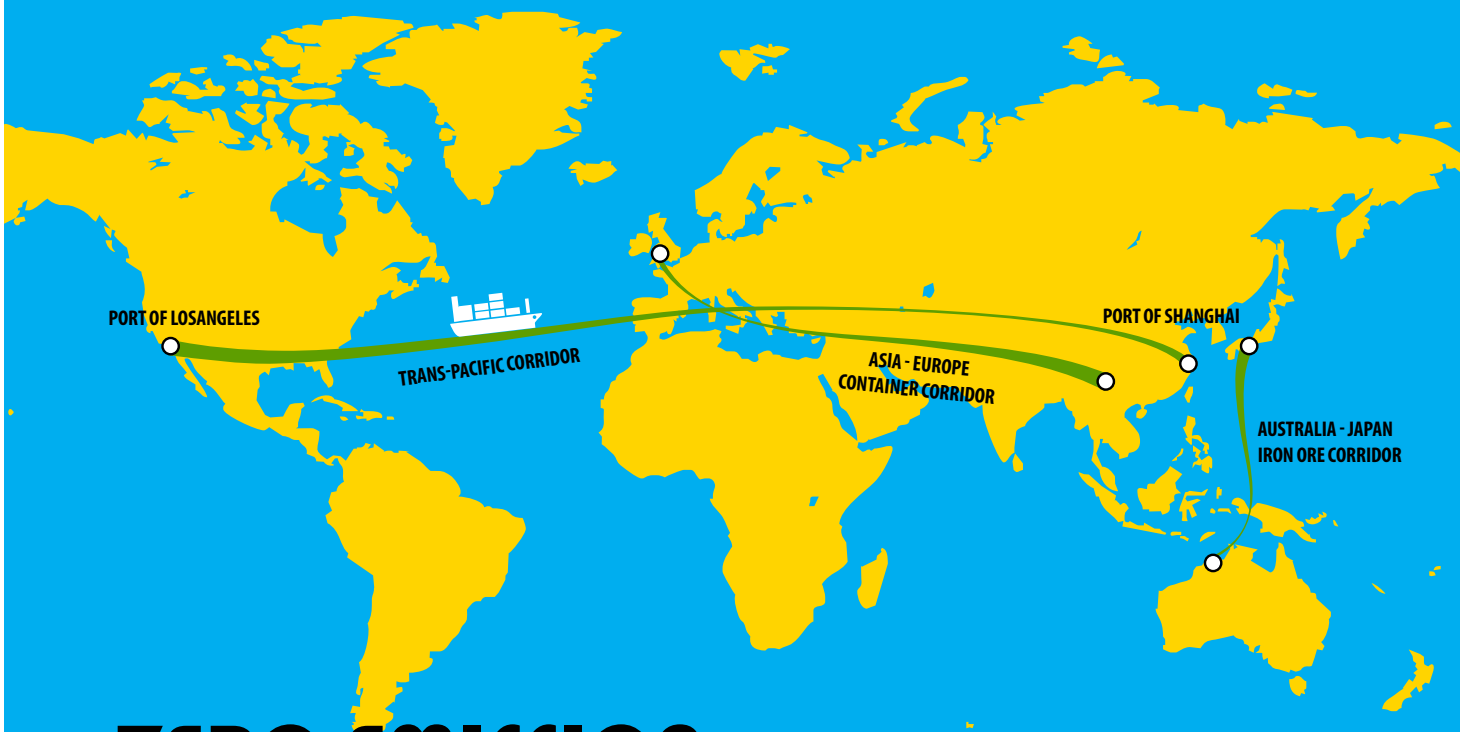
# FUTURE FUELS™

Advancing Efficiency and Environment

MAY 2022 | PRIVATE CIRCULATION ONLY




## ZERO EMISSION SHIPPING?

# GREEN CORRIDOR SHOWS THE WAY

Green corridors in shipping is one of the best ways to deal with increasing carbon emissions, as it could offer high-impact opportunities and a great deal to generate momentum towards decarbonization.

VISHWA SAMUDRA
CHALLENGE IT. CHANGE IT.

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

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## EDITORIAL

# Methanol is gaining momentum as alternative fuel for energy transition

As the world is getting ready for the energy transition with stipulated timelines, alternative fuels have started getting attention from the industry to replace carbon-rich conventional fuels. All stakeholders including governments across the world, industry bodies, and regulatory agencies have started process to find and fixing the best alternative fuels to replace fossil fuels.

Of late, Methanol has been gaining more recognition especially from the maritime industry, with major shipping liner like Mearsk choosing to build new methanol-fueled vessels. It has become favorite for the shipping industry because carbon-neutral fuel can be produced using only renewable resources, such as sun, wind and biomass, along with carbon captured from power plants or taken directly from the air. And with minor retrofits, methanol can be used with existing infrastructure in shipping.

The momentum has not just been limited to shipping industry, as it has been identified by several other industry stake holders as alternative fuel for green transition. The Indian government has recently put emphasis on the development of methanol as blend with petrol to cut its crude oil dependence. The Union Transportation minister Nitin Gadkari has stressed the need to increase methanol as alternative to crude oil in auto sector. In this direction, Indian Oil Corp (IOC) rolled out M15 petrol - 15 per cent blend of methanol with petrol - on a pilot basis in Assam's Tinsukia district.

Let us hope that methanol will become a feasible and best alternative fuel to conventional fuels for green transition in future.


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MD – AMEA Veritas Petroleum Services. He has been involved in the management of fuel quality & quantity business for 30 years.

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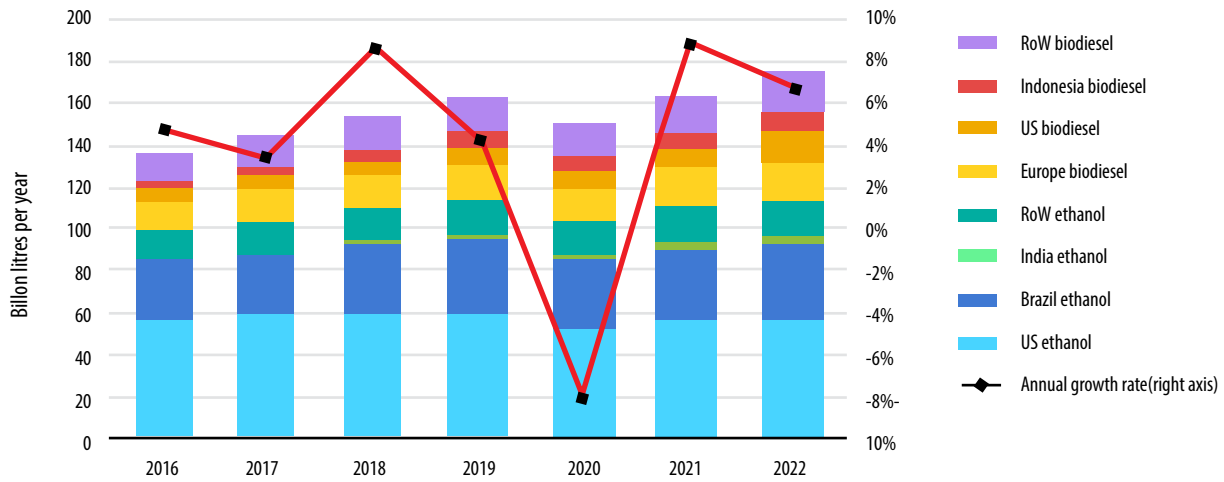
Additional Secretary General, Federation of Indian Mineral Industries (FIMI). He has more than 45 years of experience in mining and metal industry.

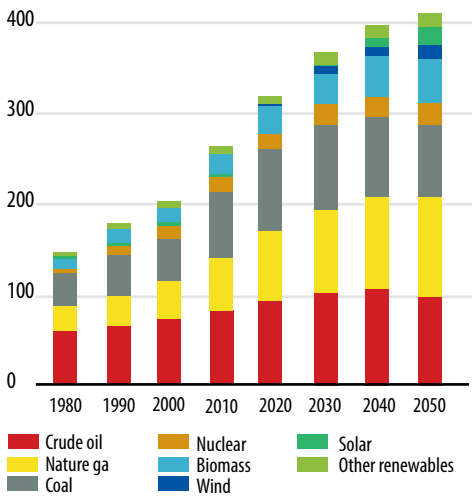
**Mr Sachin Kulkarni**
Head – Marine Power Sales (South Asia), Wärtsilä India Pvt Ltd. He has Joined Wärtsilä India in 1996 and associated with Marine industry since 2003.

## BIOFUEL PRODUCTION BY COUNTRY/REGION AND FUEL TYPE, 2016-2022

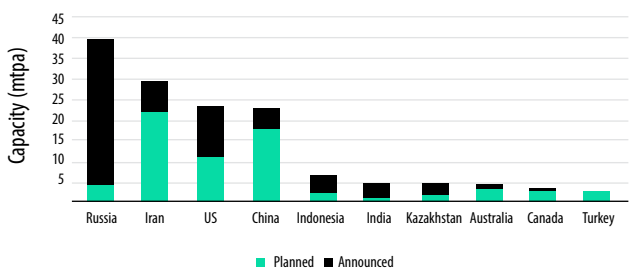



Source:IEA

## MILLION BARRELS OF OIL EQUIVALENT A DAY



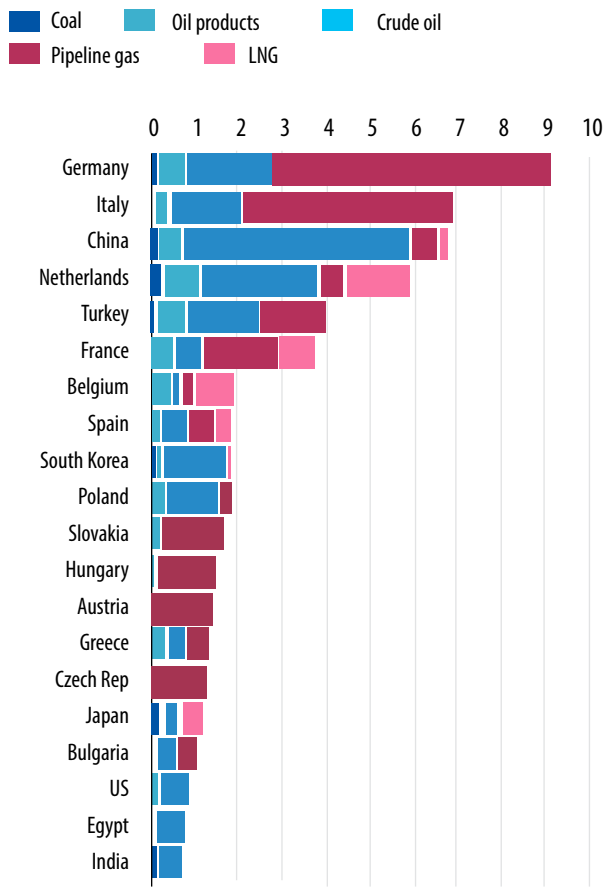

## GLOBAL PLANNED AND ANNOUNCED METHANOL CAPACITY ADDITIONS BY TOP TEN COUNTRIES (MTPA), 2030

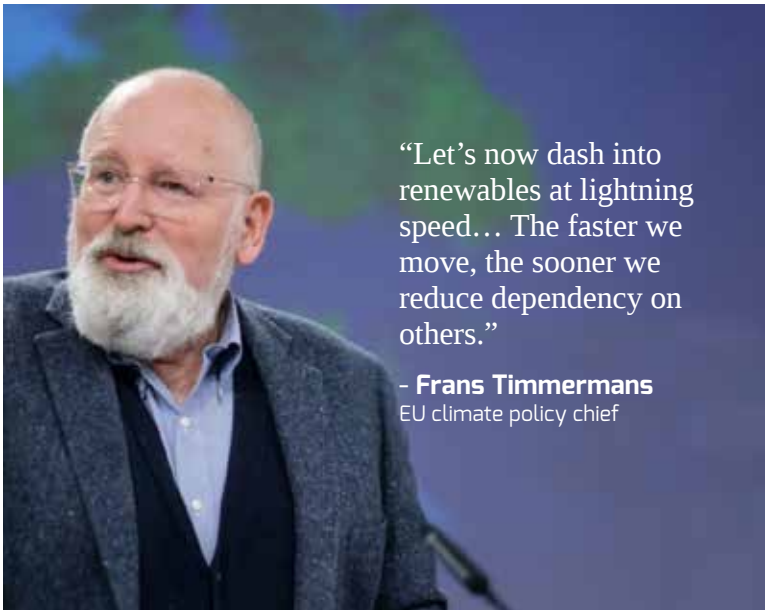



Source: GlobalData, Oil & Gas Intelligence Center

## GERMANY IS THE LARGEST IMPORTER OF RUSSIAN FOSSIL FUELS

€bn, in the two months since Russia invaded Ukraine





"Let's now dash into renewables at lightning speed… The faster we move, the sooner we reduce dependency on others."

**- Frans Timmermans**
EU climate policy chief

"We are at a crossroads. The decisions we make now can secure a liveable future. We have the tools and know-how required to limit global warming."

**- Hoesung Lee**
IPCC Chair

"This is also the time where we want our voice to reach the world in terms of what exactly is beyond COP 26 and how we work towards the COP 27 lined up later this year."

**- Leena Nandan**
Environment Secretary, India

"Methanol is the future of fuel in India, we are looking at conversion of coal, petroleum and natural gas to methanol so that LPG consumption would be reduced."

**- Dr V.K. Saraswat**
Member, NITI Aayog

"Unless we honour the promises made to turn the commitments under the Glasgow climate pact into action, they will wither on the vine."

**- Alok Sharma**
COP26 President

## MARINE

### World-first green hydrogen ferry project commences

Gladstone on Queensland's central coast is positioned to have one of Australia's first green hydrogen-powered passenger ferries after the state government promised $5 million from its $35 million Hydrogen Industry Development Fund (HIDF) for SeaLink to design and build the boat. The total cost of the project is estimated at $20.6 million. The vessel, that will be powered by hydrogen fuel cells, would operate as a shuttle between Gladstone and LNG facilities on nearby Curtis Island. SeaLink is part of the Kelsian Group. One of Australia's largest land and marine transport services.

