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** Liberia and Panama are targeted for additional port State control (PSC) examinations by the USCG for having a detention ratio "between the overall average and up to two times the overall average."

Sources: 2018-2020 Performance Lists Paris MoU, the 2020 Tokyo MoU and USCG PSC Annual Reports, and the 2018-2020 AMSA PSC Annual Reports.

*** Liberia and Panama have exceeded the overall AMSA average detention rate over the three years from 2018–2020.



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Seafarer happiness up, but tanker crew less happy

The 3rd quarter Seafarer Happiness Survey reports an average happiness of 6.6 out of 10, the highest score since Q3 2019. But tanker crews reported their happiness at average 5.98

n the third quarter of 2021 Seafarer Happiness Survey, conducted by the Mission to Seafarers, average self-reported happiness, on a score of 1-10, was 6.6.

The survey typically gets around 2,000 respondents, starting with a simple question "How happy generally when at sea?" The survey is conducted quarterly with support from Wallem Group and the Standard Club.

This is the highest score since Q3 2019, when it was also 6.6. Scores gradually declined to 6.2 in Q2 2020 during the first phase of the pandemic, then rose to 6.45 in Q1 2021, took a big jump down to 5.99 for Q2 2021 with a second wave of pandemic, the lowest ever recorded. Now the latest score is much better, 6.6.

By ship type, tanker crew were least happy, scoring themselves 5.98, compared to crew on bulk carriers (7.2), container ships (6.35) and general cargo ships (7.12). 12 per cent of replies were from crew on tankers.

5 per cent of seafarers responding said that they have been away at sea for over a year and



A vessel crew receiving gifts from the Mission to Seafarers in Falmouth, UK. Photo: Mission to Seafarers

a further 13 per cent of respondents have served at sea for over 9 months, with the remainder reporting less than 9 months, at the time of doing the survey.

The Mission to Seafarers' interpretation is that "COVID-19 related strains on seafarers are beginning to ease, and support measures for seafarer welfare have now had a chance to take effect. Yet challenges with shore leave and shipshore connectivity remain."

"The data suggests that crew sentiment has stabilised, which is, at face value, good to see," said The Revd Canon Andrew Wright, Secretary General of The Mission to Seafarers.

"However, it is too soon to say whether this is a start of positive change, or if seafarers are simply more resilient to the situation they are experiencing because of the pandemic."

Key points

There were a number of comments on standard of catering and the dearth of good quality ingredients. Some Western seafarers claimed that they suffer as their diet tends to be more expensive than other diets, and they perceive the quality of their meals is reduced to save money.

One cause of unhappiness is when crew either have no access to satellite communications, or feel that it is poor quality, slow, patchy and expensive. Many respondents see internet access as a way of assessing how a company feels about its crews.

One seafarer stated, "Our internet on board costs US\$25 for 100MB". One stated that they were given 250MB for a whole month, not even enough for one video call to their family.

On training, there was some good comments about how senior officers on board were sharing their knowledge. Also, some potential concerns. Some seafarers reported worries about revalidation periods of their certificates. They were concerned about future problems if they cannot get home to renew or refresh their shorebased training as required.

Many seafarers complained about not enough crew onboard, Mission to Seafarers said. There were complaints about ships going to an almost skeleton crew after a charter ended, while waiting for the next one.

Some seafarers complained about not having anyone onboard who can speak their own language fluently, or to a level adequate to engage in non-work-related matters. "It is arguably cultural and language difficulties which sends people back to their cabins," Mission to Seafarers said.

Crew retention

"We heard from many seafarers, particularly those aged 35 and over, that they were not intending to return to sea once they eventually got home," Mission to Seafarers said.

"Some are seeking roles within maritime, but many are just looking for a way to get out."

"The challenges of balancing home life, with the uncertainties of the crew change crisis, have led to many who were tentatively considering a move ashore accelerating their career change plans."

Some seafarers also wanted to "get ahead of the curve when autonomous ships arrive".

One seafarer wrote, "fun and happiness are taken out of sailing by most ship owners and managers for commercial gains."

Mental health

The Mission to Seafarers says that mental health impacts were frequently mentioned in the responses.

TANKEROperator

Vol 19 No 6

Future Energy Publishing Ltd 39-41 North Road London N7 9DP www.tankeroperator.com

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Very Vermilion Ltd. Tel: +44 (0)1253 812297 info@veryvermilion.co.uk

SUBSCRIPTION

1 year (7 issues) - £195 Subscription hotline: Tel: +44 (0)20 8150 5292 sub@tankeroperator.com One seafarer said, "I cannot get ashore and talk to anyone but those on board."

The survey asked seafarers how long they had been on their current vessel, so it could track how their happiness declined over time. It showed that happiness started to decline after 6 months. The full responses were: 1-3 months, 6.4; 3-6 months, 6.6; 6-9 months, 6.3; 9-12 months, 6; and over 12 months, 5.5.

One seafarer stated, "First month: 10/10, Second month: 8/10, Third month: 5/10, Longer: 1/10".

One seafarer stated, "During my last commission I started to feel depressed but was not entirely aware of it at the time." He went on to describe how he felt increasingly anxious and stressed and was having trouble sleeping, engaging and even focusing on work.

Having never experienced "these kinds of feelings before" he didn't realise the warning signs until he got home and noted how different he felt when he was away from the ship.

Bullying

On bullying, one respondent stated, "I'm sick of hearing and going along with the adage of 'it's gotten better.' No. It's inexcusable when it's bad. Bullying, intimidation, sexual harassment, sexual assault, dismissal for reporting. These are all things I've experienced within the last year. And some people try to tell me I'm lucky".

One seafarer stated, "It's a pirate ship out there on the unconquered boys club seas of the saloonstyle wild west. Nothing gets back to land. If it does, it's not the full truth, it's late, and follow up is past due with victim blame being the first topic of discussion". "We have heard from seafarers who say that their senior officers are wonderful and make a real difference, and we also read tales of those captains, chief engineers and officers who make a toxic atmosphere," Mission to Seafarers said.

Bad company rules

"Over the past year and a half, we have read reports from vessels about some illconceived, or poorly thought-out diktats, that have been added to their safety management or operational systems," Mission to Seafarers said. For example, rules about "washing all their equipment, clothing and even bedding at ridiculous intervals."

"Demanding that masks be worn on board, or social distancing when trying to hand over a navigation watch, meaning that neither watchkeeper can see the radar screen at the same time."

"Rules which are not fit for purpose, not thought through, or considered, make for tension, pressure, annoyance and frustration on board."

One seafarer wrote about a major company program, "The scheme has made our life hell on board. Are we teachers, mentors or psychologists to conduct these programs? We spent a lot of time doing this with hardly any output."

Treatment in ports

There were comments from seafarers feeling unwelcome or as potential virus carriers in ports.

"Some have reported being made to leave vessels wearing plastic disposable suits and made to transit airports looking like pariahs. This is a source of much annoyance for seafarers," Mission to Seafarers said. "It is not right, not necessary and delivers only a COVID theatre of viral protection." "On the subject of vaccinations, those who had received them were immensely relieved and grateful," the Mission said. "Ports such as Antwerp and Singapore were singled out for praise."

Respondents also singled out Japan as a country which showed appreciation for the importance of [crew] movement and worked to support it.

Wages

"Very often respondents speak of good salaries and their pride in providing for families back at home," the Mission said.

"We also hear from many who feel underpaid, who are not rewarded well for what they do, and indeed the tragic prevalence of abandoned crews who have to fight for years to get what they are owed."

One seafarer wrote, "What tickles me is when I'm told I am overpaid working at sea. Easy thing to say when you sleep in your own bed every night, can have a glass of wine with your dinner, kiss your kids goodnight each night, pop to the shop to buy whatever you need whenever you need and can pick up the phone/jump in the car to speak to family and friends any time you like."

"Try having a circadian rhythm that's totally disrupted, not knowing when you'll be home and having to work a full 12-hour shift plus occasional extra every single day for months on end".

Download the report here

https://www.happyatsea.org/wp-content/ uploads/2021/10/SHI_Q3_2021.pdf

Seafarer comments in the Q3 Seafarer Happiness Report:



OCIMF news Aug-Sept-Oct

Fuel lifecycle assessment, OCIMF's environmental plan, human factors guidance, new director, guidance on private security - our summary of the Oil Companies International Marine Forum's August-October newsletters

Fuel LCA

"There are many differences of opinion on how LCA (life-cycle assessment of marine fuels) should be considered and accounted for," said Rob Drysdale, director of OCIMF, in OCIMF's August newsletter (Note: Mr Drysdale is no longer director, see later in this article).

"Some are simple and some very complicated, and there are advantages and disadvantages to each. I don't pretend to know how all of this will shake out, but I do know that any decision is better than no decision at all.

"The high-level targets are clear, but until we land on more detailed guidance confusion will continue to reign. Industry collaboration will remain key to identifying and driving solutions."

OCIMF's environmental plan

"I'm very happy to announce that OCIMF's new environment plan has been approved," Mr Drysdale said in OCIMF's September newsletter.

"It outlines the OCIMF approach to managing one of the most important issues of our time."

"The sole aim [is] to enhance environmental performance in the maritime sector, while maintaining a focus on related safety for our members and stakeholders."

"We will achieve our objectives by providing consistent guidelines and recommendations to our members and industry, engaging with others as new technologies and alternative fuels are developed, and effectively mitigating risk."

"The plan includes short, medium- and longterm measures, in line with agreed IMO goals. As is tradition at OCIMF, it also allows us to aspire to go above and beyond where it is practical and safe to do so."

The plan outlines OCIMF's approach to marine environment issues and provides guidance and recommendations. It spans all operational activities of tankers, barges, offshore vessels, and their interfaces with terminals. It covers the four strategic priorities of publications, advocacy, programmes and membership collaboration.

It includes short, medium and long-term key actions in line with findings from the stakeholder white paper which summarised wider member feedback on key environmental risks.

The plan will ensure the committee's work is prioritised around greenhouse gas emissions and air pollution.

You can only read the plan if you are an OCIMF member however - it is available in the

members only area of the OCIMF website. Human factors paper

OCIMF has released a paper, "Human Factors: Management and Self Assessment", showing how to integrate human factors into management systems.

It is intended help companies and leadership teams address the conditions and systems that influence human actions and decisions.

OCIMF Managing Director Rob Drysdale said:

"Human Factors is .. a key enabler to further reduce safety, environment, security and health impacts within our industry. That means that it has to be part of any management system.

"However, a Human Factors element cannot be implemented overnight – it takes time for companies to become familiar with the concepts and understand how to apply them practically."

"The intention is to eventually integrate a Human Factors element into our suite of Management Self Assessments."

UK Merchant Navy Medal

The UK Department for Transport awarded the Merchant Navy Medal for meritorious service to Chris Scothern, who was seconded from IMT (International Marine Transportation Limited) to be the UK Merchant Navy Liaison Officer to United Kingdom Maritime Trade Operations. (UKMTO) / International Maritime Security Construct (IMSC) and Combined Maritime Forces (CMF) in the Middle East.

"This is great recognition of his hard work in the Middle East on behalf of the membership and the important role he played during a very challenging period of regional tension," OCIMF said.

New OCIMF director

OCIMF announced in its October newsletter that Karen Davis from US-based global oil and gas company ConocoPhillips will succeed Rob Drysdale as managing director of OCIMF, starting in December 2021 on a three-year secondment.

She was previously seconded to Qatargas Operating Company Limited as a Senior Advisor in the North Field Expansion Project. She is a member of the Marine Risk Quality and Projects team, promoting best operating practises to improve marine safety.

She served on OCIMF's Executive Committee from 2016 to 2019.

"I am delighted to be seconded to OCIMF at such an important time, as the energy industry adapts to a new post-Covid normal and increasing safety and environmental regulations," Ms Davis said.

"While I am sad to be leaving OCIMF, I am happy to be handing over to someone of Karen's calibre and know I am leaving the organisation in very capable hands," said OCIMF's outgoing director Rob Drysdale.

Guidance on private security

OCIMF has released a new information paper providing guidance on hiring Private Maritime Security Companies (PMSCs).

"The use of PMSCs onboard merchant ships is widely accepted as one of the measures which can assist in keeping seafarers safe from harm and protecting vessels operating in areas of increased threat," OCIMF said.

"While industry best management practice does not recommend or endorse the employment of PMSCs, the use of experienced and competent PMSCs either onboard the vessels, where legally permitted, or on a security escort vessel, can mitigate risk."

"This guidance is intended to help owners/ operators with pre-selection considerations before using private maritime security services."

South American terminal operator group

OCIMF and SIGTTO welcomed support from Sociedad Latinoamericana de Operadores de Terminales Marítimos Petroleros y Monoboyas (translation - Latin American Society of Oil and Monobuoy Maritime Terminal Operators).

The organisations will work together to increase cross-regional participation.

PIANC Working Groups

OCIMF has joined the World Association for Waterborne Transport Infrastructure's (PIANC) Maritime Navigation Commission Working Groups (MarCom WGs) in revising recommendations.

It has joined three groups: MarCom/InCom WG 231 Mooring Bollards and Hooks – Selection, maintenance and testing; MarCom WG 232 Metocean related risk during the construction of Marine works; MarCom WG 233 Inspection, Maintenance and Repair of Waterfront Facilities.



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Developments with flag registries

Developments with flag registries over 2021 of interest to tanker operators includes the annual reports from the MOUs; Marshall Islands and Liberia maintaining strong positions; and planned expansion of the UK

he Paris Memorandum of Understanding (MOU) on Port State Control released its 2020 Annual Report in July 2021.

It noted that efforts had to be scaled back during 2020 due to Covid, which led to decreasing numbers of inspections. The number of inspections carried out was 13,148 compared to 17,913 in 2019.

This in turn led to fewer refusal of access orders, detentions and deficiencies compared to previous years.

Over the past three-year period the flags of Comoros, the Republic of Moldova, the United Republic of Tanzania, and Togo have recorded the highest number of refusal of access orders, it said.

The detention percentage fell slightly to 2.81% (from 2.96% in 2019).

The total number of 39 flags on its "White List" is slightly less than that of 2019 (41).

The "Grey List" contains 22 flags (16 in 2019); the "Black List" lists 9 flags (13 in 2019).

Black list flags saw 545 inspections and 41 detentions, so a detention rate of 9.36%, which is less than the 12% in 2019.

For ships flying a "Grey-listed flag" the detention rate was 4.6%, which is less than the 7% in 2019. Ships flying a "White-listed flag" had a detention rate of 2.4% which is slightly higher than in 2019 (2.2%) and 2018 (2.3%).

Out of 369 detentions recorded in 2020, 37 (10%) were considered RO (Recognised Organisation) related, compared to 15% in 2019.

The five most frequently recorded deficiencies in 2020 were "ISM" (4.65%, 1,298), "fire doors/openings in fire-resisting divisions" (3.07%, 857), "seafarers" employment agreement" (1.9%, 530), "cleanliness of engine room" (1.43%, 400) and "nautical publications" (1.36%, 381).

The number of deficiencies recorded on the seafarers' employment agreement increased relatively from 1.2% to 1.9%. This was the highest increase out of the most frequently recorded deficiencies.

The top 20 flags on its white list were:

- 1-5: Denmark, Norway, Marshall Islands, Bermuda, Netherlands
- 6-10: Bahamas, Greece, Singapore, Cayman Islands, Japan
- 11-15: Hong Kong (China), Liberia, UK, Malta, Germany
- 16-20: Turkey, Italy, Isle of Man (UK), Belgium, Sweden.

Marshall Islands

The Marshall Islands registry said it was the only registry in the world to achieve 17 consecutive years of enrolment in the United States Coast Guard (USCG) QUALSHIP 21 program.

The registry also ranked in the top 10 of the Australian Maritime Safety Administration (AMSA) Port State Control Australia - 2020 Annual Report, released 4 June 2021; the top 10 on the white list of the Tokyo MoU's Annual Report, released in April 2021; and the top 10 of the Paris MOU.

"COVID-19 created unprecedented challenges for our owners, operators, ships' crews, and fleet operations team," said Bill Gallagher, President of International Registries, Inc, and organisation which provides support to the Marshall Islands registry.

"In the face of severely restricted crew changes, the inability to board vessels, and altered inspections and maintenance schedules, our owners and operators did a remarkable job ensuring safe vessel operations, which is reflected in this year's port State control (PSC) rankings,"

Liberian Registry

The Liberian International Ship and Corporate Registry (LISCR) said in September 2021 it is the world's leading tanker flag in terms of gross tonnage, following the addition of 2.7m GT of new tankers, giving it a total of 57.4m GT of tanker tonnage.

It said it had also maintained its position as the world's leading container ship flag with an 18 per cent market share and is the fastest growing major registry in the world with a 6.6 per cent growth.

"This overall fleet growth has largely been



Left to Right: Benson Peretti, EVP and Alfonso Castillero, COO of the Liberian Registry

due to an increase in newbuilding orders recently delivered, especially with larger modern dual-fuel vessels, oil tankers, LNG carriers, and mega containerships," LISCR said.

"Aiding in the high volume of vessels flagging into the registry has been a streamlining of registration processes and the increasing ease with which vessels, both existing and new buildings, can be flagged into the registry; Liberia being white-listed in the Paris MOU and Tokyo MOU; and its dedicated team of maritime professionals supporting the fleet."

"We have been able to appeal to tanker owners specifically, not just due to our costadvantages, but [due] to our continuously improving safety rankings; our detention prevention program; and our global network of 24/7 localized support," said Benson Peretti, Executive Vice President at LISCR. "What is also so encouraging about this development is in the type of technologically advanced and fuel-efficient vessels we have been registering."

In September 2021, the Liberian ship registry and DNV awarded "Approval in Principle" to Hyundai Heavy Industries (HHI) and Korea Shipbuilding & Offshore Engineering CO. (KSOE) for a new 40,000 cubic metre liquefied CO2 carrier design.

The new design would be the largest in its

OPENING / FLAG REGISTRIES

class. Otherwise, the largest CO2 carrier is under 2,000 cubic metres, LISCR said.

Maritime transport will play an essential role in the carbon capture and storage value chain, which is expected to lead to an increasing demand for liquefied CO2 (LCO2) carriers, LISCR said.

Also in September, LISCR announced that Captain Todd Howard, formerly head of the Coast Guard's Traveling Marine Inspector team, joined LISCR as Senior Vice President of Quality and Inspector Standards.

Captain Howard was with USCG for 26 years, in his final role in charge of the USCG's 42 senior marine inspectors providing professional commercial vessel knowledge, experience and advanced training. He also chaired the USCG-wide Prevention Program Quality Management Board.

UK registry

The UK government announced changes to the UK Tonnage Tax, with effect from 1 April 2022, the first shake up in its rules for two decades.

Ships that apply to the UK Tonnage Tax regime are more likely to be accepted if they are registered to the UK, and which help the UK reach net zero, the UK government said. Up to now, ships could participate in the UK Tonnage Tax regime with the flag of any European country. Now, companies are only allowed to enrol in the regime if they pass the UK tax authority's strategic and commercial management test, and UK Flag registration will now be an important contributing factor.

The regime will welcome new vessel designs and new models coming to market, relating to the UK's ambition to transition to net zero by 2050.

This includes ships that lay cables to help create wind farms and scientific research vessels. Companies that bring value to the UK by investing in decarbonisation will also be more likely to be accepted.

The lock-in period has been reduced from 10 to 8 years.

"The package of reforms aims to see more firms basing their headquarters in the UK, using the UK's world-leading maritime talent and services industry, and flying the UK flag. They will make it easier for shipping companies to move to the UK, ensure they are not disadvantaged compared to firms operating in other countries and reduce unnecessary administrative burdens," the UK government said.

"The UK Flag has committed to becoming the best performing international flag and is already a trusted partner to many top-quality shipping companies," said Brian Johnson, Chief Executive at the Maritime and Coastguard Agency.

Isle of Man

The Isle of Man Ship Registry (IOMSR) reports that it now accounts for over half of tonnage sailing under the Red Ensign (UK) Group and is ranked 17th in the world by Clarkson Research, just after Italy in tonnage terms – at around 15m dwt.

IOMSR has 138 oil, gas and chemical tankers as of November 2021, amounting to 5.35m GT.

IOMSR's client base is traditionally European, with Greek owners an important contingent. But about two-thirds of Isle of Man tonnage is now managed from Asia.

To expand flag registrations in Asia, IOMSR recently appointed its first Chinese representative, Jon Kingdon, who is a naval architect and Mandarin speaker. He is based in Shanghai.

IOMSR is on the Paris MoU white list, the Tokyo MoU white list, and one of the highperforming flags on the US Coast Guard's Qualship 21 scheme, it reports.

IOMSR was the first flag state to join the Getting to Zero coalition, an alliance of more



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OPENING / FLAG REGISTRIES



Isle of Man Ship Registry China representative Jon Kingdon than 120 organisations from the maritime, Singapore's voluntary notations

than 120 organisations from the maritime, energy, infrastructure and finance sectors.

IOMSR was the first flag to issue acceptance of a modification for a Very Large Gas Carrier to run on liquefied petroleum gas (LPG) as a greener fuel for Oslo-listed shipping company BW LPG.

IOMSR presented the paperwork for approval to the International Maritime Organisation.

IOMSR is working on the project with partners Wärtsilä Gas Solutions, MAN Energy Solutions and DNV. 15 BW LPG vessels will be retrofitted in total, with 12 due to complete by December 2021 with the remaining three due to complete by Q2 2022.

IOSMR also conducted what it believes was the world's first annual remote survey in 2020, together with DNV, as the covid pandemic broke. This was of bulk carrier Berge Zugspitze, which was anchored at Port Hedland on Australia's west coast, with the inspection monitored by IOMSR senior staff via live video stream from 14,000km away.

However doing remote inspection of tankers and gas carriers is difficult, because any camera would need to be enclosed in an Ex-rated case if it is used on deck, IOSMR says. In October 2021, Singapore Registry of Ships launched voluntary notations for Singapore ships covering sustainable shipping, digital transformation and seafarers' well-being. There are four categories – green, cyber, smart and welfare.

The Registry will review applications and issue ships which pass with a Certificate of Registration. The list of qualified ships will also be published online. Applications started Nov 1, 2021.

Caribbean

On October 5-6 2021, the Caribbean Port State Control Committee (CPSCC) for the Caribbean Memorandum of Understanding on Port State Control (CMOU) held its 26th Annual Committee meeting virtually,

Under the CMOU, Member Countries have agreed to adopt a common approach to conducting PSC inspections, and to share information on ships they have inspected.

Joel Walton, CEO of the Maritime Authority of the Cayman Islands, was re-elected as Vice Chair for the CPSCC for a further 3-year term.

The CMOU is currently undertaking a Concentrated Inspection Campaign (CIC) on

ballast water management which the Cayman Islands is co-ordinating.

Cayman

In September 2021, the Cayman Registry made electronic statutory certificates available. A full suite of statutory certificates is available, which meet the standards of IMO's Guidelines for the Use of Electronic Certificates (FAL.5/CIRC.39/ Rev. 2).

A "trusted identity", hosted and validated under European industry standard eIDAS, is incorporated in every electronic certificate.

Verification of every electronic document issued by the Cayman Registry will be available via an online verification portal.

Palau

Palau International Ship Registry (PISR) reported that it had been elevated to the Paris MOU Grey List.

The Registry also celebrated the 5th anniversary of its European office in Piraeus, Greece.

"We were determined to lift ourselves into the white list and this will be achieved through our innovative and unique technology combined with the recruitment of experts in every aspect of ship registry services," said Panos Kirnidis, CEO of PISR.

Bahamas

The Bahamas registry announced that the IMO Maritime Safety Committee at its 104 session has confirmed that The Bahamas has given full and complete effect to the STCW 78 Convention, The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.

The Bahamas also signed a STCW 1978 Regulation I/10 Agreement with Barbados. The agreement ensures that The Bahamas and Barbados each reciprocally recognise Certificates of Competency that are issued by the respective state.



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3

ENVIRONMENTALLY FRIENDLY BALLAST WATER TREATMENT

Trends in vessel losses

Allianz makes an annual study of trends in maritime safety based on data about total losses. Captain Rahul Khanna, global head of marine risk consulting at Allianz, went through this year's results

ata about total ships losses over 100gt over the past 10 years show a reducing trend, according to an annual study of maritime losses and other casualties, published by maritime insurance company Allianz.

There were 98 losses in 2011; 128 in 2012; 111 in 2013; 90 in 2014; 105 in 2015; 99 in 2016; 95 in 2017; 53 in 2018; 48 in 2019; and 49 in 2020.