### MOL orders four LNG-fueled ships

Japanese shipping company Mitsui O.S.K. Lines (MOL) has reached an agreement with compatriot Nihon Shipyard and Shin Kurushima Dockyard for the construction of four 7,000-unit capacity car carriers that will use environment-friendly liquefied natural gas (LNG) as their main fuel. The newly ordered ships are scheduled for delivery in succession, from 2024 to 2025. This will bring the company's total orders for LNG-fueled car carriers to eight. In September last year, MOL ordered the first batch of four LNG-fueled car carriers, which are slated for delivery in 2024. The units will serve Novatek Gas and Power Asia, part of Russia's PAO Novatek.

### CNOOC awards 12 LNG tankers construction contract

China National Offshore Oil Company (CNOOC) has awarded 16-billion-yuan ($2.42 billion) worth of contracts to build 12 liquefied natural gas tankers China is the world's largest buyer of the super-chilled gas, while CNOOC is the country's largest importer of the fuel and among the state majors leading a drive to expand their LNG fleet to meet rising import needs and facilitate fast-growing global trade. The 12 vessels will be built by Hudong Zhonghua Shipbuilding Co, a unit of China State Shipbuilding Corporation (CSSC).

### Esvagt contracts Cemre Shipyard to build green fuel SOV

Danish offshore shipping player Esvagt has contracted Turkey's Cemre Shipyard to build the world's first service operation vessel (SOV) that can operate on green fuels. The vessel will be powered by batteries and dual-fuel and pure methanol engines, and be capable of sailing on renewable e-methanol produced from wind energy and biogenic carbon, which should lead to a yearly emission reduction of around 4,500 tonnes of CO2. The 93m long SOV has been designed by Norway's HAV Design and will be built according to DNV class.

### ABS supports McAllister on sustainability journey

ABS is supporting McAllister on its sustainability journey with greenhouse gas inventory and sustainability reporting services for its fleet of more than 75 tugboats, crew boats and barges. ABS specialists worked with McAllister's team to calculate its operational carbon intensity and benchmark the performance of its fleet, leading up to an Environmental, Societal and Governance (ESG) report. The team helped McAllister establish a transparent governance and stakeholder engagement strategy.

### Large bore Wärtsilä engine launched to accelerate decarbonised operations

The technology group Wärtsilä announces the launch of the latest addition to its multi-fuel engine portfolio. The Wärtsilä 46TS-DF engine is designed with a focus on efficiency, environmental performance, and fuel flexibility signaling a new era of medium-speed marine engines. The engine's first order was placed by Chantiers de l'Atlantique for Royal Caribbean Cruises in April 2021. The engines will be installed on their latest Oasis class ship 'Utopia of the Seas'. The ship is being built by the shipyard Chantiers de l'Atlantique and will feature six Wärtsilä 46TS-DF engines with Gas Valve Units, NOx Reducer SCR systems, LNGPac and Transverse Thrusters.

## MINING

### Anglo American introduces biggest mine-haul truck

Mining giant, Anglo American has unveiled the world's biggest hydrogen-powered mine haul truck. The massive truck is three stories tall and weighs in at over 220-tonnes. The truck is said to have entered operations at Mogalakwena PGMs mine in South Africa. The nuGen prototype is said to be the first of a large fleet, said to replace the company's conventional diesel-powered trucks. The hydrogen truck is powered by a 1.2 MWh battery pack, with eight fuel cells producing a total output of 2,682 BHP.

## Use of green hydrogen tested by ArcelorMittal

World's second-largest steelmaker, ArcelorMittal has successfully tested the use of green hydrogen to reduce iron ore at one of its industrial sites in Canada. The company claims it as a milestone for the industry. Engineers at the company's operations at Contrecoeur in Quebec replaced about 7 per cent of the natural gas typically used to reduce iron ore with hydrogen made from renewable electricity during the 24-hour test earlier this month. Arcelor partnered with a local hydrogen producer that uses electricity from the Quebec grid, which is powered by renewable hydroelectricity, to source the gas.

**LNG**

## Australian R&D puts low-cost hydrogen within reach

Australian hydrogen technology developer Hysata says its breakthrough puts within reach the cost of producing hydrogen at a cost competitive with gas – $2 per kilogram. Hard-to-abate sectors including steel manufacturing, heavy transport and chemical production are predicted to be major customers, with Hysata forecasting "skyrocketing" demand for electrolysers. Hysata's electrolyser splits water into hydrogen and oxygen molecules with unprecedented efficiency, opening a path to producing cost-effective, zero-emissions fuel when the device is powered by renewable electricity.

## Bosch to invest for the development of hydrogen electrolyzers

German conglomerate Bosch said that it will develop components for electrolyzers in the future. The Stuttgart-based group wants to invest up to €500 million ($527.6 million) in the new business area by 2030. The particular focus will be on the development of the stacks for electrolyzers. Bosch wants to develop electrolyzer stacks with control units, power electronics, and sensors for smart modules. It will also work with partners to achieve this. The smart modules will be delivered to manufacturers of electrolysis systems and industrial service providers from 2025. Bosch said the first pilot plant is scheduled to go into operation by as early as next year.

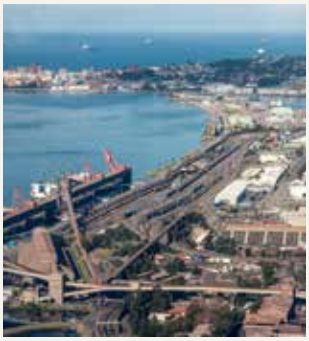
## CF Industries plans to build low-carbon ammonia plant in US

Fertilizer maker CF Industries Holdings expects a roughly $2 billion price tag for a US plant it plans to build with Mitsui & Co to produce low-carbon ammonia for fuel. The project aims to meet rising global demand for clean energy. The companies will share the cost, with CF Industries owning 52% of the intended joint venture and Mitsui owning the rest. CF Industries has cash on hand thanks to booming prices for fertilizer recently. Sanctions against exporters Russia and Belarus over Moscow's invasion of Ukraine have tightened global fertilizer supplies and boosted prices.

## Pure Hydrogen seeks leading role in Indian hydrogen market

Pure Hydrogen is looking to take a leading position in India's hydrogen sector by forming a joint venture with global automotive component manufacturer Advik Hi-Tech Pvt. Ltd. The company already has links with Advik through its investee company H2X Global – which it has a 24% stake in – that had reached a similar JV for the manufacture, source and supply of products and components for hydrogen vehicles and powered products for India and for other international markets. With this connection already in place, Pure Hydrogen has now signed a joint venture agreement to establish an Indian hydrogen production facility that will sell, transport and distribute hydrogen across India.The joint venture company (Pure Hydrogen 49%) will also supply hydrogen fuel cell electric buses and trucks in the country.

## Green hydrogen hub at the Port of Newcastle set for phase 1 construction



The Port of Newcastle Green Hydrogen Hub Project received a further vote of confidence following an announcement by The Hon Angus Taylor MP, Minister for Industry, Energy and Emissions Reduction that the project will receive $41 million in funding. The project is a joint venture with Macquarie Capital and Macquarie's Green Investment Group and is currently progressing an ARENA funded feasibility study. The project is being developed with a phase one minimum 40MW electrolyser that over time could increase to a capacity of over 1 GW.

## GSC develops ammonia-ready LNG-fueled panamax

Japan's Planning and Design Center for Greener Ships (GSC), in cooperation with member shipbuilders, has developed an ammonia-ready LNG-fueled Panamax bulk carrier.The ship's design was approved in principle (AIP) from the classification society ClassNK recently.

## First hydrogen-powered car in India makes entry into Kerala

India's first hydrogen-powered car by Toyota made its way in to State of Keral. The Regional Transport Office in Thiruvananthapuram gave registration to a red colored Toyota Mirai. The registration was done online without any vehicle tax. The car bearing registration number KL 1 CU 7610 comes with a green number plate similar to the one provided to electric vehicles (EVs). Toyota Kirloskar brought this all-hydrogen electric vehicle to the state on an experimental basis. The cost of the car is $0.014 million.

## First hydrogen FCV is ready for development at Cochin

In an effort to initiate green shipping, the Ministry of Ports, Shipping and Waterways in India has planned to develop and build Hydrogen Fuelled Electric Vessels (FCV) at Cochin Shipyard Ltd (CSL). It is the first indigenous Hydrogen FCV to be developed in the country. The FCV development is expected cost about $0.23 million of with 75% would be fundec by the central government, and the it will be based on Low Temperature Proton Exchange Membrane Technology (LT-PEM).

## MOL to build green hydrogen plant

Hungarian oil and gas company MOL announced plans to build a EUR 22 million ($23.14 million) green hydrogen plant at its refinery in Százhalombatta, south of the capital. The hydrogen plant, fueled with electricity produced from renewable resources, will turn out 1,600 tons of hydrogen a year, making it one of Europe's biggest green hydrogen production facilities. It will reduce MOL's CO2 emissions by 25,000 tones. The company will use US company Plug Power's technology at the plant which will start operating in 2023.

**METHANOL**

## Alfa Laval joins the Methanol Institute

As an enabler in the marine industry's transition to green methanol as fuel, Alfa Laval becomes a member of the Methanol Institute. Founded in 1989, the Methanol Institute serves as the global trade association for the methanol industry, representing the world's leading methanol producers, distributors and technology companies. Alfa Laval is supporting it with essential technologies, which makes joining the Methanol Institute a logical step.

## LR awards AiP to e1 Marine's methanol to hydrogen generator

e1 Marine M-series methanol to hydrogen generator has received Approval in Principle (AiP) for marine applications from Lloyd's Register, a leading class society. The AiP represents an important landmark for demonstrating the compliance of e1 Marine's technology with all applicable regulations, codes, and standards. This will act as a springboard for enabling the demonstration of the generator across different maritime sectors, from ports and towboats to offshore and deepsea vessels. Lloyd's Register has also confirmed that final approval for the technology is possible, including for inland waterways, when following Inland Waterway regulations.

## IOC introduces methanol-blended petrol

Indian Oil Corp (IOC) rolled out M15 petrol with a 15% blend of methanol over petrol on a pilot basis in Assam's Tinsukia district. In the presence of Niti Aayog member VK Saraswat and IOC chairman SM Vaidya, Union Minister of State for Petroleum and Natural Gas Rameswar Teli launched the M15 petrol. The pilot rollout was done in Tinsukia by the company due to the ready availability of methanol, which is being manufactured by Assam Petrochemical Ltd in the vicinity of Digboi refinery.

## GSI launches sea trials on Stena Pro Patria

Guangzhou Shipyard International (GSI) has commenced sea trials of the first Chinese-built methanol-driven dual-fuel tanker called Stena Pro Patria. GSI secured a contract from Proman Stena Bulk, a joint venture of Swedish firm Stena Bulk and Swiss firm Proman, for the construction of three 49,990 DWT dual-fuel tankers. The other two ships, named Stena Pro Marine and Stena Prosperous, are currently under construction and expected to be completed by the end of the year.

## Port of Gothenburg plans to become bunkering hub for methanol

By 2030, the Port of Gothenburg has set out an ambitious target to reduce shipping emissions by 70% within the port area. One key step to reach this goal is to provide a variety of shipping fuels that contribute to bringing down emissions – in the port as well as on a global scale. The shipping industry needs a variety of fuels in the future, and renewable products like e-methanol are important to achieve net-zero targets. Therefore, the Port of Gothenburg is also making arrangements to set up a value chain with the determination to provide e-methanol in the port by 2024.

# BIOFUELS

## Ethanol mixed petrol in India will come into use within 6 months

The Central Government is all set to promote ethanol as an alternative fuel in coming times. According to a statement made by Nitin Gadkari, Union Minister of Road Transport and Highways in SIAM annual convention 2021, the ministry will be expanding the network of ethanol pumps across the country in the next six months. For this move, the Central Government has already ordered the petroleum companies of the public sector to start ethanol pumps in the regions where ethanol is already available. To match the progress, automakers should also start developing new vehicles with flex-fuel engines.

## US EPA recognizes canola for its GHG emissions reduction

Canola's contribution as a solutions-provider in helping to address climate change was recently recognized, with the US Environmental Protection Agency (EPA) proposed decision that canola oil-derived renewable diesel, jet fuel and other biofuels qualify as "advanced biofuels" under the Renewable Fuel Standard (RFS) program. The proposed decision found that greenhouse gas (GHG) emissions from renewable diesel, jet fuel and other fuels derived from canola oil were more than 50 per cent lower than petroleum-based fuels.

## Ethanol blending in petrol reached 9.99% in India

The level of ethanol blending in petrol in India has reached 9.99 per cent, Petroleum Minister Hardeep Singh Puri said. India had targetted 10 per cent ethanol blending in petrol by the end of 2022 and 20 per cent blending by 2030. The Centre has also targetted 5 per cent blending of biodiesel with diesel by 2030. The ethanol blending programme is aimed at reducing the country's dependence on crude oil imports, cutting carbon emissions and boosting farmers' incomes.

## India, Italy to explore biofuels, green hydrogen sectors

India and Italy have agreed to explore joint efforts in sectors of green hydrogen, energy storage, and biofuels sectors. The decision came to the table at a meeting between External Affairs Minister (EAM) Dr. S Jaishankar and his Italian counterpart Luigi Di Maio. Both the diplomats also took note of New Delhi and Rome's closer industrial ties in the defence sector.

## Maruti Suzuki planning to launch E20 fuel compliant cars

India's largest carmaker, Maruti Suzuki is preparing to launch multiple powertrain technologies to regain the lost market share. A new media report claims that Maruti Suzuki is on track to launch E20 material compliant vehicles by 2023. Adding to it, the company will also launch cars with strong hybrid powertrain in the near future.