Captain Rahul Khanna, global head of marine risk consulting, Allianz Global Corporate and Speciality, discussed the 2020 data, speaking at a Nautical Institute webinar, "Safety and Shipping Trends" on Oct 7.

There was a particularly big drop from 2017 to 2018 which has been sustained since then, but also losses have been on a plateau for 3 years. "We hope it doesn't go up," he said.

The loss data should be seen in the context of a growth in global shipping over the 10 years.

Seafarers often say they believe that standards are slipping, but this does not reflect in the losses data, he said.

"It doesn't mean all the work is done. 49 losses [in 2020] is 49 too many. We should not have a single loss."

Of the 49 losses in 2020, the top regions were "China, Indochina, Indonesia and the Philippines" (16), "Eastern Med and the Black Sea" (7), "Arabian Gulf and Approaches" (4), "British Isles, N Sea, English Channel, Bay of Biscay" (3). Although "it is a little misleading to say these are the top regions where losses are happening over 2020 with just 3-4 losses."

Possible reasons for the high losses in that part of Asia could be "a lot of small vessels [making] congestion in some of the water."

"I would not like to comment on standards, because we don't know, but numbers are telling a story, we have a region with a bit of a problem."

For the 10-year data, the picture is slightly different - "China, Indochina, Indonesia and the Philippines" is still worst, "Eastern Med and Black Sea" still number 2, but third place is "Japan, Korea and North China", and Number 4 is still "British Isles, N Sea, English Channel, Bay of Biscay."

The weather could be a cause of problems in the North Sea, although other parts of the world also see dangerous weather such as typhoons, he said.

The 2020 loss data by type of vessel breaks down to 18 cargo (ships), 10 fishing, 5 passenger, 3 tug, 2 bulk, 5 other, and 1 each of 'chemical/ product', ro-ro, container, supply/offshore, dredger and tanker.

The top cause is described as "foundered (sunk/submerged)" with 24 vessels. 10 vessels were lost due to fire and explosion, and 7 were wrecked and stranded. 2 were lost due to collision, 1 due to machinery damage / fire, and 5 "miscellaneous".

Looking at crude tankers (not chemical and product tankers), there have only been 12 losses in the tanker sector over 10 years and no obvious trend. Losses were 4 in 2011; 3 in 2018; 2 in 2017; 1 in years 2012, 2014, 2020; None in 2013, 2015, 2016, 2019.

Incidents

The study evaluates incidents but on the understanding that they are not reported equally in all parts of the world. There were 2703 reports of 'incidents' in 2020, with machinery damage being the top cause.

British Isles, North Sea, English Channel and Bay of Biscay grouped together is the region with the most incidents - 579. The East Med and Black Sea had 429.

One particular Greek island ferry had 6 incidents in 2020, and a roro vessel in Canadian waters had a similar number.

This may mean the vessels were reporting more incidents, not that they had more incidents, Captain Khanna said.

Piracy was a big issue in 2020, with a "large number of kidnappings" in the Gulf of Guinea region (West Africa). "That was the top hotspot for piracy in 2020."



Screenshot from the Nautical Institute webinar. Left, David Patraiko, Nautical Institute; Right, Captain Rahul Khanna, Allianz

"Since the abatement of the Somali piracy crisis, we haven't seen any kidnappings or hijackings there. The scene has shifted to the Gulf of Guinea," he said.

Over 10 years, Eastern Med shows the highest number of incidents, and British Isles + Bay of Biscay is second highest. "We have to remember there's different standards in reporting, some areas may be reporting more, so this data is a little skewed," he said.

Covid

Covid had many different impacts affecting losses, including from unhappy crews who have served their contracts but were unable to return home.

"The situation is a lot better in some countries, but not everywhere," he said. "Our seafarers are still struggling."

"Some have been onboard more than 11 months, more than a year at times, there have been some horror stories, some had medical issues and still not being repatriated."

"In one very sad case, the body of a seafarer could not be repatriated for 3 months, the vessel had to go back to its own port and deliver the body."

Covid has also led to supply chain disruption, with a shortage of space on container vessels and waiting times for vessels to enter port.

The cruise shipping industry has a large part of its fleet laid up due to Covid. From the insurance sector's point of view, there is a concentrated risk with many cruise vessels laid up in the same place, which could all be damaged in a bad storm

Larger vessels

Another change which may impact losses is the movement to ever larger vessels.

"Large vessels bring disproportionately large risks," he said, with one example being the Ever Given which blocked the Suez Canal.

"The size of container vessels has gone up from 1530 TEU in 1968 to now 24,000 TEU."

"If Ever Given had gone hard aground and we had to take the containers off, we would have been talking months. The impact would have been a lot worse."

With larger vessels, "salvage, casualty management, getting the equipment in the [right] place, is all [more] difficult.

There were also 40 container ship fires in 2019, and 1 fire every 2 weeks in 2020. There is the problem of containers falling overboard. "It is not a coincidence that it's at a 7-8 year high."

Tackling piracy with private vessels, state navy

One solution to providing security for tankers offshore West Africa is a private vessel with state navy personnel onboard. PVI offers this service

rmed private security guards are not allowed to work on vessels within the waters of West African countries.

The legal constraints of carrying firearms and other controlled items within these jurisdictions are too great. Shipping companies may only use armed guards from state navies.

One solution is for private security companies to commit privately owned, purpose built, navy approved patrol vessels to the various jurisdictions, with state navy personnel onboard providing the armed capability.

These patrol vessels then act as the dedicated security escort and overwatch capability towards any commercial vessels trading within the region.

This is offered by UK maritime security company Protection Vessels International (PVI).

PVI provides its own patrol vessels to the region. It has approvals from a number of countries' navy and military to receive their personnel onboard as the armed deterrent against any potential Pirate Attack Group (PAG).

PVI have kept a proportion of their fleet out of Nigeria. This means they can offer their dedicated security escort and overwatch function to clients trading in and out of other jurisdictions in the high risk area of the Gulf of Guinea. PVI says that no other security company offers this service.

The service "is not widely known about within the shipping community," says Harry Hayes, director of strategic services with PVI. "There is a large proportion of the shipping community trading in jurisdictions where, historically, there has not been any offshore escort capability to call upon."

PVI has a sister company, Southgate, which is a fully Nigerian registered company. It holds all of the necessary licenses and permits to make the necessary arrangements with the Nigerian navy for procurement of Navy guards to operate on their patrol vessels within the Nigerian Economic Exclusion Zone (EEZ).

The tanker operator contracts with PVI to provide the dedicated security escort service from a safe distance offshore (up to 200 nautical miles), to the offshore terminal where operations are scheduled.

The reverse is provided for the outward passage upon completion of the Terminal operations.

The vessel's intended approach to the terminal, coupled with the existence of EEZ borders, will dictate the positioning of the escort link-up and release meeting point.

This should be positioned at a safe enough distance offshore and away from areas of regular pirate activity.

All security escort vessels used by PVI, whether one of its own, or a third-party vessel, will be Tier 1, purpose-built ballistic protected security vessels capable of speeds up to 28 knots.

The dominant vessel within PVI's owned fleet is the "Bastion class" vessel (see photo). These are capable of speeds of up to 45 knots.

These Bastion Class vessels have been refitted with thermal imaging systems, so can



A "Bastion Class" support vessel from PVI

operate in total darkness, through solar glare, through light fog and smoke. They have 12 berths, so can be used for long deployments offshore.

Multiple countries and beyond

Most navy personnel can only provide security to vessels in their own country's "Exclusive Economic Zones" (EEZs) which extend up to 200 miles from their coastline.

So there is a complexity because a vessel often needs to transit a number of different country's EEZs before reaching its intended terminal or port.

One solution is to have guards from each jurisdiction operating onboard independent security vessels, providing a handover from one to another on the respective EEZ boarder.

This kind of multi-jurisdictional escort function is a highly complex operation to manage and is not suited to all types of vessels and schedules, PVI says. But it has coordinated and delivered these kind of operations to some of the largest offshore projects in the region.



OPENING / MARITIME SECURITY



This is what a security escort looks like How the service works

The protection service starts when a vessel meets an incoming tanker at an agreed distance offshore West Africa, which is far enough away to be difficult for pirates to reach, and where it is possible to check there are no pirates.

"As soon as our security escort vessel arrives at the link-up RVP (Rendezvous Point), it is our responsibility to secure the area and provide a deterrent," Mr Hayes says. "When the client vessel arrives, they need to feel confident the area is safe."

The PVI security vessel, with armed navy personnel onboard, then escorts the merchant vessel, remaining at a distance of around 0.5 nautical miles to the rear of the vessel.

Most offshore terminals have their own dedicated security vessels securing the immediate area around the terminal, so a security handover is made from the PVI security vessel to the terminal security vessel.

PVI's security vessel will remain on the outside of the terminal exclusion zone, maintaining daily communications with the client vessel.

Terminal operations will typically last 24-72 hours. After this, PVI will re-engage with its client vessel, and re-commence the outward escort service to up to 200 nautical miles offshore. Only once the client vessel has been safely released will the security vessel disengage and return back to its base jetty.

How pirates work

Nigeria hosts the largest volume of tankers, because of the large volume of oil production. "It's where we conduct the greatest volume of escort services," Mr Hayes says. The "threat profile" of the region has much expanded over 2018-2021.

Historical trends in regional pirate activity

emphasised the theft of cargo, particularly oil. This was driven by factors including the resale value of stolen fuel, and the antiindustry stance of many regional insurgent groups.

Criminal groups in the Niger Delta developed relatively sophisticated bunkering and storage sites for stolen oil. Ship-to-ship robberies were likely to involve the use of violence, with attackers using firearms or bladed weapons in order to prevent the crew from interfering with the attack.

Limited numbers of kidnappings occurred alongside these incidents, typically occurring when cargo proved inaccessible, or when isolated crewmembers failed to reach safety in time.

More recent pirate activity demonstrates a shift towards hijackings specifically for ransom of the crew, with the cargo no longer a primary commodity of choice.

This is likely to have been driven by a combination of factors, Mr Hayes says. Firstly, the wholesale price for crude oil dropped substantially in recent years, reducing the benefit-to-risk ratio of conducting robbery, storing cargo, and then reselling. Additionally, in late 2017, the Nigerian Army conducted multiple disruption operations within the Niger Delta region. As a result, a significant number of illegal bunkering and storage sites were destroyed, along with other elements of insurgent infrastructure.

This shift in the pirate groups' way of working towards hijacking for ransom has enabled them to operate at far greater distances offshore due to the prevalence of suitable mother vessels. And transporting crew is easier for them than transporting oil.

In September 2020 the Lloyds insurance Joint War Committee (JWC) extended the limits of the internationally recognised High Risk Area (HRA).

"Now we're witnessing successful piracy incidents happening at 250 nautical miles offshore. That presents huge complexities and concerns.

That's a real vulnerability which the shipping community is facing at the moment," Mr Hayes says.

There have been a number of successful incidents reported over the past six months just outside EEZ borders. "That's not random, that's targeted and tactical, by pirate attack groups."

About PVI

Protection Vessels International is part of a group of companies called DG Risk Group, which also includes Halcyon Superyacht Security (working on super yachts); a Nigerian company called Southgate providing local relations; and a company called PVI Mozambique providing specialist maritime security services in Mozambique.

PVI claims to have been one of the first companies to provide armed maritime security services offshore Somalia, including in the Gulf of Aden and wider Indian Ocean High Risk Area.



A "Bastion Class" support vessel from PVI

Factors to consider with filters

Mark Riggio, head of marine with Filtersafe, shares advice about what shipping companies should consider, when deciding whether or not to buy a ballast water filter and what to buy

n its 2020 report, SGS details its experience of conducting nearly 100 tests of ballast water and observing that 21% of those tests indicated that the discharge sample likely did not meet the IMO D-2 discharge standard.

100% of the potentially non-compliant discharges did not meet the IMO standards for organisms greater than 50 $\mu m.$

The standard is inherently biased against compliance for organisms greater than 50 μ m in minimum dimension. There can be 1.5 times as many organisms in one gallon of ballast water between 10 and 50 μ m than there can be in an entire Olympic-sized swimming pool of ballast water for the greater than 50 μ m size fraction.

This highlights the critical nature that the BWMS filter plays in the potential of the system to meet the D-2 discharge standard. Any instances that the ballast water management system has been bypassed may potentially mean a small number of these robust organisms remain viable and create problems during a discharge sample.

Ballast water filters have been designed with mesh ratings between 6 and 100 μ m with the most common systems being fitted with 20, 40, or 50 μ m.