# HEAVY OILS

## Germany top buyer of Russian fuels

Germany was the biggest buyer of Russian energy during the first two months of the war in Ukraine, an independent research group said. A study published by the Centre for Research on Energy and Clean Air calculates that Russia has earned 63 billion euros ($66.5 billion) from fossil fuel exports since Feb. 24, the date Russian troops attacked Ukraine. Using data on ship movements, real-time tracking of gas flows through pipelines and estimates based on historical monthly trade, the researchers reckoned Germany alone paid Russia about 9.1 billion euros ($9.56 bn) for fossil fuel deliveries – mostly natural gas – in the first two months of the war.

## MAN awards 'no objection' to cylinder oils

Shell Marine's Alexia 40 XC cylinder oil, Chevron Marine Lubricants' Taro Ultra Advanced 40 and ExxonMobil's Mobilgard 540 AC 40BN marine cylinder oil have all received a no objection letter (NOL) from Man Energy Solutions (MAN ES) for use with the OEM's marine engines.

## Russian fossil fuel exports increased since Ukraine invasion

A latest report by a Finland-based think tank has revealed that the fossil fuel exports have been one of the key factors in the Russian invasion of Ukraine. The Centre for Research on Energy and Clean Air in its report has delved into the fossil fuel exports by Russia, of which the European Union has been a key beneficiary. This comes at a time when United Nations chief Antonio Guterres tweeted accusing fossil fuel lobby of using Ukrainian conflict in own interest.

## Japan to ban Russian oil imports

Japan will ban Russian crude oil imports "in principle," as part of a Group of Seven (G7) campaign to counter Russia's invasion of Ukraine, Prime Minister Fumio Kishida said after an online meeting of G7 leaders. "For a country heavily dependent on energy imports, it's a very difficult decision. But G7 coordination is most important at a time like now," Kishida said, according to a statement released by the government.

## UK exempts Ukraine from ban on offering fossil fuel energy

The UK will exempt Ukraine from its ban on providing public support for fossil fuel energy overseas as ministers try to make sure services can continue to operate during the conflict with Russia. It comes as ministers announced that hundreds more generators are to be delivered to Ukraine to keep hospitals, shelters and phone masts operating as Russia continues to bombard the east of the country. UK Business Secretary Kwasi Kwarteng said the energy-related announcements were part of policies aimed at "ramping up" support for Kyiv.

**BUNKER**

## Bunker exports take a dip in China

China's exports of marine fuel in March plunged 15% from a year ago, customs data showed. The exports were hit by high prices and Covid-19 curbs at domestic ports.March shipments were 1.42 million tonnes, data from the General Administration of Customs showed. Most of this was very low-sulphur fuel oil (VLSFO), with a maximum sulphur content of 0.5%, to meet the emission rules of the International Maritime Organization. The volume was up from 1.31 million tonnes in February but was lower than 1.68 million tonnes in March 2021.

## Unitrove bags hydrogen bunkering grant in UK

Clean energy technology company Unitrove has been awarded £30,000 (€36,000) Transport Research and Innovation Grant (TRIG) from the UK government to develop its mobile unit for liquid hydrogen bunkering to fuel zero-emission ships. Unitrove first presented its mobile unit at COP26 in 2021, and in December 2021, announced a development partnership with cryogenic gas processing equipment producer Nikkiso Cryogenic Industries' Clean Energy & Industrial Gases Group (CE&IG).

## Inaugural barge-to-ship LNG bunkering operation completed

The largest Jones Act-compliant LNG bunkering barge has completed its inaugural bunkering operation in Jacksonville, Florida. The 5,500 cubic meter capacity Clean Canaveral operates as an articulated tug barge unit ("ATB") and is owned by Polaris New Energy, a subsidiary of Seaside LNG Holdings.

**POLICY**

## India has no problem if Tesla produces EVs in the country: Gadkari

Union minister Nitin Gadkari said if the US-based Tesla is ready to manufacture its electric vehicles in India then there is 'no problem' but the company must not import cars from China. The road transport and highways minister said his request to Musk is to come and manufacture in India. At present, cars imported as completely built units (CBUs) attract customs duty ranging from 60-100 per cent, depending on engine size and cost, insurance and freight (CIF) value less or above $40,000.

## EU to speed up renewable energy projects

The Ukraine-Russia conflict is bringing Europe to expedite renewable energy expansion in the region that will just enable the European Union to end its dependence on Russian gas and oil. In a fresh development, the European Commission may propose a new framework that will fasten the permitting system for renewable energy projects in the member countries.

## Blueprint for Mumbai's net zero vision revealed

India's financial capital Mumbai, considered amongst the most vulnerable cities globally to hazards of climate change is charting out a blueprint of becoming the first South Asian city to achieve net-zero carbon emission status by 2050. The plan is ambitious but the city hopes to be net zero carbon 20 years before the target year that India has set for itself. Creating a favourable eco-system for e-mobility will play a key role in implementation, and already the main civic bodies, the Brihanmumbai Municipal Corporation is working out the modalities of the plan.

## Tamil Nadu will announce green fuel policies

Tamil Nadu (TN) government announced that new policies will be formed for Green and Blue Hydrogen and Ethanol. The Industries Department will draft a policy on Green Hydrogen as the state is getting many proposals for investment. The upcoming policy will give some clarity on Green Hydrogen. The new policies will be in line with the Union government's initiative to transition from fossil fuel to future fuels.

**TECHNOLOGY**

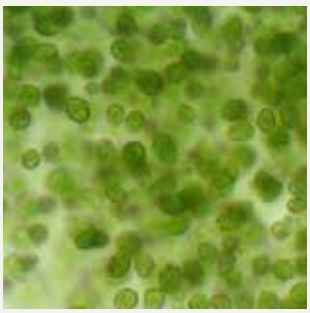
## Indian scientists developed hydrogen using hybrid material

A group of Indian scientists have designed a hybrid material which can absorb the Greenhouse Gas (GHG) methane and convert it to clean hydrogen. They have also simulated a process of capturing carbon dioxide and converting it to high-purity hydrogen. The scientists from the Indian Institute of Chemical Technology (IICT), Hyderabad, have also set up a facility to test such materials and perform carbon capture research in the institute.

## L&T to collaborate with IIT Bombay for green hydrogen

Larsen & Toubro (L&T), an Indian multinational engaged in EPC Projects, Hi-Tech Manufacturing and Services, signed an agreement with the Indian Institute of Technology Bombay (IITB) the nation's premier technology and research institution to jointly pursue research and development work in the Green Hydrogen value chain. Both the institutions have joined hands to contribute towards development of the Green Hydrogen industry in India and to develop next-generation technology in this emerging field.

## Research finds green fuel can be produced from micro-algae



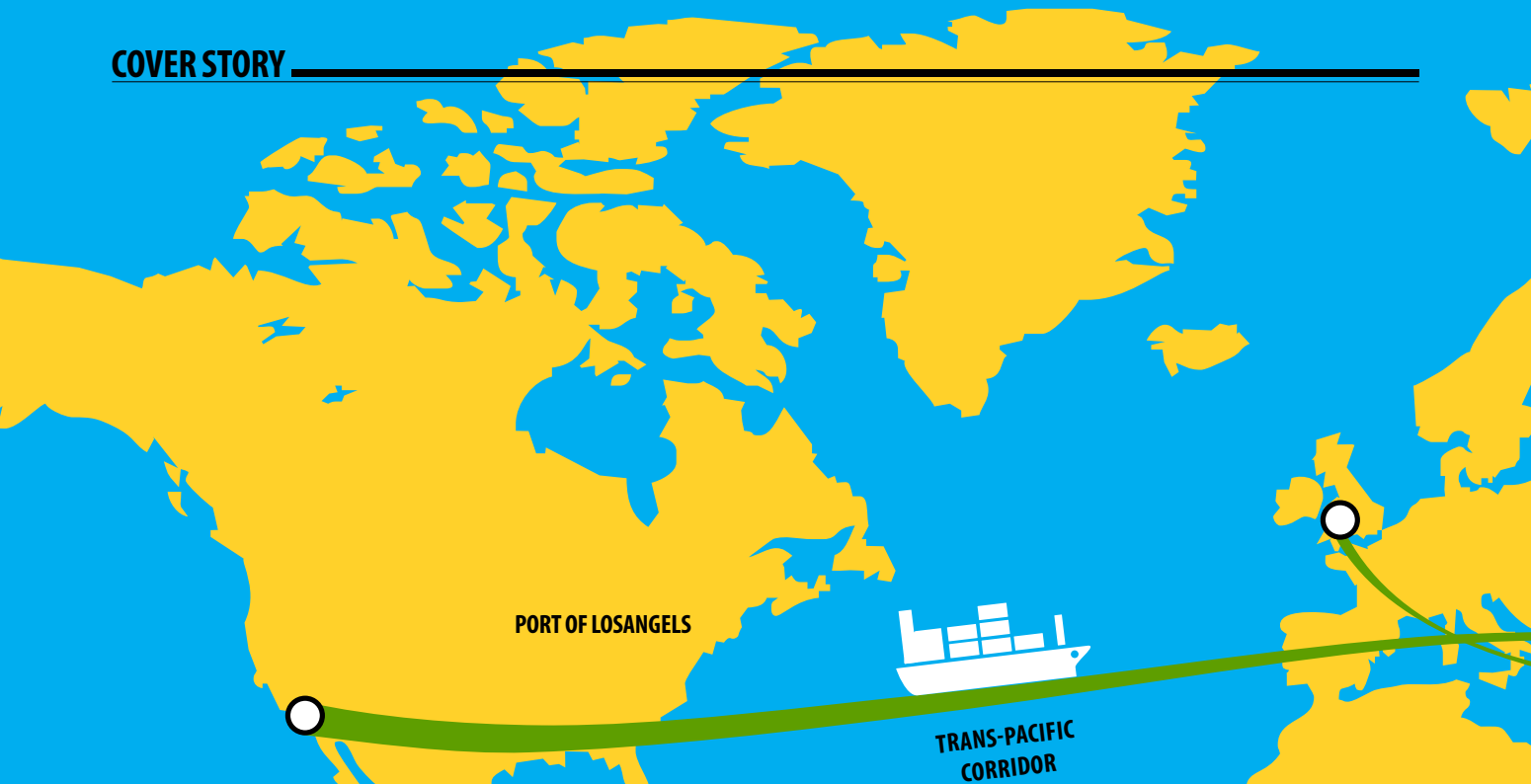
A new discovery at Tel Aviv University (TAU) may greatly speed up the industrial transition from the use of polluting gray hydrogen to the green gas. Doctoral student Tamar Elman, under the supervision of Prof. Iftach Yacoby from the renewable energy laboratory of TAU's Wise Faculty of Life Sciences, published the study in the prestigious journal Cell Reports-Physical Science under the title "Enhanced chloroplast-mitochondria crosstalk promotes ambient algal-H2 production." In the study, the researchers identified a mutant of a known strain of microscopic algae that allows, for the first time, the production of green hydrogen gas via photosynthesis on a scale suited to industrial requirements.

## Conversion of plastic waste into low-carbon hydrogen fuel

Scientists from Nanyang Technological University have found a way to convert plastic waste into low-carbon hydrogen, which is considered a cleaner fuel than natural gas. The discovery, which could power vehicles and contribute to the power grid in as soon as three years, comes as the Republic looks to adopt hydrogen as an alternative fuel, as it does not produce carbon dioxide (CO2) when burned.

## Researchers found catalytic carbon dioxide reduction to methanol

Researchers at Stockholm University have for the first time been able to study the surface of a copper-zinc catalyst when carbon dioxide is reduced to methanol. The results are published in the scientific journal Science. A better knowledge of the catalytic process and the possibility of finding even more efficient materials opens the door for a green transition in the chemical industry.




## ZERO EMISSION SHIPPING?

# GREEN CORRIDOR SHOWS THE WAY

Green corridors in shipping is one of the best ways to deal with increasing carbon emissions, as it could offer high-impact opportunities and a great deal to generate momentum towards decarbonization.

Shipping sector accounts for a large chunk of global trade and it is slated to expand further in future. According to International Maritime Organization (IMO), a UN specialized agency with responsibility for the prevention of marine and atmospheric pollution, ships emit over 1 billion tonnes of greenhouse gases every year, or just under three percent of global emissions. Without further action, shipping emissions are projected to rise by at worst 30 percent by 2050, compared to 2008 levels. Sensing the imminent danger for climate, the IMO has mandated emission reductions of 50 per cent for all vessels by 2050.

In order to find the best possible ways for decarbonization of maritime sector, governments and industry are progressively looking to simplify that task by establishing 'green corridors. They are specific routes where the economics, logistics and politics of zero-emission shipping are more

feasible and rapid deployment can be supported by policy and industry action.

In the COP26 Global Climate Summit held last year at Glasgow in the UK, several world leaders have given commitment for decarbonisation and for that signed a declaration to support the establishment of green shipping corridors. They have collectively supported the establishment of at least 6 green corridors by the middle of this decade.

The UK announced the launch of the Clydebank Declaration at COP26 in Glasgow in November 2021. The signatory states declared their desire and intent to support the establishment of green shipping corridors – zero-emission shipping routes between 2 ports.

"There's no incentive to switch to new fuels and build zero-emissions vessels now. Declarations like Clydebank are trying to create those incentives but they are not enough in themselves," said **Aoife O'Leary, a long-time IMO observer and head of Opportunity Green,** a non-profit focusing on international climate issues, including shipping. "But they will help build up momentum for policy that can make it happen," she added.

## What are green corridors

In fact, the term 'green corridors' actually mean the pathways or cycle routes running through a city that are rich in trees and plants, which offer benefits to residents and natural wildlife. The concept was initially applied by the European Union (EU) way back in 2007 with the objective to develop integrated, efficient and environment-friendly movement of freight between major hubs and by relative long distances.

Green shipping corridors are like special economic zones at sea. The companies deploy new technologies and business models at full scale, interacting with each other and with regulations and incentives tailored to their efforts.