Having no filter

The risk is especially high for the BWMS which are approved without a filter.

These BWMS allow sediments and larger, hard-bodied, and shelled organisms to pass through the treatment stage and enter the ballast tanks.



Mark Riggio, head of marine with Filtersafe

These complex organisms will remain in the tanks over time from where they could be discharged, hide in dead-ends of piping systems, and develop colonies in the unpumpable residuals and sediments inherent to normal ballasting.



BALLAST WATER



A filter being disassembled

As the IMO standards are discharge standards, the ability of these large organisms to persist in the tanks creates significant risks of discharges being non-compliant with the standard.

The unpumpable residual sediments building up over the years between vessel drydock periods can harbour many treatment-resistant organisms.

Ballast flow rate

The primary reason that ship owners provide for choosing a BWMS that does not include a filter is the inherent risk that the filter will impact the flow rate of the ballast pumps and consequently slow down ballast water flow.

This decreased flow occurs for two primary reasons:

During heavy loading, the filter will often go into continuous backflush and a significant portion of the water will be diverted through the backflush line;

Filter loading and increased differential pressure across the mesh causes a larger discharge head on the ballast pump, causing the pump to flow less water to the tank.

A test was done using water with a sediment mix equivalent to that found in the Yangtze River near the port of Shanghai.

It found that for a typical small bulk carrier with an 800 m3/hr ballast pump moving 10,000 m3 of ballast during a typical cargo operation, the time to move that much ballast can range from 12 hours to nearly 90 if the filter is not designed for heavy loading.

A filter designed for the loads may be able to move more than 3 times as much water at the extremes.

Clogging

Chief among the problems that are encountered by ballast water filters is the potential that they can clog. We define "clogging" here as high organic and sediment deposits that build up on the filter element and reduce water flow to

the BWMS and the ballast tanks to less than 5% of its designed rate.

Shipboard tests conducted by the Korean Institute of Ocean Science and

Technology, using seawater from Shanghai Port (high sediment) and three types of IMOapproved BWMS, found that they all failed to operate properly because of filter clogging.

Systems which are unable to be used due to filter clogging must be manually cleaned during the ballasting process, a task that could occupy two or three people to disassemble the filter, manually clean the elements, and reassemble it before restarting ballasting.

Clogging might be avoided if a vessel completed all of its ballasting operations prior to entering the challenging waters. For many vessels, this is impractical due to need to navigate up long rivers, over or under restrictions in the waterway, or due to the need to bring on ballast during cargo operations.

It would be prudent to explore a filter's potential for clogging in the regions where it will have to operate before making a final selection.

Clogging is primarily related to the filter's ability to clean itself automatically or remove the deposits on the filter element at a rate faster than, or at least equal to, the rate that the deposits are being formed. So the ability to scale the cleaning mechanism of a ballast water filter is critical to being able to address clogging issues.

Sediment

When designing the IMO Type Approval testing requirements, 50 mg/L of TSS (Total Suspended Solids) was the standard chosen by the IMO for the minimum challenge condition.

This reflects the average for the world's waters, it does not represent the maximum challenge condition that ships may face.

Two particular locations, the Mississippi River Delta and the Yangtze River, show exceptionally high TSS levels. Both rivers are very long. Both, therefore, have ample opportunity to collect sediment on the way to their estuaries and to the ports located there.

Allowing sediments to accumulate onboard the vessel has a further implication to the vessel.

First, the build-up between drydocking periods becomes a form of unpumpable, permanent ballast that, if not removed,

reduces the vessel's cargo capacity over time. Second, these unpumpable residual sediments must be handled in the future and remediated under the Convention.

This may affect the charter agreement and cause vessels to carry less than the obligatory cargo amounts as per the voyage plan, with implications for a ship's earning ability. Ferrying around even a few inches of sediment over the entire bottom of ballast tanks can quickly see tonnes of additional weight added to their dead weight.

This additional dead weight may offset cargo if vessels, in particular

the bulk and oil carriers, are contracted to carry their full load weight.

In addition, both the US ballast treatment requirements and the IMO Ballast Water Management Convention require ballast tanks to be regularly cleaned to remove sediments which will add to operational costs.

This sediment is considered hazardous because it can allow invasive alien species (IAS) and harmful aquatic organisms and pathogens (HAOP) to accumulate and breed, potentially being released during a subsequent de-ballasting or cleaning.

When a vessel goes into dock, many owners are learning that ballast sediments may now be considered a hazardous material and require special remediation and proper disposal under the Convention. This either requires payment at the yard, or bringing a special crew on board and conducting cleaning safely offshore.

Filter construction materials

For many years austenitic stainless steel grade AISI 316 has been known simply as 'marine grade' stainless steel. But the latest advice from the International Stainless Steel Forum is that AISI 316 and its derivatives "are no longer recommended for permanent contact with seawater."

Researchers identify 904L grade as a "super austenitic stainless steel" that is designed "for more aggressive environments with long-term performance." With this in mind, 904L is now recognized as a more appropriate material for filter.

You can go filterless – with chlorine dioxide treatment technology

You can go filterless if your ballast water management system uses chlorine dioxide technology, because its effectiveness is not reduced by any sediment, says Andrew Marshall, CEO of ballast water management system manufacturer Ecochlor by Andrew Marshall, CEO of Ecochlor

here are certain advantages to utilizing a filter within the treatment process of a ballast water management system (BWMS).

Some shipowners view it as an additional level of security in ensuring BWMS efficacy.

Whilst this is certainly a strong argument for adding a filter, the reality is that under certain water conditions a filter can also bring real problems to the ballast operation.

For example, in turbid or "dirty" waters, clogging can become problematic with some filters due to their mesh design or screen size in relation to the rate and quality of the dirt load presented to it.

Extended back flush cycles can reduce the ballast rate, whereas the need for additional piping and equipment results in an increased maintenance overhead for the BWMS.

So why filter? The simple answer is because most BWMS treatment technologies don't work very effectively without one.

An ultra violet (UV) BWMS must use a filter because it requires the removal of sediment to enable the UV light to hit all the organisms, rather than them be shielded by silts or sediments. There is no option for UV BWMS treatment without a filter.

Likewise, as a reputable electrochlorination (EC) manufacturer has confirmed, the EC treatment technology doesn't lend itself well to a filterless system due to the need to significantly increase the chemical dose in order to be certain to treat ballast water effectively.

This not only raises the power requirements (and by extension, the carbon footprint of the vessel) but can also cause damage to the ballast water tank coatings.



The Ecochlor "EcoOne" generator, making chlorine dioxide onboard

Chlorine dioxide

Early this year Ecochlor launched the EcoOne filterless BWMS, which is wellsuited for use as a no-filter system.

Why? Because, the chlorine dioxide (ClO2) treatment technology is particularly effective in all water conditions, especially turbid water as a direct result of the chemistry that is at the heart of the system.

"Filtration to remove sediments prior to treatment with ClO2 is simply not necessary," stated Pete Thompson, Vice President of Operations.

"In contrast, Sodium hypochlorite or EC-based technologies react with any organic matter living or dead."

"This means in waters with high levels of total suspended solids, the sodium hypochlorite reacts with everything, so there is a need to significantly increase the dose, lest the operator run the risk that there will be insufficient hypochlorite left over to kill the organisms.

"On the other hand, ClO2 treatment reacts primarily with living organisms, rather than all organic matter.

"Due to this limited reaction with nonliving organisms, the need to increase the dose to effectively treat the ballast water is minimal. As a result, power consumption remains extremely low and vulnerable tank coatings are still protected."

The benefits to the crew in operating a BWMS without a filter are vast since issues with some filters can be severe, especially in heavy challenging waters.

With fewer operational obstacles along with less maintenance requirements, these new Ecochlor filterless BWMSs are an attractive option for shipowners.

Airseas – kite that saves an average 20% fuel and emissions

Airseas of Nantes, France, is developing 1000m2 kites for ships, flying at an altitude of 300m, which, it says, can save 20 per cent of fuel costs and are suitable for tankers

irseas of Nantes, France, is developing 1000m2 kites for ships, which fly at 300m vertical height, with a 700m cable. Its models say the kites can save 20 per cent of fuel costs. They are suitable for use on tankers as well as most other vessels across the global fleet.

The company has a close relationship with aeroplane manufacturer Airbus. It was founded by former Airbus engineers, Airbus has an 11 per cent stake in the company, and is a launch customer.

Airbus has a plan to fit the kite on its vessel Ville de Bordeaux at the end of 2021. This is a ro-ro vessel used for transporting large components of its aircrafts from factories in Europe to the city of Mobile in the United States.

The technologies are developed by Airseas engineers and belong to Airseas, but the product development is based on the aeronautical expertise and experience of its engineers. Airseas remains independent from Airbus in terms of decision-making.

The kite actually works like an aeroplane wing. Instead of the wind blowing the kite and pulling the vessel, the wind blows across the kite. It is curved so that the wind has farther to go on one side than the other. This creates a suction force which moves the ship in the direction it is going.



Vincent Bernatets, CEO and Founder of Airseas



Vincent Bernatets, CEO and Founder of Airseas, was an Airbus employee for 15 years, including as business development senior director and aircraft information systems operations director. He has a MSc in aeronautics from Stanford University

Airseas is in discussion with a number of bulk, tanker and container shipping companies. Mr Bernatets is unable to reveal further details at this stage, except in the tanker sector it is "VLCCs and Suezmaxes in particular." The company's confirmed early customers include Airbus and Japanese shipping company "K" line.

Airseas modelling estimates that the kite can typically save 20 per cent of a vessel's fuel, and the investment can make a return after 2.5 to 5 years. The 20 per cent figure "comes from both modelling and tests," Mr Bernatets says. It has tested the wing and the typical wind power achievable on land, showing results consistent with the model.

Companies can improve the benefit they can get from wind power by taking it into account when making weather routing decisions, he says, if there is a choice of a route with a more favourable wind.

Airseas was founded in 2016. It has just moved into its new 6,000m2 headquarters, and plans to scale up production when it opens its 20,000m2 factory by 2024. The company anticipates producing about 75 sails over 20222024. It has 85 employees as of November 2021.

Installing and launching it

The kite and its apparatus is installed on the bow of the ship, bolted onto the deck. The apparatus includes a 35m mast from which to launch the kite, a winch, and fans to blow the kite out to its full size. Installation takes under 2 days. The bow of a tanker is a non Atex zone, Mr Bernatets says.

The kite is folded when not in use. To launch it, the kite is hoisted to the top of the mast with the winch, and then blown to its full shape using the fans.

There is a sophisticated system for releasing the wing while it is folded in half, 'inflating' it using fans, letting it take its shape with the extremities of the wing held together, and then releasing both ends of the wing at the final stage, so it takes its final flying shape. This whole process takes 20-30 minutes. The cable is 700m long.

The same process is followed backwards to store the kite.

Using wind power

The kite uses wind power to make a 'suction' force, the same as an aeroplane wing does.

An aeroplane wing is curved on the top and flat below, so the wind blowing over the wing

DECARBONISATION

has further to go, and the pressure above the wing is lower. This creates a suction force lifting the aeroplane. The suction force for the vessel kite uses the same method, but with the vessel being 'sucked' along the water, in the direction the vessel is travelling.

Airseas' modelling estimates that wind can be useful 70 per cent of the time, so long as you have wind, and it has an angle of more than 40 degrees from the line of the ship.

Or to put in other words, if the vessel is going Northwards and you have a Northerly wind (blowing from North to South) then the wind power cannot be used. But if the wind direction is more than 40 degrees to East or West (or in 360 degrees terms, between 40 and 320 degrees), then it can be used.

The kite will typically fly at 300m vertical height. Winds at this height are typically double the strength of wind at ground level, Mr Bernatets says. But by doubling the wind strength, you get four times as much power from the wind. This is a similar rule of thumb to the one that says, to double a conventional vessel's speed, you need four times more fuel.

The kite has a surface area of 1000m2.

There is an automation system which makes it possible to get the most propulsion power with the wing, without needing any manual piloting. It also makes operation of the wing completely "transparent or seamless" to the crew, Mr Bernatets says. "There is no need for human intervention, no workload for the crew or captain."

Commercial trials

The first commercial trial will begin in December 2021, with the installation of a Seawing on Airbus' vessel Ville de Bordeaux, operated by Louis Dreyfus Armateurs. The second Seawing will be installed on a vessel from the Japanese shipping company "K" Line, which has dry cargo, container, LNG, ro-ro and tanker vessels.