> Green Corridors can help simplify the challenges of zero-emission shipping, bringing solutions to the water faster and at a meaningful scale. The maritime ecosystem is embarking on a journey to a transformed, zero-emission shipping sector. The task ahead is complex, but not impossible.
>
> **JOHANNAH CHRISTENSEN**
> CEO, Global Maritime Forum.

The Port of Los Angeles and the Port of Shanghai are the first international ports to team up for the creation of a 'green shipping corridor'. This corridor will have far-reaching consequences for the ocean freight shipping sector.

The primary aim of the partnership is to lower the emission of greenhouse gases for moving cargoes between the largest ports in the US and China. The corridor also known as Trans-Pacific corridor, is the world's busiest cargo route. In 2020, ships moved 31.2 million 20-foot unit containers – 21% of the world's total – across the Pacific Ocean.

The corridor has strong first-mover potential because it carries out liner trade, which means goods are transported along a fixed route on a regular schedule.

"International collaboration is essential to decarbonise global supply chains. It's time to get started on this important work," said **Gene Seroka,** the **Executive director of the Port of LA.**

The idea of green corridors is to shrink the challenge of coordination between fuel infrastructure and vessels, in the value chain and between countries, down to a more manageable size, while still retaining the scale necessary to create impact.

## Objectives of green corridors in shipping

The major decarbonization goals for the green shipping corridor include, the introduction of ships with extremely low or even zero carbon emissions. Moreover, there is a focus on the use of zero-cargo freight ships.

Another objective is to come up with sound management principles. The aim is to reduce emissions and enhance the efficiency of the ships that ply in international shipping corridor.

"The green corridors will allow countries to identify which decarbonisation solutions are scalable," said **Katherine Palmer, shipping lead on the UN High-Level Climate** Champions team. They are a "testbed" that provide "an evidence base to show policymakers what is possible," she added. "They give them confidence in what can be done."

The partnership aims to lower the supply chain emissions from the ports. The goal is to lower the pollution in and around the ports.

## How green shipping corridors could work

Green corridors in shipping will enable useful conditions for decarbonization, as they would allow policy makers to make an enabling ecosystem with targeted regulatory measures, financial incentives, and safety regulations.

They could also consider regulations and incentives to lower the cost of green-fuel production, which could in turn help to mobilize demand for green shipping. Green corridors could create secondary effects that reduce shipping emissions on other routes. For example, once the

infrastructure to provide zero-emission fuel for one green corridor is in place, it can then be used for shipping on other, adjacent routes.

"Green corridors will enable us to go from ambition to action. However, there will still be a cost gap between fossil-based shipping and zero-emission shipping of the order of 25% to 65%. Targeted government action to close that cost gap on corridors could pay big dividends for the transition overall," said **Faustine Delasalle, Co-Executive Director of Mission Possible Partnership.**

What green shipping lines will look like is still to be seen, but the selection process is vital for the initial green corridors. Four important aspects are must for potential green corridors including stakeholders that are committed to decarbonization, and are willing to collaborate across the value chain, a viable fuel pathway, customer demand for green shipping and initiatives to pool demand, and policy and regulation that can narrow cost gaps and expedite adoption.

### Promising shipping routes for developing green corridors

Australia-Japan iron-ore corridor is one of the largest dry-bulk trade routes in the world that exports about 65 million tonnes of iron ore annually from Australia to Japan. As a potential first mover corridor, the route benefits from favourable production conditions for green hydrogen production, with companies active in Australia already having announced plans to build approximately 30GW of hydrogen electrolyser capacity by 2030, with much of this capacity located near to the centres of iron ore production and ports from which it is shipped.

Given that zero-emission shipping fuels are likely to be derivatives of green hydrogen, investors in zero-emission ships on this route could potentially benefit from security of supply and cost advantages.

> By convening international coalitions of the willing and creating a scalable and replicable model for other cities to follow we hope this ground-breaking green shipping corridor initiative will catalyze action on a global scale…Accelerating efforts to decarbonize the shipping sector is urgent if we are to limit global heating to 1.5 degrees
>
> **MARK WATTS**
> Executive Director, C40 Cities.

Nonetheless, zero-emission ships here as everywhere will be more expensive to operate than fossil-fuelled vessels – we estimate a 50-65% increase in the total cost of ownership for vessel operators in 2030. The cost gap can be reduced, however, by forming joint ventures and/or utilising innovative mechanisms to share costs and emission reductions among the relatively few companies in the value chain along this route. Additionally, policy mechanisms such as contracts for difference can also be used to bridge the cost gap. If such a mechanism specifically targeted this route, it could bridge the entire cost gap at an annual cost of $250-350 million.

The Asia-Europe container corridor is another largest shipping lane in the world, that generates more GHG emissions than any other single global trading route. This route too is a promising candidate for developing a green corridor.

The route has multiple potential bunkering ports, so that fuel supply could originate from Europe, the Middle East or Australia. Given the announced hydrogen electrolyser capacity by 2030 across the three regions have already exceeded 60GW, fuel supply is likely to be available for initial decarbonization efforts on the route. Additionally, there is growing demand for decarbonization across the route's value chain, including cargo owners. Moreover, the characteristics of a significant part of the freight shipped on the route can allow cargo owners to share costs with end consumers without significant increases in retail prices.

### Issues and challenges in establishing green corridors

There are several issues on path to establishing green shipping corridors and one such issue the shipping industry is facing today is its own research having shown that zero-emission vessels need to be entering the world fleet by 2030. This in turn requires shipping to be planning and building new shipboard solutions and land-based infrastructure immediately.

There is a problem, however, since zero- emissions solutions have so far only been deployed in niche applications, such as remote ferry routes in Scandinavia, while solutions for large scale ocean shipping are not yet established. This dilemma has created uncertainty across the sector, with lots of different alternative fuels and propulsion technologies – and evolutionary pathways to arrive at the same – under discussion.

There is a need for reliable and impartial guidance in the face of so many conflicting opinions on alternative ways to decarbonise, for the benefit not only of ship owners and operators but also fuel suppliers, shipbuilders and equipment manufacturers, policymakers and regulators, financiers and insurers, and more.

According to the experts in the industry, future fuel is going to be much more expensive than current fuel so some sort of policy lead is necessary to close the gap. The use of technologies such as electrolysis or direct air capture / carbon capture and storage to produce zero carbon fuels is still lacking in "demonstrations of application at a scale than can be used

for shipping. So, more work is needed, particularly for hydrogen, ammonia and methanol.

Moreover, there is the supply vs. demand problem that new fuels will not be made available until there are ships that can use them, and vice versa.

Of course, ports have a role to play as well in shipping's decarbonisation effort. Reducing dwell times of ships by advising them well in advance on when they should arrive at berth for fastest turnaround – so-called Port Call Optimisation – is just one solution, with electrification of port equipment and use of solar energy other developments that are increasingly taking place.

## Framing policy for green shipping corridors

Given the diverse nature of shipping industry, governance of shipping is primarily the domain of international regulations and policies set by the IMO. In order to achieve decarbonisation, the IMO has set an aspirational goal of emission reductions of 50 percent for all vessels by 2050. The target is not net-zero aligned and there have been calls from industry for the IMO to set more ambitious reduction goals. There have also been several calls by industry to accelerate decarbonisation through the introduction of some form of global carbon taxation or levy on the shipping industry. Such measures would be the most powerful driver of industry decarbonisation, but their prospects remain uncertain, and first movers on zero-emission shipping will have to manage this uncertainty.

Therefore, catalysing green corridors is specifically proposed regardless of the global framework, and the focus of it will be on regional, and potentially route-specific, policy and regulatory measures that will be essential for the creation of green corridors. The IMO is also a key player in determining future fuel pathways for international shipping based on its ability to approve global fuel standards and safety regulations. Of the fuel pathways that have been introduced, methanol has been given interim approval by the IMO for use as a safe ship fuel. Other fuels, such as synthetic diesel, could require a new certification process since additives or different sealings in the engine system might be needed for safe operation.

> Green corridors is a targeted area where fuel production and port infrastructure can be built up super quickly and efficiently and where safety procedures and regulations can be put in place,
>
> **APARJIT PANDEY**
> Shipping lead at the Energy Transitions Commission.

The IMO has not yet approved safety and fuel handling guidelines for ammonia and hydrogen, however, and use of either as a marine fuel requires special approval from the relevant regional regulatory authorities.

## Way forward for shipping industry

Recently, Five Northern European port authorities announced that they are joining in partnership with the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping to lay the foundations for a green corridor serving Northern Europe and the Baltic. It will kickstart this ambitious initiative with the port authorities of Gdynia, Hamburg, Roenne, Rotterdam, and Tallinn. The project is designed to demonstrate the early commercialization of alternative fuel supply chains and provide a roadmap to scaling the supply chains and create a blueprint for rolling out green corridors in other locations.

"Developing green corridors are instrumental in activating industry first-movers across the value chain, and this project can be used as industry references to develop blueprints for new business models and identify the maritime industry's interdependencies. We hope this project will also help facilitate the important work with maritime standards at the EU and IMO," said **Bo Cerup-Simonsen, CEO of Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping.**

Creating green shipping corridors is an important step to allow the early adoption of long-term decarbonization solutions for international shipping, especially along major routes.

Full decarbonisation necessitates the development of alternative and innovative green technologies and fuels. The first results are promising, especially for smaller ship sailing on short routes. The use of "drop-in" alternative fuels, for example, can start reducing emissions immediately. R&D spending has to increase considerably and technologies have to be mature before they can be applied, also to deep sea shipping. To achieve these efforts by all maritime stakeholders are needed.

The international associations representing the shipping industry submitted a joint proposal to IMO to establish a $5 billion maritime R&D fund, financed by the shipping industry via a surcharge on bunker fuels.

Shifting to smart and safe zero-emission shipping is possible but it requires a radical change throughout the whole maritime industry and its supply chain, from fuels producers to the engineers on board. The shipping industry embraces these environmental challenges and is also ready to contribute financially to these long-term goals through the dedicated maritime R&D fund proposed to the IMO. FF

# ‘Main challenge in the transition to zero carbon future is the lack of clear pathway’

**Mr Kari Hietanen,** Executive Vice President, Corporate Relations and Legal Affairs, Wärtsilä in an exclusive interview with Future Fuels shares his thoughts green transition in Europe.

**Q. What are the technical solutions Wartsila offers for the green transition?**

Wärtsilä has a wide range of technologies enabling green transition both in marine and energy sectors.

In marine sector the decarbonisation measures include decarbonisation of the power trains, energy efficiency and savings and optimisation of the whole logistic chain. Wärtsilä has solutions for all these measures. We can already today provide engines capable of running on carbon neutral fuels and hybrid solutions and our goal is to provide engines capable of running on zero carbon fuels. Our portfolio includes many technologies providing energy savings. We offer retrofits, guarantee of performance, and also data driven solutions for optimizing fleet and vessel operations. We believe that there is no single solution to decarbonise the marine sector, instead it requires a wide range of different measures.

Wärtsilä is also in key position to lead the transformation towards 100% renewable energy future. Wärtsilä offers future-fuel-enabled balancing power plants, hybrid solutions, energy storage and optimisation technology, including the GEMS energy management platform. Wärtsilä Energy’s lifecycle services are designed to increase efficiency, promote reliability, and guarantee operational performance.

**Q. Will the climate targets set with fit for 55 proposals help Europe meet the carbon neutrality by 2050?**

Fit for 55 package is a wide regulatory package, which is meant to support the EU’s GHG emissions reduction targets by 2030. EU’s climate targets 2030 are kind of mid-targets in the way to carbon neutrality by 2050. In this context the Fit for 55 package will at least try to create a regulatory framework aimed at safeguarding the necessary GHG emissions reduction.

**Q. What is the pace of green transition in Europe with the latest transition measures?**

The ambition level is high and there are many on-going developments in various sectors. Decarbonisation of economies require however huge changes in infrastructure, technologies, and business models. Some crucial elements need to exist until the other developments can take place. E.g. decarbonisation of the power systems requires major renewable capacity additions on annual basis. Green electricity is needed also for alternative fuels production. In that sense the pace could be quicker.

**Q. What are the main challenges in the transition to zero carbon - and what solutions have caught your attention?**

The main challenge in the transition to zero carbon future is the lack of a clear pathway. The change cannot happen overnight due to, for example, lack of zero carbon fuels or proper infrastructure. We need to remember that it is equally important to focus on the transition period as it is to focus on the end goal. Future-proof technologies, such as engines capable of running on different fuels, enable the transition to decarbonised shipping and 100% renewable power systems.

**Q. Will the Russia-Ukraine conflict impact the climate targets set in Europe?**

In general, Russia’s attack to Ukraine impacts on many sectors, including energy supply. It is still difficult to estimate the impact to the upcoming directions, but presumably this may accelerate the development and usage of green energy. FF

# ‘We will have to wait till 2024 to know which fuel will be more beneficial’

In an exclusive interview with *Future Fuels*, **Mr Indra Nath Bose,** Advisor, the Great Eastern Shipping Company Ltd, shares his views on the energy transition in shipping industry in general and its impact on the Indian coastal ships in particular.

**Q. Marine industry’s current worry is the impending regulations that are for milestones of 2030 and 2050, what do you think is happening to meet the deadlines of 2030, especially with reference to marine industry and Indian ship-owners’ perspective?**

2030 is a short-term goal where IMO has got a GHG reduction strategy, which was framed in 2018. That says the energy intensity i.e., the grams of CO2 emitted per tonne/mile of cargo carriers or transport work must reduce by 40% by 2030, compared to 2008 base level. So, we are talking about this particular goal. There are a couple of regulatory measures; one is Energy Efficiency eXisting ship Index, (EEXI) which at present about 68% of bulk carriers worldwide will not meet that standard without doing certain technical modifications like fitting energy saving devices, or reducing the engine power. So similar is the situation among the Indian fleet and Indian register shipping deals with Indian fleet very much. So, their estimation is that most of the Indian vessels averaging about 17% will require reduction of main engine power ranging from 25% to 45%.

The second one is an operational carbon index. That means what we talk about EEXI is a design index which we do it one time, that has to be done in 2023, and it remains unchanged. The other one is operational per tonne mile of unit carriage transport work. How much CO2 you are emitting and your emission should be below or benchmark is like telling a car owner it’s okay you have bought Bharat IV and this is your standard, but every year you have to reduce your CO2 per tonne mile. So, accordingly ships have to be operated to make sure that emissions don’t exceed that benchmark. It’s a very harder task than EEXI which is a simpler task than CII which is an operational one. It’s going to have a lot of implications on commercial operations of the ships, because ships are chartered out with chartered parties you will have different kind of agreement with to say that ships can maintain a particular rating which is permitted by law, otherwise you will get inferior rating and you will have to do certain corrective measures.

For Indian ships being older profile ships there will be more problem here and Indian ship owners will have to take all kinds of actions to reduce their energy consumption and do everything possible from fitting energy saving devices to changing the electric lights to LED lights, then using antifouling coatings, operational measures, taking care of the hull, propellers, etc. All these things have to be done to make sure you remain in compliance with regulatory requirement for CII rating.

**Q. The big shipping lines have started off using LNG as fuel, we have seen exclusive LNG-fuelled ships. Another major shipping line has started using methanol as its fuel. What is the story with LNG and methanol and where do we progress after these two fuels?**

I need to describe a little bit about fuel. Today, we use fossil fuel which we pull out from underground and use it. It is a combination of hydrogen and carbon. Fuel will continue to be hydrogen and carbon but the feedstock used for producing that fuel, and production pathway will be different from what it is fossil fuel today.

For example, to have a green fuel like green methanol, green ammonia, and green hydrogen you need to have green energy. That means it must come

from renewable sources like wind and solar power. Feedstock you use must come from renewable sources, for example split the water which consists of hydrogen and oxygen split it to get the hydrogen and use that hydrogen. Use carbon from biological sources or capture the carbon air directed or from funnel of some existing plants and use that carbon in manufacturing fuel. Same is the process for green methanol and green ammonia.

Right now, methanol is already being used in engines for last five to six years and about eight product tankers are using it. As methanol is the most transported chemical in the world, they take it from cargo and use it, and that methanol is produced from LNG, and it can also be produced from coal. So, they don't give you environmental benefit, the benefit will come if you use green methanol.

Now some container and shipping lines are trying to develop green methanol with green sources of energy in seven different parts of the world. Methanol is a viable fuel it's easy to handle compared to ammonia and hydrogen which have a lot of safety concerns. We can see methanol being in use in 2050 in good measure, but that will be green methanol.

For LNG there is a lot of debate about environment benefit of it. Today, we are measuring carbon footprint of a marine fuel based on how many grams of CO2 has been emitted for burning one gram of fossil fuel on the ship, we are not bothered about how much CO2 has gone out in production, refining, and transportation. Some of the fuels in production pathway will have a lot of emissions. If you make the methanol from coal, it's no environmental benefit there.

So, to capture this IMO is developing a Life Cycle Assessment (LCA) of Carbon Capture and Utilization guideline, and each of the fuel based on feedstock and production pathway will have a carbon emission factor from production to ship tanks and from ship tanks to propeller.

Right now, methanol is already being used in engines for last five to six years and about eight product tankers are using it. As methanol is the most transported chemical in the world, they take it from cargo and use it, and that methanol is produced from LNG, and it can also be produced from coal.

So combined we will know how much CO2, methane, NOx and all sustainability issues will be captured. This guideline will tell us which fuel is more environmentally beneficial than the other and they will be listed out. This is under development and the work has already started on these two or three months ago and some data already available now, but not much data on the green production path are available yet.

It will be available by 2023 or 2024 where we can judge whether LNG is giving benefit to us or not. So, those who have invested in LNG is it a problematic investment? This is questionable, because there are certain people in the industry sector who believe that LNG is not an answer. It is a fossil fuel after all and you are locking your investment for another 20 to 30 years and that's not good for the earth. There are some sections of people in the industry are saying that at least LNG is giving some benefit, and what is happening in exploration and production is a global issue and not just for shipping, so we are promoting LNG everywhere. So, these are the two interest groups, and only after the LCA guidelines comes in we will know how much beneficial or not we will have a clearer view.

**Q. Does that mean we will have a clear picture by the first quarter 2024 that which fuel will be more beneficial?**

Yes, what is being developed is a sort of an interim guideline and it is being said that this will be updated as more information and data comes in, meanwhile a lot of research will be going on actually measuring, and we will put in only the fuel for which has confirmed values are available, because ship owner is investing for the next 25 to 30 years in a ship lifetime. So, we will have a more confirmed future fuel to be used by 2024, going by the present developments.

**Q. Could you please tell us what will be the impact of CII and EEXI on coastal ships?**

As I said in the first question, the ships are older and EEXI applies to some of the ships, however, it won't apply to tugs and dredgers, it only applies to bulk carriers, tankers, gas carriers, and container ships for these main ship types there is a reference line or standard it's already there in MARPOL convention.

So, for those ships EEXI will have significant impact as power will be limited unless the ship owner goes for retrofitting energy saving devices, but that commercially may not be viable because of the remaining life of the vessel. If the remaining life is very short it doesn't make any sense in investing money in that. So, the choice will depend on ship owner on case-to-case basis for a ship. More ships will be reducing their engine power and that way more ships will reduce their speed and therefore, there will be a shortage of tonnage, and you may need more number ships to complement that.

CII is an operational carbon intensity of the ship. Every year you have to calculate how much the ship has emitted, and whether it has met the benchmark or not. If it is inferior then it has to take corrective action to bring it back. Just to add to that, this is valid until 2026 calendar year. As of now we have 2% carbon reduction target every year from 2023 to 2026 calendar year beyond which 2027 to 2030 is not decided. It will be decided in 2025 based on how the shipping world performed in 2023, and 2024 calendar years and these will be taken to decide on further reduction measures. FF

# ROLE OF BIOFUELS FOR ENERGY TRANSITION IN SHIPPING

Biomass has the potential to supply the marine sector with sustainable fuel and is a promising solution for both reducing net carbon emissions and meeting sulphur regulations

Biofuels are transportation fuels such as ethanol and bio-based fuels made from biomass materials. In many cases, these fuels are blended with fossil fuels (gasoline and distillate diesel fuel and heating oil) but they can also be used independently.

These fuels consist of many promising candidates and are closer to commercialization than other alternative fuels/technologies such as ammonia, hydrogen or batteries for marine vessels. Moreover, compatibility with existing fleets is a big asset for several (diesel-type) biofuels, making biofuels a promising short- to medium-term solution to reduce the carbon footprint of the maritime sector and to meet more stringent sulphur regulations.

Biofuels are considered to be carbon-neutral because the carbon dioxide that is absorbed by the source of the biomass is equal to the carbon dioxide that is released when the fuel is burned. With increasing demands for reducing greenhouse gases emitted from ships by oceangoing shipping around the world, biofuels are currently attracting attention as an alternative fuel for ships to replace heavy oil.

The benefits of biofuels have to some extent been recognized by the maritime sector, where the interest in biofuels in the last 5 years have been visible through progress in engine development, in sea-going biofuel trials of blends, as well as in 100% biofuel trials. However, greater use of biofuels in the sector is limited by the volumes presently available with delays in commercialization of technologies. This report seeks to uncover the largest barriers for the commercialization of biofuels for the marine sector, as identification of the current barriers will excel concrete actions from various stakeholders advancing the employment of sustainable biofuels in the maritime sector.

Of late, several shipping industry stakeholders identify biofuels as the most promising short- to mid-term solution for both for reducing carbon emissions and meeting sulphur regulations. With increasing international stringency on sulphur emissions and ship energy efficiency, the price gap between fossil fuels and biofuels is declining. Especially in some local markets where elevated pricing – due to long distance to major fuel hubs – combined with CO2 pricing and additional hedging cost savings, unite to provide a real opportunity for biofuels to compete with the fossil alternatives.

The capesize bulker Friendship, owned by Seanergy Maritime and chartered by NYK, has collaborated with global mining company Anglo American completed a trial using biofuel to transport cargo in March 2022.

French shipping and logistics major CMA CGM with the support of the Maritime and Port Authority of Singapore (MPA), started biofuel bunkering in Singapore as part of its global trial to scale up the wider adoption of clean energy. The 6-month global trial will involve up to 32 containerships running on different blends of biofuel to measure carbon dioxide (CO2) and nitrogen oxide (NOx) emissions in order to obtain a trend analysis, which will be shared with the respective flag administration including MPA. Some of these vessels will be fuelled in Singapore with B24 biofuel, which comprises 24% used cooking oil methyl ester (UCOME) in the advanced biofuel blended with conventional fuels. FF

# Can methane slip be controlled?

A small but significant amount of unburnt methane ends up in the atmosphere – more commonly known as methane slip. Gunnar Stiesch, Head of Engineering Engines at MAN Energy Solutions shares more information.

**Q. When we talk about methane slip, the stress is always placed on prevention. Why is this so crucial? Is there no way to recapture methane like the direct air capture of carbon, to put the proverbial genie back in the bottle?**

Once the methane is out, the quantities and concentrations in the atmosphere are so low that it's close to impossible to get a hold of it again. So no, unlike carbon dioxide, recapturing methane isn't feasible.

We also have to keep in mind that carbon dioxide stays in the atmosphere for several thousand years, while methane has an average atmospheric lifetime of only around 12 years. Then it naturally decomposes into water vapor and carbon dioxide. This means that direct prevention offers far more opportunities to control methane in the atmosphere – which is why we need to address the issue of methane slip quickly. Using technical solutions to reduce methane slip can have a real impact on climate change and our environment.

**Q. To date, MAN Energy Solutions has managed to reduce methane slip in their ME-GI two-stroke dual-fuel engines to a range between 0.2–0.3 grams per kilowatt hour. How much lower can that number go?**

Well, we can get that number even lower, sure, but we have to remember that when we look at the entire greenhouse gas impact of these engines it's already close to negligible. Upgrades will definitely have lower values in the future, but our main focus is addressing those engines that still have a higher methane slip. For example, Otto-cycle dual-fuel engines have an inherently higher methane slip than our Diesel-cycle ME-GI. To minimize this as much as possible, we're using our well-proven exhaust gas recirculation (EGR) technology on our Otto-cycle ME-GA engines.

**Q. Two of the options MAN Energy Solutions is pursuing with these engines are direct gas injection and aftertreatment with an oxidation catalyst. How's the assessment going so far?**

Direct gas injection is technically feasible: Four-stroke engines can run with high pressure gas injection on the Diesel combustion scheme that two-stroke ME-GI engines are already running today. And the resulting methane slip would be in a similar range, lower than for Otto cycle gas engines. But under the current framework and boundary conditions, it's not a cost-competitive solution for four-stroke engines. FF

*Source: MAN Energy Solutions*

# 'India is on the right path towards energy sustainability for future'

**Mr Gurmeet Singh,** Director General of Federation of Indian Petroleum Industry (FIPI), in an exclusive interview with *Future Fuels* shares the challenges ahead for Oil Marketing Companies (OMCs) in India and how they are getting ready for the decarbonisation.

**Q. What is the role of FIPI in the decarbonisation efforts?**

Federation of Indian Petroleum Industry (FIPI) is an apex Society of entities in the hydrocarbon sector and acts as an industry interface with Government and regulatory authorities. It supports the Government in resolution of issues and evolution of policies and regulations. The Federation of Indian Petroleum Industry firmly believes in evidence-based policy advocacy. Over the last few years, FIPI has successfully engaged itself in studies and seminars aimed towards responsible used of fuels, clean energy and decarbonisation.

FIPI has been engaged into various knowledge seminars to discuss the pathways towards energy transition. FIPI undertook studies such as:

Gas Roadmap Vision 2030: The study was undertaken to chart pathways for moving towards a gas-based economy, reducing the use of polluting fuels and increasing the share of Natural Gas in India's energy mix from the present 6.5 per cent to 15 per cent.

Natural Gas for Power Generation: This study proposed various routes for mainstreaming of natural gas in power generation mix and reducing dependence on coal.

FIPI also undertook studies such as study on Impact of Electric Mobility on India's Oil & Gas sector and LNG as a fuel for long distance transportation to evaluate the decarbonisation options in the mobility space.

FIPI is currently undertaking studies on – Role of Natural Gas in mitigating industrial air pollution and emerging Hydrogen markets in India. These studies are also targeting promotion of clean fuels which will be key for decarbonisation.

**Q. Recently after COP26 climate summit at Glasgow, the approach to move on the path of decarbonisation has gained impetus from several sectors. So, can India achieve Net zero target by 2070 in oil sector?**

India's announcement that it aims to reach net zero emissions by 2070 and to meet 50% of its electricity requirements from renewable energy sources by 2030 is a hugely significant moment for the global fight against climate change.

The clean energy transition in India is already well underway as it has achieved its commitment made at COP 21- Paris Summit by already meeting 40% of its power capacity from non-fossil fuels- almost nine years ahead of its commitment and the share of solar and wind in India's energy mix have grown phenomenally.

Further, Government has laid down various initiatives like One nation one grid, National Hydrogen mission, Ethanol blending programme, SATAT (bio gas) scheme, Ujjwala Yojna, FAME (EVs) scheme

etc to ensure efficient, sustainable and clean energy system for India in future.

To achieve net zero emission by 2070, many Indian oil and gas companies have already stated plans to cut carbon emissions. Companies are reviewing its strategies and supply chain to compete in the new market dynamics. They have responded in many ways like:

Diversifying business models to capture opportunities around electrification, electric mobility, coal-to-gas switching or lower GHG-intensity oil and gas as a complement to renewables.

Supporting the decarbonisation technologies including carbon capture, utilisation, and storage (CCUS); methane efficiency; and hydrogen.