K Line has been participating in the development and testing of the system. It announced in June 2019 that it would install the system on a cape size bulk carrier which normally operates between Japan and Australia, with installation now planned for summer 2022. In August 2021, "K" line confirmed it would like to fit a second kite on a new build cape size vessel.

Mr Bernatets hopes that shipping companies will be comfortable investing in these wind propulsion solutions before waiting for the outcome of the commercial trials, as wind propulsion will save time and costs towards the decarbonisation of the shipping sector.

ICS webinar – pathways to shipping decarbonisation

Speakers from ABS, International Seaways and a renewable energy agency discussed the pathway for shipping to decarbonise, at an International Chamber of Shipping webinar in October

"his [decarbonisation] challenge requires all of us to embrace a new language of shipping which is basically CO2 emissions per tonne mile," said Christopher Wiernicki, president of ABS.

The 2030 targets may be achievable through changes in operations only, what Mr Wiernicki calls an operational reach. But reaching 2050 targets "will require a solution across the whole value chain," he said.

"It isn't going to be a 'combustion cycle solution', it will be a solution that takes us outside the ship, from well to wake."

"Reaching the targets as we know them for 2050 is a big challenge - we can only see an outline of a solution today."

It will require the availability of renewable energy to be "scaled up by around a factor of 10, incentivising early movers and a framework for carbon neutral fuels," he said.

"It's going to require a new level of public private partnership, require governments to step up and step in, major economic and policy

levers."

"It's going to require a significant increase in funding, most importantly demonstration of low emissions technologies."

"Ports are going to be vital as well," including providing bunkering infrastructure.

In the short term, ABS estimates that almost 25,000 ships "will have to explore improvement options to comply with EEXI."

"Owners and charterers are going to need to demonstrate that vessels are high performance [or otherwise] subject to performance improvements. Shipyards may have to improve standard designs to meet minimum level of EEDI performance," he said.

"The entire value chain is going to be basically torn down and rebuilt."

We will see a "varied game", with new fuel technology, new technologies which are not related to fuels, digital technology to support vessel performance, and new policy.

"The challenge to the industry is going to be how do you come up with the right combination and timeline of those 4 levers." "This is not just about the owner. The charterer is going to be really important in this process, probably more important than we've seen before."

It is important to "guard against unintended safety consequences," handling this new generation of fuels, which come with safety challenges, some of which are so far unknown.

We should also factor in an expected greater integration of ship systems, 'smart' ships and increased autonomy.

Mr Wiernicki cited three "wild cards" (unpredictable factors].

One is the availability of clean hydrogen made using renewable energy, "which I think is going to be very important".

Another is availability of carbon capture, making it possible to have zero carbon fuels made from fossil fuels but with CO2 sequestered to make hydrogen. "People don't' talk enough about carbon capture, that is essentially a wild card," he said.

A further wild card is availability of biofuels. "it's not an issue on the ship, it's the easiest

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drop-down fuel. It's an issue of supply and demand, is there enough of it."

There is no standard formula shipowners can follow, it depends on ship types and operational profiles. "The recipe for a large container ship may be different to a VLCC."

"We've kind of come from a linear pedigree, we're now moving to a multidimensional matrix for how to get there."

As of late 2021, shipping companies are ordering dual fuel LNG vessels, LNG vessels with electrification, methanol fuelled vessels, conventional fuelled vessels with electrification, and conventional vessels which are ammonia ready.

"When you look at where we are and where we're going, ammonia will come before hydrogen. The engines are coming out in a couple of years. Hydrogen is a much longer-term play. Hydrogen will have lots of challenges, its energy density is so different."

"LNG and methanol are the near-term fuels. Containment systems have been developed, power plans and infrastructure are there. It is proven that it is somewhat scalable."

"If you take a conventional vessel, say a large container ship, and ordered it right now with conventional fuel, when you run down the CII trajectory, in 10 years you will get to a grade where you are going to have to make an adjustment."

"If you used LNG as a fuel initially, you can get another 10 years, then you start worrying about those other incremental things that have to go on."

"Everyone is looking at futureproofing," he said.

"let's not forget about nuclear technology. Let's not forget about carbon capture as a technology which could come into play."

"I would like to add one thing. Safety is a mantra of our industry. At the end of the day when we talk about safety, remember technology has no common sense, no sense of humour, no instincts. It is people. Let's not forget about the people in this process."

International Seaways

"Every vessel that is operating today will need to incrementally increase efficiency constantly," said Lois K Zabrocky, president and CEO of International Seaways. "Whatever it is that all of us are going to do, including slow speeding, microbubbles, Mewis Ducts."

International Seaways is one of the world's largest tanker operators, with a fleet of 94 vessels, including 13 VLCCs, 15 Suezmaxes, five Aframaxes/LR2s, 12 Panamaxes/LR1s, 41 MR tankers and six Handy tankers.



Screenshot from the International Chamber of Shipping webinar, Pathways to Shipping Decarbonisation. Top row, Christopher J. Wiernicki, American Bureau of Shipping; Lois K. Zabrocky, International Seaways Inc. Bottom row, Guy Platten, International Chamber of Shipping; Roland Roesch, International Renewable Energy Agency

International Seaways is partnering with Shell to build 3 dual fuel VLCCs, which can also run on either LNG or conventional fuels, scheduled to "hit the water" in early 2023, she said.

"These VLCCs will be 40 per cent more efficient than your average 10-year-old vessel, 20 per cent more [carbon] efficient than a newbuilding on conventional fuel," she said.

It comes at a cost – based on prices in October 2021, a conventional fuel bunker costs are \$24k a day, and \$52k a day if burning LNG.

LPG is "incrementally more efficient than low sulphur fuel oil," she said. "All the VLGCs order book is dual fuel, including LPG."

A price on carbon will be very helpful in pushing people to decarbonise. People will ask themselves what is most "economically smart to go for", not just what is the cheapest fuel, she said.

"What Chris is talking about is to an extent the de-commodification of shipping, as we partner with our customers to move energy."

Doing it with renewables

The International Renewable Energy Agency (IRENA). published a report in October 2021, "Pathway to Decarbonisation of Shipping Sector by 2050".

IRENA is an intergovernmental organisation (like the International Energy Agency) and has 166 member countries. It is headquartered in Abu Dhabi, but the Innovation and Technology Center is in Bonn, Germany.

According to the report, it is "feasible and achievable" for the shipping industry to decarbonise, without using any 'blue' fuels (fossil fuels with CO2 sequestered), if it can reduce fuel consumption by 20 per cent with efficiency methods, reduce fuel consumption by 17 per cent through less use of vessels (described as "sectoral activity changes"), and then replace the remainder with zero carbon fuels - 3 per cent with biofuels, and 60 per cent, using "e-fuels", made with renewable electricity. For example, hydrogen from electrolysis of water.

The "sectoral activity changes" mean we may see more buyers switching to local and regionally sourced products, and so less need for shipping, said Dr. Roland Roesch, Deputy Director of IRENA's Innovation and Technology Center.

The report says that short-term energy efficiency methods are "essential", in the short term. Biofuels "may" play a key role, some blended with current shipping engines, and in the medium and long term, "green" (renewables sourced) fuels based on hydrogen.

This means that by 2050 shipping will need 46m tonnes of green hydrogen a year, of which 73 per cent will be converted to ammonia, accounting for 183m tonnes a year of ammonia. 17 per cent will be converted to methanol and 10 per cent used as liquid hydrogen, according to IRENA's pathway.

"E-ammonia will be the backbone for decarbonising shipping by 2050," Dr Roesch said.

IRENA sees part of its role as to work with its member countries to ensure they are investing enough in renewable power, he said. Renewable energy "has become extremely cheap," he said.

The report calculated that international shipping's total energy consumption was 27 per cent container ship, 23 per cent bulk carriers, 15 per cent oil tanker, 7 per cent chemical tanker, 8 per cent LNG tanker, 5 per cent general cargo and 15 per cent other.

It calculated that shipping is responsible for 3 per cent of global GHG emissions. If it was a country, it would be the 6th or 7th largest Co2 emitter. (Note this means the combined tanker sector is responsible for 30 per cent of maritime emissions, so 1 per cent of global GHG emissions).

Understanding the biofuels opportunity

Biofuels offer the potential of a zero carbon fuel which can be dropped into current ship fuel systems without any changes. There's a bit more to it, but it is something shipowners can consider, we heard at an ABS webinar

iofuels offer the shipping industry the possibility of a fuel which can be dropped into their current fuelling systems and engines, which is zero carbon. There's quite a bit more to it, but all the same, it is something which shipowners may wish to consider.

That could be a summary of a webinar held by ABS to explore the subject on Oct 8, together with representatives of the US National Biodiesel Board, a trade association representing biodiesel producers.

The biggest problem is availability of the biofuels. Biofuels are not available in large quantities now. The question is how much the supply chain could generate, should a market exist. But this is very difficult to answer without seeing what the market can do.

Biofuels may compete with other uses of agricultural products such as food. But also, they may not, some biofuels are made from agricultural and forestry waste.

The chemical properties can match existing maritime fuels, so they can be 'dropped in' with minimal or no changes. For land applications, a blend of 5-10 biofuel, the rest conventional fuels, is normally used, but a higher proportion of biofuel is possible.

With ammonia and hydrogen, the other possible zero carbon fuels, not likely to be available for 5, maybe 20 years, "biofuels are your best, most competitive option available today," says Scott Fenwick, Technical Director, National Biodiesel Board.

The emissions picture is not straightforward. Biofuels still emit CO2 when combusted but can be considered carbon neutral because they absorb this carbon from the atmosphere while the plants are growing.

But this only counts if emissions are being assessed on a well (or farm) to wake basis, not a tank to wake basis, and IMO measures such as EEDI are based on tank to wake.

Also there are other emissions to consider in the equation, including emissions which

would have been absorbed by plants growing on the land had there not been biofuel plants, and emissions from fuels used in making fertiliser, then transporting and processing the fuel.

The webinar only focussed on liquid biofuels, but there are also biogases such as methane being considered as fuels, for vessels equipped to run on liquefied natural gas.

Fuel availability

The current fuel demand of the global fleet for international trade has been estimated to be 200 to 215m tons a year, with a further 50m tonnes for domestic trade, an ABS spokesperson says.

This compares to the current production capacity of the two most likely biofuels, FAME (Fatty Acid Methyl Ester) with 50m tonnes a year, and HVO (Hydrotreated vegetable oil) being 4.2m tonnes a year. Most of this FAME and HVO is used in road transport.

However, the annual production capacity of biofuels is continuously increasing.

However, the maritime industry does not have much direct influence over availability and cost of biofuels. That is influenced by factors such as government land policies and regulations.

Basics of biofuels

Biofuels is a term for any fuel derived from biomass (plant or animal material), including waste.

The many different biofuels can be classed into fuels which can replace distillate maritime fuel oils, and biofuels which replace residual (heavy) fuel oils, said Meg Dowling, engineer with the Machinery, Electrical and Systems Engineering Department of ABS Technology.

Biofuels which can replace distillates include Fatty Acid Methyl Ester (FAME), Hydrotreated renewable diesel, and Fischer Tropsch diesel.

Biofuels which can replace residual fuel

oils are vegetable oil, pyrolysis bio-oil, and hydrothermal liquefaction biocrude.

Many biofuels are named for their production process, she said. For example, "Fatty Acid Methyl Ester" is produced by a process called transesterification, and the feedstock is fats, oils, grease and vegetable oils.

For complex feedstocks, such as lignocellulosic biomass (plant dry matter) a chemical process is required, such as gasification and Fischer Tropsch synthesis, or "fast pyrolysis" (heating up to high temperatures in absence of air). "Hydrothermal liquefaction" is a process for a fuel which needs further liquefaction, under moderate heat and low pressure.

Different biofuels have differing combustion properties and other characteristics.

They can be compatible with existing bunkering infrastructure - so minimum changes may be necessary to use them.

There are some benefits of biofuels over conventional fuels. They have detergent properties, which means that they can help keep the fuel system clean – although this may also mean they "may at first require more frequent maintenance," Ms Dowling said.

If there is an oil spill, they will degrade quicker than petroleum-based oils.

"The production specifications have shown that biodiesel quality across the globe is better than it's ever been. It is better than petroleum fuel quality (in many cases)," said NBB's Mr Fenwick.

A variety of emissions

All biofuels contain carbon and so emit carbon dioxide at the point of combustion. The big question is how much this is counterbalanced by CO2 absorbed when the plant is grown, and other CO2 impacts during the process.