Adopting climate-focused Environment Social Governance (ESG) principles into business models;

Thus, with widespread use of renewable energy sources, led by solar power, and other low-cost solution in the form of alternate fuels including-electric fuel, ethanol, hydrogen, methanol, natural gas (CNG/LNG) etc, India is on the right path towards energy sustainability for future.

**Q. What impact does decarbonisation have on the oil sector business?**

The government of India's target for 20 % ethanol blending in petrol to 2025 is aimed at reducing the country's oil import bill and carbon dioxide pollution. This initiative is also part of measures to improve energy security and self-sufficiency measures.

India's per-capita energy consumption is about one-third the global average, creating the need to invest in building a wide variety of fuels to meet the anticipated growth in consumption.

With rising energy consumption base and progressing towards energy transition, oil and gas industry will remain a vital part of the global energy mix by adopting and positioning itself to provide lower carbon energy products to consumers around the world.

The target to achieve 20% ethanol blending with gasoline to 2025 from the previous target year of 2030 will help in reducing import dependence on crude oil. The country is already one of the world's largest producers of modern bioenergy and has big ambitions to scale up its use across the economy.

Further, accelerating the gas initiative in line with the aim to raise the share of gas in the overall energy mix to 15% by 2030 from the current level of 6%, would also mean initiatives to boost country's city gas distribution network in order to expand the use of cooking fuels, as well as initiatives such as LNG trucking.

Also, many refiners are looking towards clean source of opportunities emerging in low-carbon markets, including renewable power, bioenergy, next-generation mobility, energy services, and hydrogen.

Thus, oil sector business will adapt and bring in synergies with the low carbon fuel technologies to position itself in the energy transition scenario.

**Q. India is planning to introduce E20 from 2025, will it benefit the country go green and depend less on oil imports?**

The government of India's target for 20 % ethanol blending in petrol to 2025 is aimed at reducing the country's oil import bill and carbon dioxide pollution. This initiative is also part of measures to improve energy security and self-sufficiency measures.

According to Niti Aayog reports, immense benefits can accrue to the country by 20% ethanol blending by 2025, such as saving Rs. 30,000 crore of foreign exchange per year in terms of crude oil imports, lower carbon emissions, better air quality, energy security, and self-reliance.

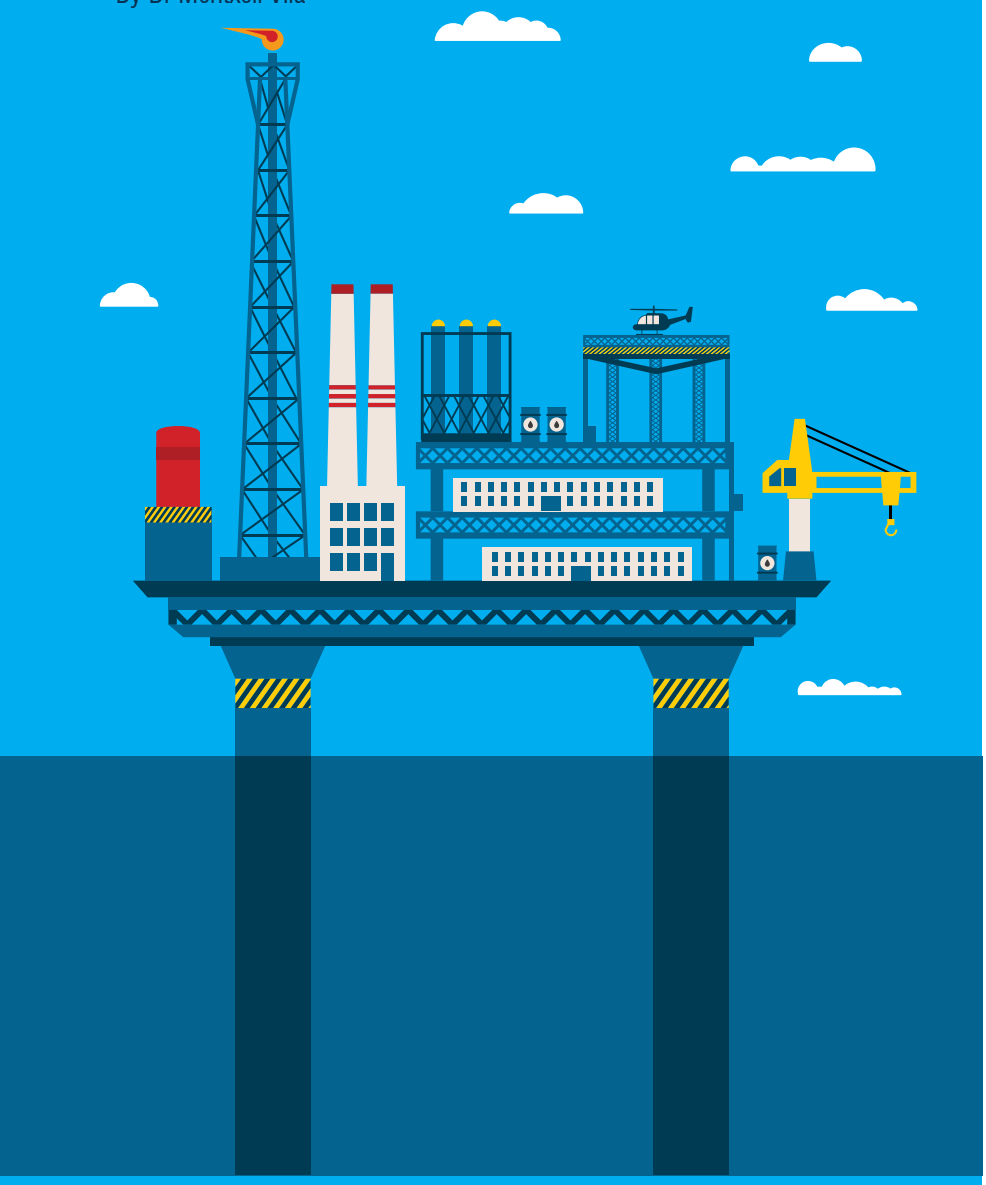
Further, the use of ethanol-blended petrol reduces emissions of some regulated pollutants such as carbon monoxide, hydrocarbon, and nitrogen and can help in complete combustion.

These biofuels can thus be environmentally friendly as well as sustainable energy sources and can help generate employment, promote Make-in-India. FF

# Catalysts and adsorbents in the energy transition

Catalysts and adsorbents play a crucial role in the energy transition, from the development of biofuels and the circular economy to green hydrogen production.

By Dr Meritxell Vila



Energy transition means the shift from current energy production systems, which are based mainly on non-renewable energy sources (oil, natural gas and coal), to energy systems based on renewable energy sources. Catalysts and adsorbents, used in around 90% of current industrial production processes, are therefore key players in the energy transition. They will be responsible for new processes, or must be improved or modified for current processes.

**Catalysts by themselves are essential in the energy management of chemical refinery**

Catalysts are the main energy savers of the industry. Therefore, their role in the energy transition is crucial. With the energy transition, there is a change in fuel demand compared with chemical derivatives. Environmental protection legislation and the increase in consumption of chemicals from developing countries could set the stage for a future world with lower demand for transportation fuels and higher demand for petrochemical feedstocks. This demand is also favoured due to the higher margin of petrochemical products. Catalysts and adsorbents in crude oil to biofuels and crude oil to chemicals (COTC).

The main objective of a COTC refinery is to convert oil to chemicals, from a traditional refinery conversion of 8-12% to more than 50%, even to 70-80%.2 To achieve this ambitious modification, researchers, catalysts companies and licensors have been working hard for many years to develop different proposals.

**Direct processing of crude oil in steam cracking:** This process requires preconditioning of the crude oil before being fed into the steam cracker to avoid too much coke formation. The steam cracker requires a packing bed and a catalyst bed. This catalyst bed may be disposed of at the bottom of the vaporiser to enhance cracking, and

will help to remove metals such as Ni, Fe, V and trap non-vapourisable material such as asphaltenes. Materials such as alumina, silica-alumina, molecular sieves and natural clays may be used. Industrial references for this technology come from ExxonMobil (Singapore refinery) and Shell.

**Integrated hydroprocessing/ deasphalting and steam cracking:** Saudi Aramco has patented an integrated hydrotreating, steam pyrolysis and coker process for the direct processing of crude oil to produce olefinic and aromatic petrochemicals. In this scheme, the role of the hydrodemetalisation catalyst before the hydroprocessing catalyst is vital to protect it.

**Processing of middle distillates and residues using new hydrocracking ebullated bed technology:** This scheme has been adopted by Hengli Petrochemical Ltd to produce diesel and naphtha range stream, which can later be processed to produce aromatic compounds. In these new COTC schemes, the most affected processes produce naphtha, which is the source of olefins and aromatics, feeds to chemicals.

These processes are fluid catalytic cracking (FCC) and hydrocracking. In hydrocracking, new developments present ebullated catalytic beds, as in Axens H-Oil process.7 In this process, fresh catalyst is continuously added to the reactor, and the spent catalyst is withdrawn to control the level of catalyst activity. This technology provides higher conversion and no limit on catalyst life compared to traditional fixed beds.

Other hydrocracking technologies with moving catalytic beds are LC-fining, from CLG, VCC from KBR, EST from Eni, Uniflex from UOP and ORH from TIPS RAS. In the last four technologies, the conversion reached of the residue with recycling is higher by 95% Regarding FCC trends, the selection of catalyst and optimal operation conditions are crucial to increasing the yield of propylene and naphtha.

Characteristics that need to be improved in this type of catalyst are metal poisoning tolerance, hydrothermal stability, fluidisation properties, attrition resistance and accessibility. Increasing the addition of ZSM-5 helps to obtain more propylene, but only to a certain extent.

In future refineries, the CO2 emitted will be captured and profited to produce hydrocarbons. In this respect, numerous catalysts are being developed to carry out the reactions of conversion of CO2 to hydrocarbons, via methanol or directly. For the first route, via methanol, several catalysts are needed: a metal oxide to convert the CO2 to methanol, a zeolite to convert the methanol to hydrocarbon, a noble metal with non-noble metal catalyst to convert the CO to methane, and an iron base catalyst to convert the CO to hydrocarbon.

For the direct conversion of CO2 to hydrocarbon, many catalysts based on the reverse water gas shift (RWGS) reaction and the Fisher-Tropsch synthesis reaction (FTS) are currently under research and development. These catalysts include zeolitic imidazole frameworks (ZIFs), covalent organic frameworks (COFs) and metal organic frameworks (MOFs), among others.

Production of biofuels and circular economy Another critical role for catalysts and adsorbents is producing biofuels, as many refineries are converting to biorefineries to adapt to new regulations and process not only biomass but also prepare to process recycled materials.

In this refinery configuration, pretreatment of the feeds to protect catalysts is crucial, and in this sense the role of adsorbents is very important.

Feeds that can be processed are vegetable oils and UCO (used cooking oil, animal fats, tall oil, and so on). In oils, we find phosphorus, metals, chlorine and other contaminants. Different adsorbents are used in different units in biorefineries, depending on the stream and the contaminant to be removed: resins, activated carbon, clays, silica gel and zeolites.

These refineries must also process pyrolysis oil feeds from plastic recycling. This oil contains various elements that were added to manufacture the plastic and must be now removed to protect the catalyst downstream. The challenge is to design catalysts that are resistant to all these contaminants.

**Production of green hydrogen**

Green hydrogen is produced by the electrolysis of water, meaning the breakdown of water molecules into the two individual elements, hydrogen and oxygen, and only electricity from renewable energies is used. Since electrocatalysts are needed, research in this field is enormous, especially as analysts estimate that clean hydrogen could meet 24% of the world energy demand by 2050.

Much research and development are being carried out on new catalysts for the production of green hydrogen. Swinburne University's Centre for Translational Atomaterials (Australia) and Shaanxi Normal University (China) are developing a new catalyst based on platinum (but scalable and produced by a low-cost calcination method) that can produce green hydrogen from seawater.

The prototype, called 'Ocean-H2-Rig', is a floating platform equipped with the single-atom platinum catalyst. Another exciting development is from the University of Delaware (UD), US, to produce hydrogen from water at ambient temperature and with a Cu-Ti catalyst at a rate twice as high as the conventional platinum catalyst. FF

*Source: Decarbonisation Technology*

# Can methanol be the fuel of future in maritime sector?

The usage of carbon-neutral methanol is likely to gain momentum, as maritime shipping transitions to become a greener industry. But what are its real advantages, and why methanol is so attractive.

Because of the International Maritime Organizations (IMO) decarbonization goals, the shipping industry has shown a keen interest in methanol. Most recently, Maersk, the largest container shipping line and vessel operator, signed a shipbuilding contract for the world's first container ship fuelled by carbon-neutral methanol. The vessel will be ready by 2023, and MAN Energy Solutions will be providing the engine.

If we are talking about green methanol that is synthesized from carbon dioxide and hydrogen, then we can actually achieve CO2-neutral combustion. Furthermore, methanol has some advantages concerning its emissions behaviour: There are fewer NOx emissions and no SOx or soot emissions for pure methanol combustion. So, there's great potential for methanol to play a key role in the maritime energy transition.

**Advantages of using methanol in shipping**

Methanol has several advantages as a carbon-neutral fuel. It can be produced using only renewable resources, such as sun, wind and biomass, along with carbon captured from power plants or taken directly from the air. And by adding water to the combustion process, methanol is able to meet the stringent emission limits of nitrogen oxide (NOX) Tier III regulation.

The first methanol two-stroke engine on board a ship has been at sea for more than four years and is operating well.

Moreover, with minor retrofits, methanol can be used with existing infrastructure. Compared to more conventional fuels, would drastically reduce carbon emissions anywhere from 65 to 95 percent, depending on how its produced.

Although the majority of methanol used today is still produced conventionally from natural gas, there is a great potential for it to become a carbon-neutral resource for the maritime energy transition. While the production costs will initially be higher than other alternative fuels, such as synthetic natural gas (SNG), its handling costs will be lower.