A biofuel has a negative emission where it absorbs CO2 from the atmosphere while it is

DECARBONISATION

being grown or protects CO2 from otherwise being released. But it has positive emissions where it has caused more emission, such as from forestry being cut down to make land to grow them.

There are emissions caused during the production and transport of the fuel, such as fuel for a chemical process. And there are emissions released in the combustion.

One of the most efficient biofuels from a CO2 standpoint can be "biowaste" such as forest residues, used cooking oil. This because any energy inputs into creating it have been accounted for elsewhere.

One ideal feedstock for biofuel is "silvergrass", which can grow quickly on marginal land, so does not take land use away from other purposes, and "absorbs carbon rapidly when growing".

A change in land use may be not directly associated with emissions, but there can be indirect emissions, such as a change in carbon content of the soil, or chemicals used.

The more that fuel needs to be transported before loading onto a vessel, the bigger the transport related emissions.

All of this needs to be calculated. Biofuels end up with a wide range of overall CO2 emissions over their lifecycle, Ms Dowling said.

Matt Herman, Director of Environmental Science with the US National Biodiesel Board, recommends that shipping companies do due diligence on their biofuel supplier to find out what the emissions actually are. They can ask for an International Sustainability Carbon Certification (ISCC) or some other form of government certification.

The "Roundtable on Sustainable Biomaterials" (RSB) is a voluntary standard that can be certified by ISCC, to prove the biofuels are sustainable. Sustainable is defined with metrics such as a "significant" reduction in CO2, not impairing food security, minimising pollution and following applicable laws.

Biodiesel and renewable diesel are generally expected to achieve at least a 50 per cent GHG reduction," Mr Herman said.

Regulatory pressures

There are regulatory pressures to drive use of biofuel, such as the US Renewable Fuel Standards and the European Union Commission Renewable Energy directive (RED) II.

For example, RED II states that a minimum of 14 per cent biofuels or other renewable fuels for transport shall be used in every EU Member State by 2030, while also encouraging use of advanced biofuels, minimising direct land use, Ms Dowling said.

However, the European and US policies are not consistent, said Scott Fenwick, Technical Director, National Biodiesel Board (NBB). This may cause shipping companies challenges with vessels going from one region to another.

There's a really big opportunity for us as fuel producers and consumers to sit down and work on standardising the environmental assessment," said NBB's Mr Herman.

"Groups like the Global Emissions Logistics Council have started to have the discussion, to understand how a carbon intensity which we're so familiar with in the biofuel industry, can be translated to that industry."

"Once we solve that, there's going to be a lot more excitement about this."

Biofuels on ships

When considering biofuels for ships, the important consideration is the actual emission saving and how it compares to other options, and the technical requirements.

The shipping industry uses the jargon "well to tank" to describe the emissions caused in getting the fuel from its source to a ship's tank. [Although for biofuels the fuel does not come from a well, it comes from land].

The well to tank emissions are calculated by adding up all of the emissions along the chain, which is a complex calculation the fuel supplier should do.

Then the term "tank to wake" is used for the combustion emissions at the ship engine.

Many companies are using the Greenhouse Gas Protocol reporting standard for emissions. This segments emissions from any company into Scope 1 (emissions they directly control), and Scope 3 (emissions from their value chain – purchases and customers). [Scope 2 is mainly grid electricity purchases which shipping companies would only do in a port.]

Under this definition, a shipping company's tank to wake emissions are "Scope 1" and its well to tank emissions are "Scope 3".

The list of emissions which could potentially be considered as Scope 3 can be infinite, so in practise shipping companies would set a 'materiality threshold', said Matt Herman, Director of Environmental Science, National Biodiesel Board. The emissions they will be most concerned about will be those from production and transport of fuel. A ship using biofuel can include this in their EEDI calculation under MARPOL Annex VI regulation 22, Ms Dowling said. This includes a factor for the amount of CO2 released by the fuel the vessel is using.

Onboard a ship, biofuel emissions must also comply with IMO's MARPOL ANNEX VI Regulation 18 for fuel quality, including NOx emissions limits (as for petroleum fuels) and rules on sulphur content. There is still some uncertainty about how this rule will be applied to biofuel, an ABS spokesperson said.

There are some unknowns on how the greenhouse gas footprint of fuels will be captured in future (this is an issue for every fuel). So far, most applications are being done as trials, and discussion with the flag state administration to confirm acceptance and the right carbon factor to use in reporting.

Technical issues for ships

One the technical side, "a lot of shipping companies, engine manufacturers have already done the work behind the scenes to prove that biodiesel works in their engines," said Scott Fenwick of NBB.

"To date we haven't seen any technical roadblocks from a level of performance, assuming you're using biofuels that meet current standards."

"Engine manufacturers have noted that the use of biodiesel in main engines and auxiliary engines do not cause any operational issues, as long as the fuel is managed properly onboard the vessel."

"Renewable diesel is a hydrocarbon, it is indistinguishable when blended into a (hydrocarbon) fuel."

Biofuels are being used in the US in vehicles and off-road, onshore applications, without being blended with fossil fuels at all, and at as little as 2 per cent blend, he said.

Biofuels can emit more NO2 per unit energy than hydrocarbons, which may limit the amount of biofuel you can blend with conventional fuel, such as to 50 per cent, Mr Fenwick said.

The move to very low sulphur fuel oil (VLSFO) on a wide scale in the maritime industry in 2020 means that maritime oils have become closer in specification to many biodiesels, which means that there are fewer fuel compatibility issues, he said.

However, it is important that tanker operators pay attention to fuel specifications, and to fuel handling, he said.

What shipping thinks about alternative fuels

26 per cent of newbuilds in 2021 by gross tonnage are expected to be LNG fuelled. Interest in LPG is growing. There is some interest in methanol, ammonia, hydrogen and batteries, we heard at a DNV webinar

hat we have seen with LNG in the last few years, there's a very strong interest in LNG as fuel for new buildings," said Christos Chryssakis, Business Development Manager, Maritime with DNV.

"This is driven by several factors. Some is [driven by] charterers interested in their own carbon footprint; LNG is useful for [shipowners to] comply with EEDI requirements or for vessels looking to reduce CII. So, it is offering several benefits."

LNG is being mainly used on very large vessels – this is illustrated by the statistic that 6 per cent of newbuild vessels in 2020 had LNG fuel, but that amounted to 20 per cent of gross tonnage.

In 2021, 12 per cent of new vessels have LNG as a fuel, but it works out about 26 per cent by gross tonnage. LNG fuelled vessels include 40 per cent of large oil tankers and 30 per cent of large bulk carriers, he said.

"In the largest vessels of each segment we see a very strong interest for LNG. These are the vessels that can benefit the most.

LNG might be better referred to as a "fuel in transition" rather than a "transition fuel", since LNG itself may be decarbonised in future, such as being made from biogenic sources or from green hydrogen, Mr Chryssakis said.

"We already see some large container owners running bio-LNG as part of their fuel needs. We see many owners being interested in testing and using that fuel. We expect availability of bio-LNG to increase very significantly in coming years."

"This is definitely going to be an option, to reduce carbon intensity by replacing fossil LNG with a clean version of that fuel."

LPG

Interest in LPG is also growing. "We had the first 10 LPG carriers retrofitted to run on LPG. 100 per cent of new orders for LPG carriers are placed with LPG as fuel," he said.

"This is definitely a fuel for that segment with obvious reasons, they always go to LPG terminals, they can refuel as they load their cargo."

"We have seen interest from other ship types, but we haven't seen orders yet for other ship types."



Christos Chryssakis, Business Development Manager, Maritime with DNV "LPG so far this year is about 5 per cent of orders in terms of number of vessels."

Other fuels

Methanol is another fuel that is growing in interest. Until fairly recently it has only been used for tankers, but "earlier this year we saw the first order for container vessels," he said.

"We see a lot of interest in other fuels, for example ammonia, [but] you can't really place an order yet."

"We know there are projects for vessels planning to install ammonia engines that will be commercially available after 2024-2025. We're seeing interest in vessels that are 'ammonia ready'."

Interest in hydrogen so far is mainly for small vessels.

Batteries are being considered as part of "hybrid propulsion architectures," where a battery is used alongside a conventional engine, as with a hybrid car.

Audience 2050 survey

The audience was asked which fuel they think will dominate shipping in 2050.

32 per cent said ammonia, 29 per cent hydrogen, 19 per cent methanol or other alcohols, 15 per cent said LNG and LPG, 6 per cent electricity (total 101 per cent due to rounding). There were 950 respondents.

Commenting on this, Mr Chryssakis said, "it seems that our audience is really forward leaning I would say, looking at fuels which are carbon free molecules."

"I see there is quite a bit about methanol."

"It is very important how these fuels are produced. We can have clean LNG, clean methanol, we can have clean LPG."

"And also, it is quite interesting to think about how we're going to get there. Ammonia is not available today. There's a lot of development as we speak. We expect this technology to be available in the next few years. It will take some time before we can use it in large volumes. For 2050 our audience is looking forward to using such a fuel."

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European decarbonisation regulation

DNV's Eirik Nyhus gave an overview of regulations from the EU to encourage maritime decarbonisation

he EU Emissions trading system is coming to shipping in 2023. The current carbon price, around Eur 60 a tonne, would equate to a cost of Eur 200 a tonne on top of your current fuel price, said Eirik Nyhus, Director Environment, Regulatory Affairs, DNV.

"Even if there is some likelihood of small tweaks and changes, it will certainly be implemented for shipping and 2023 is just around the corner."

The European Union has also set targets for ships calling at EU ports to reduce the average greenhouse gas intensity of their fuels. The target reductions are 2 percent by 2025, 6 percent by 2030, 13 percent by 2035, 26 percent by 2040, rising to 59 percent by 2045 and 75 percent by 2050, all from a 2020 base, he said.

European rules will also look at the "lifecycle perspective" of fuels taking into account emissions from fuel production, transport and storage.

"Even if you find some ways to use conventional fuels, it will not be far off before you have to use alternatives if you want to be compliant with this regulation," he says.

Vessels which are non-compliant two years in a row may be denied access to European ports in future.

There is also an "Alternative Fuels Infrastructure" regulation for ports. This does not directly impact ships, but impacts EU member states, with obligations to make sure there are adequate suppliers of LNG in European ports by 2025, and electricity by 2030.

There is a revision of the Energy Taxation Directive (originally implemented in 2003) with a 10 year tax exemption for alternative fuels, while a tax exemption for LNG and conventional fuels will cease.

There is a "Taxonomy Regulation" to drive sustainable fuels. The EU taxonomy is



Eirik Nyhus, Director Environment, Regulatory Affairs, DNV

a classification system, establishing a list of environmentally sustainable economic activities. It is based around six objectives of climate change mitigation, climate change adaptation, sustainable use and protection of water, transition to a circular economy, pollution prevention and control, and protection of biodiversity and ecosystems.

"NOX and particulate emissions from ships are quite significant contributors to European pollution," he said.

How LNG as fuel is evolving

There are 200 vessels running on LNG fuel and 300 on order as of Oct 2021, we heard at a DNV webinar

NG was first used as a marine fuel in 2011. Today we have 200 LNG fuelled vessels in operation and 300 in order, said Dr Reetta Kaila, Director, Sustainable Fuels & Environment, Wärtsilä Energy Business.

It was first introduced as a fuel because the emissions have less particulates (soot). But now, the reduced CO2 emissions are the main reason for interest.

The capital expenditure for an LNG fuelled vessel is higher, with larger volume of storage tanks needed, and special systems onboard the vessel to handle it.

There are fuel availability risks, if there is uncertainty about whether LNG will be available at your destination port so you can refuel.

"We need to consider the whole value chain, port operations, fuel logistics onshore that need to



Dr Reetta Kaila, Director, Sustainable Fuels & Environment, Wärtsilä Energy Business

be developed, to have the fuel finally in use."

There have been concerns that LNG engines could become 'stranded assets' if the maritime industry widely adopts other zero carbon fuels. But Ms Kaila noted that the engines are all dual fuel, so customers have an option of using a liquid fuel. They may also be able to move to bioLNG.

The "technology readiness level" for LNG engines, including bio and synthetic LNG, is considered mature, she said.

Green LNG

Green variants of LNG are promised but will be more expensive. Dr Kaila believes that bioLNG will cost around double the price of fossil LNG, and synthetic fuels (from renewables) will be triple.