Methanol can be handled and transported under normal temperatures and pressure, and it's been a used for decades as a base chemical in many industries – which means that its storage, handling and properties are all known and documented. In fact, the only issues holding back its use, for example, as a fuel in cars, are toxicity and corrosiveness.

**Disadvantages of methanol as marine fuel**

Methanol as marine fuel also comes with certain disadvantages as well. It is a dangerous substance that comes with a relatively low flashpoint. Methanol is toxic when inhaled, swallowed, or handled, and the fuel increases the risk of corrosion. Therefore, the fuel must be handled carefully by the crew and additional protector systems must be put in place to ensure safety. However, these additional measures may result in increasing cost of the fuel. Methanol seems to be an exciting and very promising option with benefits to both the environment and the shipping industry. With enough support and bunkering development methanol could be a very attractive future marine fuel.

The cost factor is key thing that will determine the future of the fuel, as it is relatively high in price when compared the existing conventional fuels in the market. If level playing field for methanol is established then the fuel may well become a potential alternative to the fossil fuels. FF

# Can dual-fuel engines offer green transition in maritime industry?

Dual-fuel engines are exclusive because they can operate on both conventional fuels, and future fuels like methanol or gas fuels.

As the maritime industry explores different approaches towards decarbonization, dual-fuel engines are becoming increasingly prevalent in the build of new vessels since they are more environment-friendly than other alternatives. Ship owners are showing strong interest to install them to reduce vessels' emissions of greenhouse gases, to comply with the environmental requirements, set forth by the International Maritime Organization (IMO) for 2030 and beyond.

Vessels are largely divided into two groups including the ones built as per the IGC Code, and the others not built as per the IGC code. The former vessels are built to carry liquefied gases in bulk, and the latter vessels operate using dual-fuel engines that run on gases or low-flashpoint fuels.

**Manufacturers introducing new dual fuel engines**

Paving the way for the maritime energy transition in shipping are MAN Energy Solutions and Wartsila, and the other major producers of large marine engines are offering several types of dual-fuel engine that are specific to the type of fuel a vessel utilizes.

MAN has introduced three marine engines including MAN 51/60DF, MAN 28/32S DF, and MAN 23/30S DF.

The first engine type is a dual fuel engine that converts diesel or natural gas efficiently, and can switch from one fuel to another without any fluctuations in speed or output. It's also possible to easily upgrade our MAN 51/60 engine to dual fuel capability if necessary. Also available with two-stage turbocharging. The second engine is based on the MAN 28/32H workhorse, the MAN 28/32S DF can switch effortlessly from diesel fuel to gas and vice versa.

The third engine MAN 23/30S DF is designed after the proven classic 23/30H genset. Impressively powerful and completely reliable, it is cost-effective and also available as a retrofit option.

Swiss engine designer WinGD has confirmed an X-DF2.0 order for LNG dual-fuel, ammonia-ready vessels. Four 14,000 TEU container ships for Singapore-based Pacific International Lines (PIL), being built at the Jiangnan shipyard in China, will feature state-of-the-art WinGD X92DF-2.0 dual-fuel engines capable of operating on both gas and liquid fuels.

Signaling a clear commitment to the environment the engines will be fitted with WinGD's latest GHG emission reducing technology iCER (Intelligent Control by Exhaust Recycling) which delivers enhanced combustion control. This creates an energy consumption reduction of 3% in gas mode, and fuel consumption savings of up to 5% in diesel mode, while reducing methane slip by as much as 50% in gas mode.

The Wärtsilä 46TS-DF engine – the latest addition to the company's multi-fuel engine portfolio – can run on LNG, which reduces air pollutants as well as offers a viable platform for further decarbonization through the use of bio- or synthetic methane in the future. FF

# Cutting vessel fuel consumption and emissions with shore-power

Connecting to shore power when in port eliminates the need to use auxiliary engines to generate this electricity, reducing emissions and fuel costs as well as lowering OPEX.

By Tosten Büssow

Picture a container vessel with an hourly electricity demand of 4,000 kWh. On a 10-hour port stay that translates into enough electricity to power 10 average four-person households for a year. With shore power infrastructure available at the port and the right equipment and systems onboard vessels, instead of burning fossil-based marine diesel oil (MDO) in its auxiliary engines to meet this demand, a vessel can simply plug into the local grid.

**Maturing legislation is gradually levelling the playing field**

The problem in the past has been a classic chicken-and-egg situation: owners have not installed shore power onboard their vessels because ports have not been offering it. Ports on the other hand are competing on price and those that invest in the technology first need to have paying customers in order to generate a return on their investment.

Another factor that has hindered the adoption of shore power by ports is the fact that historically, electricity has been more expensive than MDO. But there are pioneers out there, such as the Port of Long Beach, which has been offering shore power connections for container vessels since 2014. Regulators around the world are taking action to secure a level playing field and most governments are now making it mandatory for ports to install shore power facilities and even co-funding projects as part of their decarbonisation efforts. There are hundreds of such projects on both US coasts, throughout Europe and at the large Asian port hubs.

**Standards already exist**

As most ports and vessels meet randomly, a common standard is needed to make sure vessels can plug in wherever in the world they are sailing to. The IEC 80005-1 describes a high voltage solution for container, RoRo and cruise vessels and LNG carriers and tankers, and this standard can also be applied to pure car truck carriers, RoPax vessels such as ferries and super yachts. The IEC 80005-3 standard regulates a low voltage solution for all vessels that need up to 1 MW shore power, for example bulkers or offshore vessels. Regardless of the solution in question, it must be approved by a classification society.

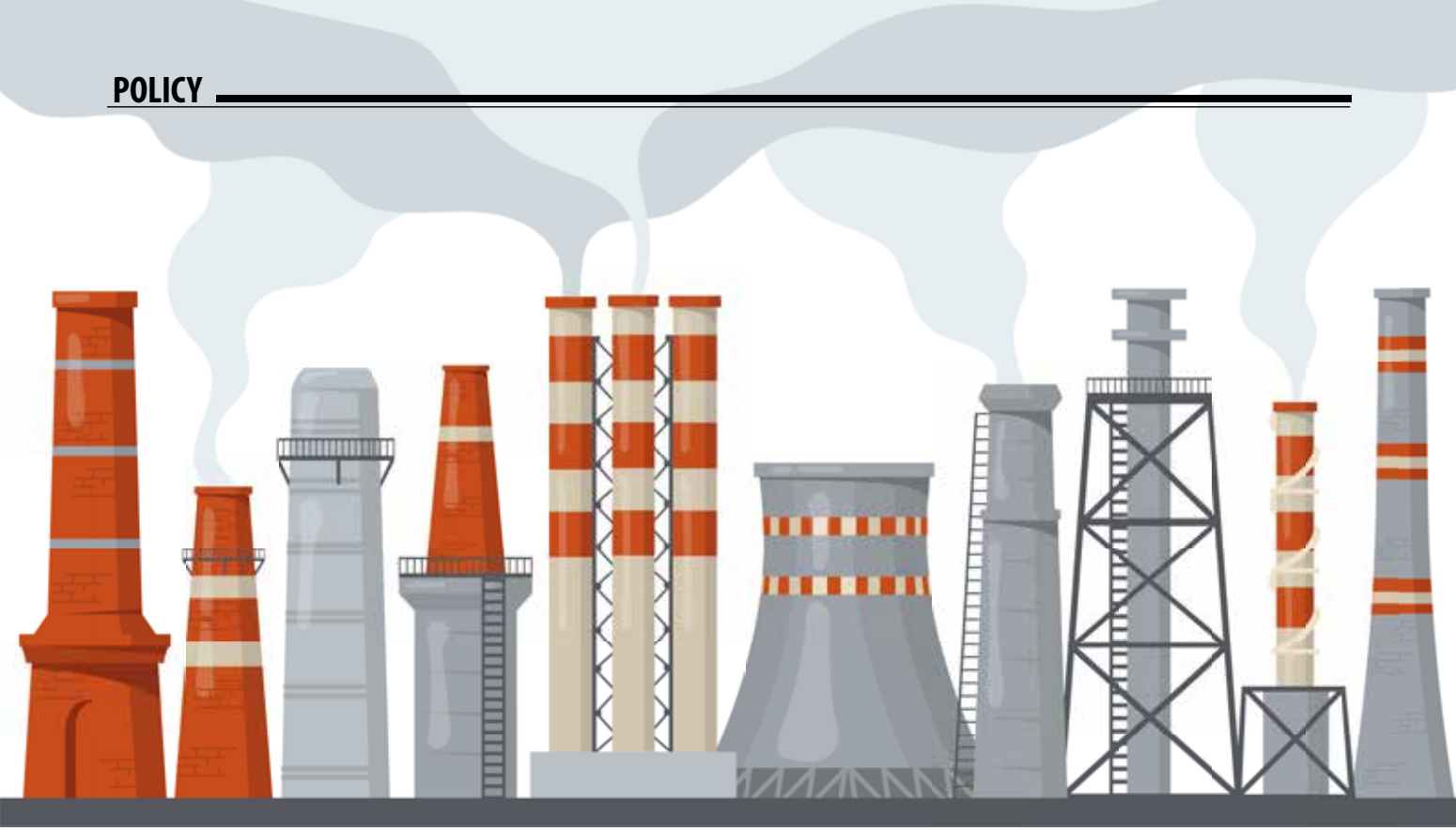
**Most vessels need medium voltage technology, which demands an experienced provider**

To transmit the needed power with a manageable current, the voltage needs to be high enough. The IEC Standard uses 6.6kV or 11KV (for cruise) connections, which requires a medium voltage switchboard, cables, connection points, transformers and so on, that is far beyond the capabilities of your local electrician. These kinds of projects demand an experienced electrical systems integrator and strict adherence to design rules and installation best practices to ensure a safe, functional and reliable system.

**Investing in shore power is a matter of compliance, not ROI**

Due to the fact that electricity has historically been more expensive than MDO, most investments in shore power today and in the future will be for compliance reasons. Ports are now investing in shore power facilities and it will gradually become mandatory for vessels to use them. This development will create the required level playing field between competing ports. We have seen this happening in California's ports in recent years, and many container and cruise terminals in China are following suit by requiring ship operators to use shore power. FF

*Source: Wärtsilä*



# India should focus on CCUS to realise netzero goals

Carbon capture and storage could well be the key to keep fossil fuel generators running while the country stays on track to achieve its climate goals.

The role of carbon capture, utilisation and storage (CCUS) has been a topic of debate for climate change mitigation across the world for several decades. The Intergovernmental Panel on Climate Change's (IPCC) Special Report on Global Warming of 1.5°C and the recent series of announcements by nations on netzero have stimulated the proponents of this technology, given the potential role offsets are expected to play in a netzero world.

However, the debate on CCUS in India has not been given a critical attention, but it is not new to the energy and climate policy space. In India, stakeholders have largely remained sceptical of the CCUS technology because of the negligible progress on the deployment of this technology in the last two decades, the perverse incentive it presents to postpone mitigation actions, and the potential increase in the cost of power generation if this technology is deployed. In contrast, CCS offers a lease of life to investors and corporations in fossil-energy-dependent businesses and could save them from massive disruptions required to achieve a low carbon future.

**Milestones in CCS developments in India**

There have been many key developments happening in the evolution of the CCS/CCUS debate in India. The establishment of the Indian CO2 Sequestration Applied Research (ICOSAR) Network by the Department of Science and Technology (DST), Government of India, in 2007 was one of the key developments to initiate and facilitate research dialogue on CCS applications among stakeholders.

**Current Scenario**

But in the recent times, much headway has been made in adding renewable capacity to India's generation mix, yet coal remains the baseload fuel with gas taking up an increasing share. Thermal power plants have been built to run for decades, and with sunk costs in the tens of billions of dollars, decarbonising by forcing them out of the electricity generation space into bankruptcy can weigh significantly on individual businesses and the broader economy alike. FF

# RELIANCE'S PLAN TO DECARBONISE TO MAKE IT A LEADER IN BLUE HYDROGEN

Reliance Industries has revealed a plan to repurpose its gasification assets at the world's largest refinery to become one of the world's largest producers of blue hydrogen.

Reliance, owned by Indian billionaire Mukesh Ambani, revealed recently that it planned to produce blue hydrogen at its Jamnagar oil refinery in Gujarat, India. The company will use syngas, which is already produced at the refinery's petroleum coke gasifiers, to make the blue hydrogen, with plans to implement a carbon capture and storage scheme to offset the emissions.

Reliance unveiled a $10 billion plan last year spanning renewables, storage and hydrogen, including what it claims will be the world's largest green energy equipment "giga-complex" and a 100 gigawatts capacity goal.

Ambani also announced in September last year that Reliance was aiming to bring down the cost of producing green hydrogen to under $2 per kilogram, while it has set a stretch goal of bringing that cost down to below $1 per kilogram within 10 years.

The refinery has an aggregate refining capacity of 68.2 million tonnes per annum and has the capacity to produce 1.06 million tpa of hydrogen. The company's plan to produce green hydrogen will make it one of the most significant blue hydrogen projects globally. The projects of similar scale include 1.5 million tpa H21 North of England scheme planned by Equinor, Cadent and North Gas Network, and Air Products' 660,000 tpa Louisiana Clean Energy Complex in the US.

Reliance believes it will be able to produce blue hydrogen at a "competitive cost" of between $1.2 and $1.5 per kilogram. However, the final cost will depend on a number of factors, according to analysts.

According to the analysts, CCS deployment has been highly dependent on carbon pricing in the other parts of the world, unlike India, where the carbon pricing mechanism is yet to be decided. There are other factors to be accounted for, such as carbon dioxide concentration, which determines the energy required to capture CO2.

According the analysts, it is premature to predict the cost of blue hydrogen at this facility in India now as it would depend on several factors.

Reliance revealed in its presentation that hydrogen production from gasification provided a highly concentrated CO2 stream, which it said presented "a unique opportunity" to capture roughly 15 million tpa of CO2 at 30% of the "typical cost" of carbon capture. But the gasification of petcoke is one of the hard-to-abate sectors for emissions, as the application of CCS has been highly effective with high-concentration syngas. FF

# Decarbonizing the automobile industry with alternative fuels

To minimize the carbon footprint of cars, manufacturers must focus not only on production, use, end-of-life phases and improving fuel efficiency, but also plan on reducing NOx, SOx, CO2 and other particulate emissions.