The carbon footprint of bio-LNG will depend on how the biofuel is made (there are complex parameters). But if it is made from agricultural waste, which would otherwise rot and let the methane emit to the atmosphere, the carbon footprint attributed to the bio LNG is low. Biogas can also be sourced from sewage sludge and forest waste.

Biodiesel in comparison can only use oily based feedstock. Developing biogas may prove easier than biofuel, because biofuel needs to be collected from farms by tanker, whereas biogas can just be injected into the existing gas grid, she said. Then shipping companies can remove the same amount and say they are using biogas. "That's how we get a quick scale up of that fuel for shipping."

Companies can start immediately with LNG fuel blends, with a mixture of bioLNG and fossil LNG and then gradually move to zero carbon fuels. Swedish ferry operator Rederi AB Gotland is planning to run vessels on 10 percent bio LNG, she said.

"By investing today in LNG fuel gas supply systems, you invest in bio and electric LNG," she said.

A further decarbonising option is to blend hydrogen with LNG, which has been tested at up to 25 per cent, she said.

For the maritime industry to progress further, technology is not the challenge, the technology is in place. "It is just to scale it up," she said. "It is more the joint industrial effort; we need to create the whole value chain."

"It is not enough to only have the onboard technology, you need the bunker facilities at port, you need the logistics of the fuel to come to port, so it's the whole chain. If some of those bits are missing then we can't use the green fuel."

Experience with LPG as a fuel

Pontus Berg, EVP (Technical and Operations) with shipping company BW LPG shared his experience using LPG as a fuel

iquid petroleum gas (LPG) could actually cause lower emissions than LNG on a well to tank basis, according to data from the Research Council of Norway, said Pontus Berg, EVP Technical and Operations with shipping company BW.

LPG's "Tank to wake" emissions are higher than LNG, estimated to be 475g CO2/KWH vs 404g CO2/KWH for LNG. This is because there are more carbon atoms in the average LPG molecule. It is normally propane and butane, with 3 or 4 carbon atoms, compared to 1 carbon atom in methane, the main constituent of LNG.

But this is compensated for by the well to tank emissions, which the Council estimate to be about half as much as LNG (60 g CO2 / KWH for LPG, vs 133 g CO2/KWH). A reason for this was not provided, but it may be due to estimates of fugitive gas emissions (leaks), which is not a problem with liquid fuels.

By adding the numbers together, the estimated well to wake emissions are 535 g CO2/KWH for LPG and 537 g CO2/KWH for LNG.

LPG is cheaper than ammonia and safer than hydrogen, Mr Berg said.

In addition, the study estimated LNG to have further emissions of 12-80 g CO2 equivalent / KWH from methane slip (the amount depends on the engine design and other factors). There is nothing equivalent to methane slip for LPG, Mr Berg said.

LPG is storable and transportable, as a liquid under pressure.

Because the fuel is also carried as cargo, there is no problem finding a supply of LPG



Pontus Berg, EVP (Technical and Operations) with shipping company BW LPG shared his experience using LPG as a fuel



On left: event moderators Tomas Barrett and Anne Moschner, DNV. Top right, Dr Reetta Kaila, Wärtsilä Energy Business. Bottom right, Pontus Berg, BW LPG

at loading ports, and LPG can be loaded into fuel tanks at the same time as it is loaded as cargo.

Operational experience

BW already has 10 LPG powered vessels and is committed to retrofit 15 ships with LPG propulsion. So, by 2022 it will have the largest fleet of LPG propelled vessels.

So far, "we have not had any major surprises" from using it, he said. "Shipping is ready for LPG as a mainstream fuel."

"Our team has had to manage quality concerns from main and sub suppliers, but overall, we have had good experiences."

"We have learned valuable technical lessons. We know the importance of having appropriate filters to manage organic materials in the bunker supply.

"We were also facing challenges from uncertain berthing schedules. We took an innovative approach to an established maritime practise of ship-to-ship transfer and did the same technique for LPG fuel at sea.

"We have our own LPG bunker ship, so we don't have to stress out about finding a slot."

"What has been most challenging for us has been the impact of COVID on movement of people and parts," he said. The company calculates that its staff spent a total of 14,000 hours (538 days) in quarantine.

"There's no doubt that LNG has been the favourite 'fuel of the future,'. It's been around for a couple of decades; it has had a head start."

"LPG is a simpler fuel to handle; it is a simpler fuel to actually have infrastructure around."

"If I was head of technical in another shipping company, I would revisit my calculations and future plans." The same engine can also be used for ammonia fuel. "The LGIP engine [a trade name for MAN] is the foundation for being able to burn ammonia in large two stroke engines. We have 60-70 LPG carriers with LGIP technology."

Mr Berg was asked about future supply of bio-LPG. "That is a very good question which I don't have the answer to. It is an interesting one to theorise over," he said.

Mr Berg is sceptical about the idea of using "e-fuels" (fuels made from renewable electricity) for shipping. "That's a bit like chasing mosquitos once there's elephants roaming around. There's much more heavy polluters on the shore side, that's where we should use the electricity."

"E-fuels will develop - it is going to come without a doubt. I don't think it is in this decade, it is in 2030 plus, when we have a built-out infrastructure."

Collaboration

Mr Berg believes that collaboration is crucial in getting alternative fuels used, "that is something that everybody has not succeeded in when it comes to shipping," he said.

As an example of failure to collaborate, Mr Berg cited the 2020 SOX regulations. "We started to buy scrubbers, and cleaning what was supposed to be cleaned shore side. I'm worried this will happen again; everyone will develop their own solutions."

It may also be helpful if the industry could agree on what fuels it wants. "If everyone is going to produce their own favourite fuel it's going to be hard for anyone to produce the volumes," he said.

More information is online at **BWLPG.com**.

Experience with methanol fuel

Capt. Kanchan K. Mukherjee, Director Operations, NYK Bulkship (Asia) presented his experience with methanol fuel

YK Bulkship of Singapore operates the Takaroa Sun, an oil and chemical tanker (IMO Type 2), which can run on either conventional fuel or methanol.

Capt. Kanchan K Mukherjee, director of operations with NYK, discussed his experience with methanol, speaking at the DNV Alternative Fuels conference in October.

The vessel was built by Hyundai Mipo, and chartered to Waterfront Shipping in September 2019.

It has a MAN B&W engine, supplied ready for water-methanol blending, with a scrubber.

Between delivery of the ship in Sept 2019 and Sept 2021, the vessel had clocked around 5000 running hours on methanol, and consumed 6,000 metric tonnes of fuel.

The vessel was awarded a 'special mention' in the category "Green Ship of the Year" of the Singapore International Maritime Awards 2021, organised by the Maritime and Port Authority of Singapore.

Two more vessels will be delivered in Feb 2022 and Apr 2022.

These vessels have a "Pilot Oil Fuel Ignited in Water" (PIFIW) system which lowers the NOx level in the emissions, which eliminates the need for a scrubber.

Methanol basics

Methanol produces up to 15 per cent less CO2 than conventional fuel during combustion. This is less than LNG, which emits 25 per cent less CO2. But methanol is much easier to handle than LNG, being a liquid at under 64 degrees C. As with LNG, there are no sulphur oxide emissions.

Its volumetric energy density is less than half of diesel, so it requires fuel tanks more than twice as large for the same energy output. The pipeline systems need to be double walled.

There have been methanol carrying tankers which have used their cargo as a ship fuel since 2014. The world's first barge to ship methanol bunkering was carried out in Rotterdam in May 2021.

Globally, there are 12 methanol fuelled ships in operation and 20 more on order. It is available in almost 90 of the top 100 ports with minor modifications to existing bunkering and storage infrastructure, we heard in the webinar. In future, it is envisaged that methanol could be produced from green (renewably sourced) hydrogen combined with biogenic CO2, such as collected from combustion of organic material. This would mean the whole cycle was 'net zero' since the CO2 would have been taken from the atmosphere.

But availability of methanol is still very low compared to the supplies that would be needed.

Crew training

"The first challenge for operations comes in crew training," he said.

All crew except galley staff were required to undergo training in the basic IGF code (International Code of Safety for Ship Using Gases or Other Low-flashpoint Fuels). The master also undergoes an advanced IGF course.

Masters, before being given a command, are required to serve a month on an LNG, methanol or other low flash point fuel vessel, including witnessing 3 bunkering operations. If the advanced training includes simulator training, they only need to watch one actual bunkering operation.

However, the "ME-LGIM" engines proved to be very user-friendly for crews, he said.

Set-up

On the Takaroa Sun, the fuel supply system, service tanks and slop tanks are all located on deck, kept segregated with a fuel valve train.

The methanol fuel supply line is double walled, with a gas detection system and nitrogen purging.

Methanol is supplied at 8-10 bar, and injected at around 600 bar. This is similar to conventional oil fuelled engines, he said.

A 40 bar (high pressure) sealing system ensures no methanol is leaked in the injection system.

The quality of methanol is benchmarked to standards from the International Methanol Producers and Consumers Association (IMPCA).

The methanol needs 5 per cent pilot fuel, because it has a low self-ignition quality.

The second and third vessels operated by NYK have a "Pilot Oil Fuel Ignited in Water" (PIFIW) system which delivers pressurised water to be mixed with the methanol, which reduces NOx emissions to meet Tier III levels.

There is a safety system which monitors methanol injection and combustion, and if



Capt. Kanchan K Mukherjee, director of operations with NYK

there are any alarms, it enables a seamless switch to low sulphur fuel oil or low-sulphur marine gasoil.

The vessel has a fuel conditioning system, known as a "Low Flashpoint Fuel Supply System (LFSS)", provided by

Alfa Laval. This has a panel providing easy identification of functioning / operation of various components during draining, purging of methanol, he said.

Experience

During the first 2 years of using the engine on methanol, no major failures were experienced with the main engine, he said.

There were some minor problems, which Captain Mukherjee described as a "Fuel Booster Injection Valve (FBIV) cut off shaft failure, a LGI (liquid gas injection) Connector Piece Seal ring damage, an LGI Connector Block Sleeve seal damage, and scrubber failures during operation due to IP converter and flow meter".

To resolve these problems, the LGI connector was replaced with an improved design and a seal with different material, filters were installed in the air line going to IP converters, he said.

On a non methanol voyage, it is recommended to run the main engine on methanol for at least an hour a day, to avoid "seizing of cut-off shafts inside the nozzle".

The CO2 emissions during the period were calculated at 24942 tonnes, where it would have been 26813 tonnes without methanol, so a reduction of 7 per cent. Theoretical minimum emissions, if methanol was used for all voyages and auxiliary engines, could have been 23404 tonnes, so a reduction of 13 percent.

In terms of the final economics, there was a marginal increase in OPEX for maintenance and training. However maintenance may become easier than with conventional fuel as the technology matures. It is very important to monitor liner lubrication, wear, and "scrape down analysis" (iron content in scraped oil), he said.

"The future of methanol certainly holds good."

Hydrogen fuel for ships

Hydrogen is the simplest zero carbon fuel, but dangerous to handle and takes up a lot of space. DNV's Mónica Alvarez Cardozo explained where we are with it

road vehicle hydrogen fuelling station, very close to DNV's headquarters building in Høvik, just outside Oslo, had an explosion in 2019.

The explosion happened because of a very small gas leak, so small only 3kg of hydrogen leaked in 2.5 hours, before it ignited. Nobody was injured. But it gives an example of the dangers of hydrogen, said Mónica Alvarez Cardozo, Senior Engineer, Piping Systems & Alternative Fuels, DNV.



Senior Engineer, Piping

Systems & Alternative

Fuels, DNV

There are two main learnings from the incident, the need for early leak detection, and the need to ensure hydrogen is well contained, she said. But this can be easier to do on land than on a ship.

Hydrogen is much more reactive than

other potential alternative fuels, especially at high concentrations, and has a higher burning velocity. "We can say hydrogen has a higher explosion risk potential," she said.

DNV tested the power of an explosion with a gas mixture 20 per cent hydrogen and 80 per cent air, and 10 percent methane with 90 per cent air. It showed that the hydrogen explosion would be much worse.

Explosions are also hard to model and predict, she said.

Hydrogen has been used safely in many land applications for decades. But it is often used with large safety distances / safety zones, or using blast walls, keeping people well away from risk, which is not possible to do onboard.

And onboard systems have multiple pipes and valves, offering more potential leak locations.