From exhaust fumes to infrastructure in the form of the roads on which they run, the carbon footprint of automobiles on the earth's environment has always been huge. Automobile production burns humongous amounts of energy even before the final products come onto the roads. This is because materials such as rubber, steel, glass, paints and plastics need to be manufactured before an automobile rolls out of the factory.

In the European Union (EU), with transport being responsible for almost 30% of the total CO2 emissions, where road transportation shares about 72% of the blame, the EU's goal for 2050 is to reduce transport emissions by 60%.

To minimize the carbon footprint of cars, manufacturers must focus not only on production, use, end-of-life phases and improving fuel efficiency, but also plan on reducing NOx, SOx, CO2 and other particulate emissions, extending the life of automobiles and components, and recovering, recycling and reusing the various materials of the vehicles.

Two obvious methods come to mind for minimizing CO2 emissions from automobiles. One is to make them more efficient and the other is to change the type of fuel.

One of the most effective ways to tackle CO2 emissions is the introduction of Electric Vehicles (EVs). Best example is the EU, where stringent CO2 standards have been recently proposed and good sales of Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) are expected to replace the more conventional Internal Combustion Engine (ICE) vehicles. The EU regulatory framework provides credits to BEVs as they are considered zero emission vehicles. However, BEV operation being emission-free is a moot point as it consumes electricity and the supply of electricity releases CO2.

A methodology called Life Cycle Evaluation (LCA) has been developed to assess the environmental impact made by a product, process or service during its life cycle. A complete LCA could measure emissions from the raw material extraction and processing stage to components manufacturing, transportation and distribution, product assembly, product use, and right up to end-of-life stage. Therefore, a car's CO2 emissions must be taken into account not only while it is running but also during its production and disposal. In this context, the production and disposal of EVs have been found to be less environment-friendly than an ICE car. Although the first step to decarbonizing the automotive sector is to use alternative fuels, older petroleum-based vehicles still have a large carbon footprint. Apart from this, vehicle owners hesitate to make the transition to EVs because of the high cost involved. For this purpose, some startups have come up with biofuels to replace conventional fuels to help such vehicle owners, as they need not invest in retrofitting or modifications in order to minimize their environmental impact. FF

# HIGH-END TECHNOLOGIES CAN DIMINISH EMISSIONS IN MINING OPERATIONS

Realizing the need to be more environmentally responsible, mining companies have adopted technological advancements to increase automation, saving their workers from entering dangerous mine shafts where they could potentially risk exposure to toxic substances.

The world derives most of its energy through mining resources, such as natural gas, petroleum, coal and uranium. To extract them, heavy and reliable equipment are needed that can run continuously under demanding circumstances and environments. However, mining operations guzzle down enormous quantities of energy. The mining industry is responsible for around 10% of world energy consumption and around 80% of the world's electricity usage.

The main energy used by mining comes from burning fossil fuels and the industry stands as one of the largest sources of CO2 emissions. Coal, petroleum, natural gas, oil shales, tar sands, bitumen and heavy oils are some of the main fossil fuels. All are carbon based and are the result of geological processes that began billions of years ago.

Most consumer products in today's world rely on mining. Present day electronic devices contain over 60 minerals, which are extracted through mining. Another

subterranean product, petroleum, is used in the production of more than 6,000 consumer items.

Termed the world's top toxic polluter, mining severely damages ecosystems and humans, and has been given the infamous sobriquet "dirty industry". However, mining is such a gigantic business that the planet's three most produced commodities, coal, crude oil and iron ore, are all derived from mining or drilling.

Mining also uses some of the world's largest and heaviest machines, some weighing as much as 13,000 tonnes and able to excavate 160 cubic meters of soil at a time. This makes mining one of the most energy-intensive industries.

The mining industry is also a huge supplier of raw materials for the manufacturing, transportation, construction, and energy sectors. This demand is expected to rise as world population rises, which when combined with dropping mineral ore grade, would most probably increase the industry's energy demand. As most mines are remotely located, operations here mostly depend on fossil fuels such as heavy oil fuels, diesel and coal, for on-site generation. To tackle all this, the mining industry needs to adopt clean energy solutions such as energy efficiency, renewable energy, energy recovery and carbon capture.

The main challenges looming over the mining industry and feeding the interest in renewable energy use are: declining ore grade, volatile prices, increasing environmental concerns, increasing political and social concerns.

Realizing the need to be more environmentally responsible, mining companies have adopted technological advancements to increase automation, saving their workers from entering dangerous mine shafts where they could potentially risk exposure to toxic substances. Exploration and drilling equipment also, nowadays, come with a high level of precision, minimizing unnecessary excavation. On site, many mining companies have modernized their vehicles to run on hydrogen.

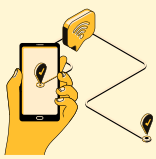
With plenty of advancement in renewable energy technology, mining companies can expect to see many benefits as they switch to renewable energy. These benefits include: minimizing the dependence on fossil fuels, thereby minimizing carbon emissions; satisfaction of social and environmental criteria; better investor engagement; and power price stability. Chilean and Australian mining companies have gone on to satisfactorily adopt this trend.

Although mines need huge capital investments to fully decarbonize, there are some economic measures, such as using renewable energy, electrification, and ensuring operational efficiency.

Soon, shifting to renewable sources of electricity will become increasingly feasible as the cost of battery packs is expected to reduce to half the rate by 2030. Chilean mining company Codelco already uses solar power for one of its copper mines and Australian miner Fortescue Metals Group is switching to renewable energy at its iron ore mines in Pilbara, Australia. Electrifying mining vehicles and equipment is another economically viable decarbonization option. Many mining giants have formed their own sustainability committees, as they report emissions while trying to understand the pathways to decarbonization FF

## SMART SOLUTIONS FOR SMART MINES

### HIGH ACCURACY GPS

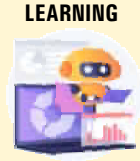


High accuracy GPS technology brings precision to mining. From GPS assisted precision drilling to autonomous haul trucks for worker safety. GPS enables safe and efficient operations.

### DRONE TECHNOLOGY

Drones provide real-time aerial footage of mining sites for maintenance, monitoring (e,g, the environment) and mapping, which improves safety and increases efficiency and cost savings.

### DATA OPTIMIZATION & MACHINE LEARNING



Optimizing data collected from equipment and monitoring devices enables engineers to create simulations to precisely plan and schedule operations, and complete highly complex tasks.

### AUTOMATION

The integration of autonomous vehicles and automated technologies supports more competitive operations and enables ultra-deep and remote mines to operate more effectively and safely.

# Methanol the future proof marine fuel

From left **Mr. Bhupesh Tater, Mr. S.M. Rai, Mr. Rajesh Kasaragod, Mr. Sunil Kumar, Mr. David Birwadkar, Mr. Saanjeev Mehra, Mr. Amit Bhatnagar** from Institute of Marine Engineers (INDIA).

With the technological and regulatory challenges associated with burning methanol as a bunker fuel largely resolved, it's time for the industry to move forward, as Maersk has done, and get ready to go green with methanol.

That was the view widely expressed at the "Rise of Methanol As A Future Proof Marine Fuel" seminar held in Mumbai and online on 29 April 2022. The event organisers were Sea Commerce America Inc. and Institute of Marine Engineers of India's Mumbai Branch and sponsored by Methanex, Canada and Methanol Institute, Singapore. FutureFuels, India were media partner.

**Berit Hinnemann** from Maersk talked about the partnership Maersk has entered into the producers of Green Methanol to supply their fleet methanol powered fleet. Maersk will require 10000ts in the year 2023 and 500,000 tonnes by mid-2025. Berit also mentioned that Maersk sees "methanol in combination with biodiesel for the pilot vessel as the only certain and scalable pathway towards significant impact this decade."

These 16,000 TEU DF Maersk vessels are to be classed with ABS and will provide "20 percent improved energy efficiency per transported container".

**Mr. Vikrant Rai,** took over the stage and presented the regulatory views on the subject. He also stressed upon the importance of port energy enhancements and ship energy enhancements.

Methanol is available in over 100 ports as per an independent study conducted by Methanol Institute. Availability of green methanol, which has near zero carbon foot print on life cycle analysis basis, is still limited. Irrespective of the fact how methanol is produced, whether brown or grey or green or blue, because methanol molecule has same characteristics it is possible to mix green and grey or others to reduce the carbon footprint to comply with the relevant CO2 regulation.

The event was designed to address the needs of shipowners and operators, and moderated by **Richard Clayton,** Chief Correspondent at Lloyds List. Speakers, including the host and organizer **Capt. Saleem Alavi**, delved into the technical, commercial, and regulatory details. Top industry experts spoke on the occasion including **Berit Hinnemann,** Head of De-Carbonization Business Development at Maersk; **Ayca Yalcin**, Director Market Development EMEA at Methanex; **Chris Chatterton**, Chief Operating Officer at the Methanol Institute; **Fredrik Stubner,** Chief Executive Officer, Green Marine Engineering; **Kjeld Aabo,** Director New Technology at MAN Energy Solutions; **Rene Laursen,** Manager of Global Gas Solutions at ABS; **Vijay Arora**, Managing Director Indian Register of Shipping; **Vikrant Rai,** Engineer & Ship Surveyor cum-Deputy DG(Tech), Mumbai.

Most of the near 400 event participants indicated that they had more confidence in methanol's viability as a bunker fuel after hearing from the expert presenters.

Closing the seminar Capt. Saleem Alavi took the opportunity to thank IMEI as co-organiser, Methanex, Methanol Institute for sponsoring the event, and Future Fuels as Media partner and the support of, Envirown, Lloyd's List, IRS, ABS, MAN, WARTSILA, Green Marine Engineering, Engineering and Ship Surveyor from Govt. of India for their time to participate in the event. A special thanks to **Captain Kapildev Bahl,** active member of Company of Master Mariner of India and **Mr Surendra Rai** of Institute of Marine Engineers India for their help in organising this event. FF

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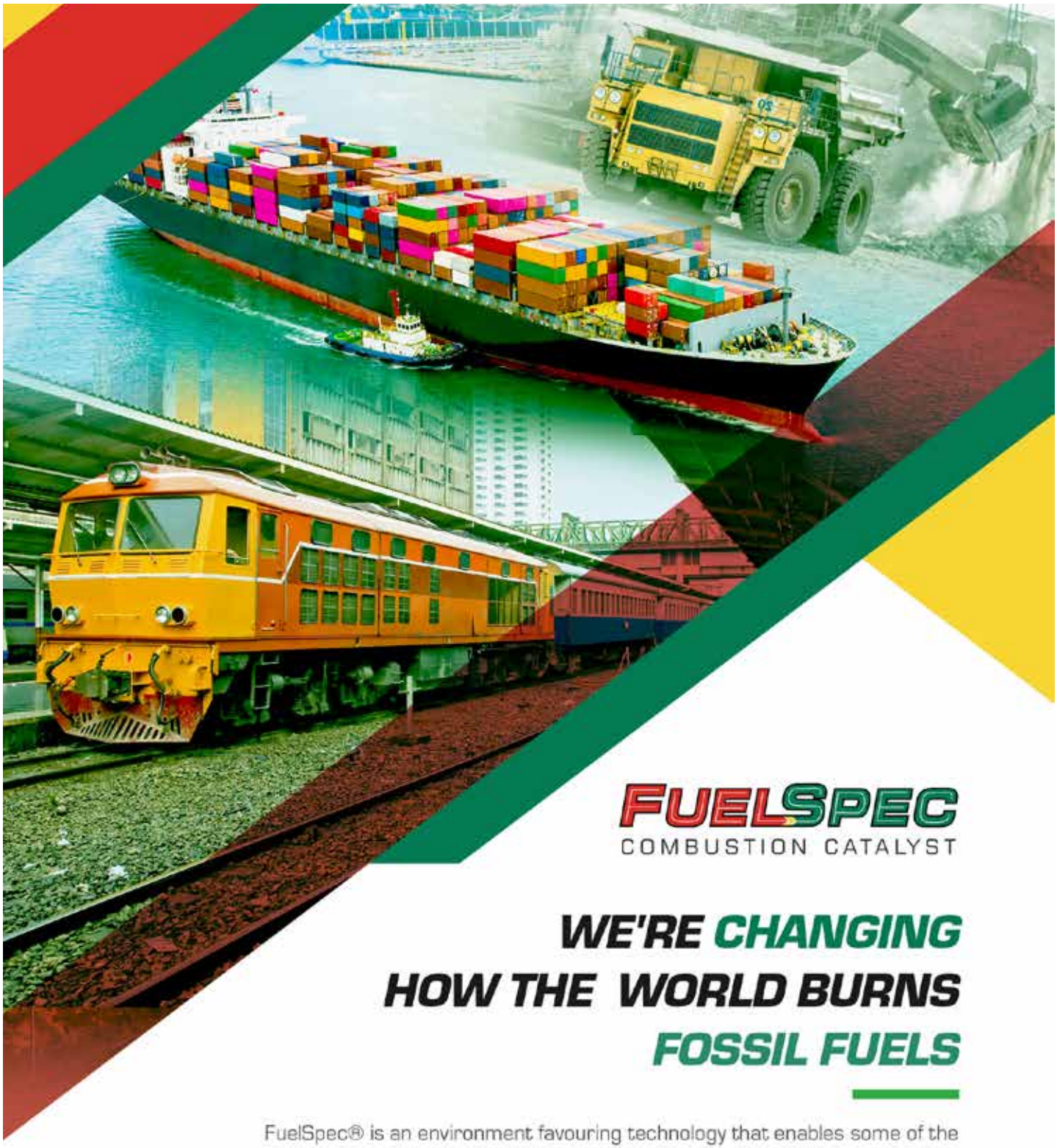

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