The maritime industry already has experience with competing fuels like LNG and ammonia from carrying them as cargo, but hydrogen has never been carried as a cargo. Another challenge with hydrogen is that it needs to be either compressed or liquified to carry onboard, and even liquefied hydrogen will be a third of the density of LNG, so needing a tank three times as big for the same energy content.

However there have been a number of research projects looking at hydrogen as fuel.

The MarHySafe joint development project (JDP), with 26 companies, led by DNV, aims to create a knowledge base for safe hydrogen operations in shipping.

The ZeroCoaster project study, coordinated by Vard, a Norwegian shipbuilding company, aims to show that zero carbon shipping "is theoretically possible."

There is increased interest in use of fuel cells onboard which run on hydrogen.

Where hydrogen is used in shipping, it will likely be on vessels running on coastal areas where hydrogen is available, such as in Norway, UK, and certain areas of Europe, Asia Pacific and the US, she said.





Developing an ammonia engine

MAN Energy Solutions is developing a ship's engine which can run on ammonia



AN Energy Solutions is developing a 2 stroke engine to run on ammonia fuel, expected to be available in 2024.

It is about "applying a new fuel to an old engine concept," said Peter H. Kirkeby, Principal Specialist Dual Fuel Engines, MAN Energy Solutions.

"We focus on developing an engine that has the reliability that you expect and the predictability," he said.

The higher cost of the fuel adds particular



Principal Specialist

MAN Energy Solutions

Dual Fuel Engines,

to be efficient. One challenge with handling

emphasis to the need

ammonia fuel is its high toxicity. Also combusting it can result in NOx and nitrous oxides, which need to be controlled with exhaust gas cleaning (scrubbers). A ship would be fitted with a double walled piping system, for extra protection against leaks. There are sensors in the space between the inner and outer pipe to detect any leaks.

A challenge is "gas freeing", removing all of the gas from an engine before any maintenance work is done.

On a conventional engine, this is done by purging the engine with nitrogen from an onboard supply. With an ammonia engine you also would need to purge any machinery or other equipment the fuel comes into contact with, because ammonia cannot be vented.

"We have developed a system that allows you to collect the ammonia and put it back in the tanks," he said. Only nitrogen is emitted to the atmosphere.

An ammonia ship would be expected to have a system to condition the fuel for the engine, including pressurising, heating or cooling, he said.

The technology for managing NOx emissions is "very well defined", including catalytic reactors, a mature technology. Another challenge is nitrous oxide (N2O), otherwise known as laughing gas, which is a greenhouse gas. If this is emitted to the atmosphere, it negates the benefit of avoiding CO2 emissions.

"We have a very good control of what happens in the combustion chamber," he said. "Our target is to tune the engines, so we limit the formation of N2O or decompose it before the exhaust valve opens."

"We are not interested in an additional after treatment system to manage N2O. Our target is to handle N2O through the combustion tuning."

Another aspect is the pilot fuel – a small amount of conventional fuel added to the ammonia to start the ignition. This will make CO2 emissions.

"In the first iterations of this engine, we believe 5 per cent [pilot fuel] is sufficient," he said. Over time, this pilot fuel could be replaced by biofuels, to remove this CO2 emission.

Seaspan – experience with big dual fuel fleet

Container ship management company Seaspan is ordering 25 LNG fuelled vessels, maybe the largest ever order – and its experience may be useful for tanker operators

easpan, a container ship management and owning company, has 70 vessels now on order, of which 25 vessels will be designed for LNG as a 'dual- fuel'.

Many of Seaspan's vessels are branded or named with the names of its customers, including COSCO, APL, CMA CGM, CSCL, Maersk, MOL, MSC, Yang Ming.

Torsten Holst Pedersen, COO of Seaspan, says that dual feel is seen as a way to future proof the vessels. "We believe that certainly

the LNG fuel should

be able to run until

the end [of the

said

vessel's life]," he

The rest of the

vessels on order

designs. "We

have conventional

envisage that we will

need modifications

down the line to be



Peter H. Kirkeby, Principal Specialist Dual Fuel Engines, MAN Energy Solutions

in compliance with whatever international regulations will come up," he said.

Many vessels in container shipping have high powered engines, so there is scope to 'de-rate' them, since the high power is rarely needed. After that, "then we will look at what is the best fuel available."

In terms of fuel, "we acknowledge, like everybody else, that LNG is a transition fuel," he said. But "batteries, hydrogen is a far cry from being relevant for deep sea shipping."

The most likely future fuel will be methanol and ammonia. "In the meantime, we will learn a lot about how to operate these types of ships by our LNG fleet," he said.

Reducing emissions while also remaining competitive as a company can be difficult. "We are working very closely with our customers on solving their needs. That's a very good way to stay competitive," he said.

In terms of financing, "we're doing quite a bit of green financing, bonds and direct credit facilities with sustainability linked performance goals," he said. "The pool of capital available for sustainability linked financing is growing. It is a pool of capital that we don't have access to if we're not progressing down the decarbonisation trajectory."

"There's some massive investments needed to decarbonise just the global container shipping fleet. We need a level playing field or there will be a drive towards the lowest common denominator. The industry cannot be doing this on their own."

"If your only access to capital is on a decarbonisation path, you'll have a very strong incentive to get there. It's been fascinating to see the interest we've had from the investor community."

Regulation will probably end up being a patchwork of different regional measures, he believes.

"People will argue shipping is using this as an excuse not to do anything. But if you have to switch between regulations it is going to be a very complicated matter," he said.

Selektope antifouling proven for 5 years operation

The antifouling Selektope showed outstanding protection against barnacles for five years when applied to a chemical tanker, says its manufacturer I-Tech

he antifouling Selektope showed "outstanding protection against barnacles" for 5 years, when applied to a chemical / product tanker, according to its manufacturer I-Tech.

The coating containing Selektope was applied in Nov 2015 on chemical / product tanker M/T Calypso, at Sembcorp shipyard in Singapore. The coating was designed to last 60 months. It was inspected at a dry dock in Feb 2021.

The vessel was operated by Team Tankers over most of this period.

The chemical tanker is 46,067 DWT, known both as M/T Calypso and Team Calypso. It was built in 2010.

Analysis of the voyages showed that the vessel was in water above 25 degrees C for about 15 per cent of its operation over the five years. Water temperatures above 25 degrees are classed as "biofouling hot spots," I-Tech says.

Also, she was idling for over 14 days on five separate occasions, three of these occasions being in water above 25 degrees C.

Studies have shown that ships at anchor, or moving at under 6 knots, are more susceptible to hard marine fouling by barnacles, leaving their larvae on the hull, I-Tech says.

The ship's hull was never cleaned during the promised service life of the paint technology, neither mechanically nor with divers.

In addition, M/T Calypso laid at anchor off the coast of China for one month before dry docking. During this month, the hull was exposed to a very high risk of hard marine fouling.

When the ship was taken to dry dock and inspected in February 2021, after 63 months of operation, the hull's paint showed a normal amount of wear but there was no growth of barnacles.

I-Tech used the ship data modelling tool "Slipstream" made by Molflow of Sweden to analyse the hull performance.

This analysis shows that the average yearly speed loss was smaller than 0.5% or 0.06 knots.

The 0.5 per cent compares to the 6 per cent, which I-Tech says is "commonly known within the industry as a benchmark for average speed loss."

It also exceeds the best speed loss guarantees of premium coating systems, which are set at



Where the waters are warmer, the fouling is faster

around 1.2 per cent speed loss, I-Tech says.

The vessel modelling tool predicts the vessel's true speed over ground, in any loading condition and any weather condition, by training a model.

In a performance review of the fleet, Team Tankers compared the Calypso to nine of its sister vessels, and Calypso's speed losses then turned out to be "significantly lower" than the other tankers, it said.

"Despite the fact that Team Calypso has been active in the harshest conditions for marine fouling for the past 63 months, data on the ship's sustained performance show that the Selektopecontaining antifouling paint has helped maintain the ship's efficiency," said I-Tech's CEO, Philip Chaabane.

Defining idling

One complexity with the analysis is that there is no clear definition of what 'idling' is, although it is used as a factor in guarantees of coating performance, I-Tech says.

Shipowners can have a perverse incentive to make sure the vessel is not stationary for the period of time which would trigger the definition 'idle time', by making a short trip just before this period begins and thereby keeping their guarantee active.

The study developed a new definition "fouling idling", as a period which would increase the risk of fouling.

For example, a vessel waiting for discharge of cargo or being stationary as a floating storage is commercially employed and active, but it is idling when it comes to fouling exposure.

Stationary times at yards will not be counted as fouling idling because the vessels are usually drydocked and, in most cases, a long stay implies that the vessel will be re-coated with new antifouling coating.

The vessel's activity was divided into three segments: stationary or below 1 knot; manoeuvring at 1-6 knots; steaming, above 6 knots. Up to 12 hours manoeuvring is allowed between 2 stationary activities; up to 6 hours steaming are allowed between 2 stationary activities; and yard calls are all excluded.

Growth in idling

The study also showed that the absolute number of idling vessels increased from 8,000 in 2009 to over 16,000 in 2020, indicating that the total idling problem has roughly doubled over the past 10 years.

For the tanker fleet, idling was at the highest level in May 2020 it had been since 2009. 15.4 per cent of all tankers were idling, i-Tech says. At this time, 1421 tanker vessels were idle for more than 14 days. A notable 84.2 per cent of the idling happened in medium to warm waters with high risk of fouling.

Automatic control of electric cargo pumps

Pump manufacturer Svanehøj has developed an automatic control system for electric cargo pumps on product and chemical tankers, keeping the pumps always operating at the

ump manufacturer Svanehøj has developed an automatic control system for electric cargo pumps on product and chemical tankers, which keeps the pumps operating at the optimum speed.

It is particularly useful when you have pumps operating in parallel.

They need to be electric pumps for the system to work, because their speed is adjustable.

In discharge operations, operators often switch flows between tanks and pumps. This requires the speed of the pumps to be adjusted manually. When you adjust the speed, the pump will operate outside its optimal duty point. Svanehøj's control system for cargo pumps, "Flow Control", will keep the system operating continuously on its 'optimal' duty point.

Overall pumping will be faster, in some cases up to 20 percent, so port time can be reduced.

It can be installed on existing vessels by a software service engineer, with no hardware replacements needed, Svanehøj says.

The system was tested on the Product

optimum speed

and chemical tanker Fure Ven, operated by Furetank of Sweden.

It allows the operator to take full control of the pumps, simplifying the entire cargo discharge operation. Without installing any additional hardware.

There is also a video online at https:// youtu.be/u8hmf0NBxQk

The system makes it overall easier to work with electric pumps.

"It is well known that electric cargo pumps weigh less, make less noise and use significantly less power than hydraulic cargo pumps," says Johnny Houmann, Director, Sales & Projects at Svanehøj.

"Yet most product and chemical tankers have hydraulic pumps installed because electric pumps are different to operate, and in some modes of operation a bit more challenging.

"FlowControl is changing that, and our intention is to encourage more shipowners to choose the more environmentally friendly solution."

The system connects to the vessel's VFD (Variable Frequency Drive) electricity supply.



With FlowControl we are making discharging of product and chemical [tankers] a matter of choosing the right software," says Anders Lürzer Askholm, Service Manager, at Svanehøj.

As FlowControl does not require any additional hardware, the system can be installed while the ship is in operation.

Once the service engineer is onboard, the vessel will be upgraded within a few days in parallel with the loading/discharge operation.

Fure Ven

In recent months, Svanehøj has been testing FlowControl in collaboration with the Swedish shipping company Furetank on board the P&C tanker Fure Ven.

The 18,000 DWT vessel was built in 2019 as one of Furetank's "V-Series" product and chemical tankers. Fure Ven is among the first vessels at Furetank to have electric cargo pumps installed.

The company says it has recorded a 25 per cent reduction in power and fuel consumption in relation to cargo discharge operations compared to vessels in the fleet that have hydraulic pumps.

"We have experienced a significant improvement, especially while discharging with multiple (four or six) cargo pumps simultaneously against high backpressure and high power output," says Clas Gustafsson, Technical Manager, Furetank.

"Some tuning can be done when running multiple pumps at low speed against medium or high backpressure. But overall, we are delighted with the FlowControl system," he said.

Electrical pumps have the advantage of being able to be very precisely controlled, compared to hydraulic pumps, which have a fluid under pressure used to turn the pump impeller.

Although many people prefer hydraulic pumps because they can provide much bigger forces for their size. Jotun developed the HullSkater - a hull cleaning robot for vessels. But they're...





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