MARITIME REPORTER AND ENGINEERING NEWS

marinelink.com

May 2023

MOL GREEN TECH SETS SAIL

Since 1939

Number 5 Volume 85

Voyage Optimization
Demise of the Data Silo

Classification
Remote Survey Evolves

Clean Hulls
Help Make Green Ships

Norway
Pioneering Propulsion Projects

regi.com

Renewable fuels drive change and power possibility.

InfiniD™

Lower carbon fuel solutions for your marine fleet — starting today.

Chevron Renewable Energy Group's InfiniD™ is a high-quality biodiesel that can help reduce engine emissions by up to 100% for fossil carbon[1] while improving the combustion quality and lubricity of petroleum. Together, we can drive change now.

Visit regi.com for marine fleet fuel solutions.

Chevron

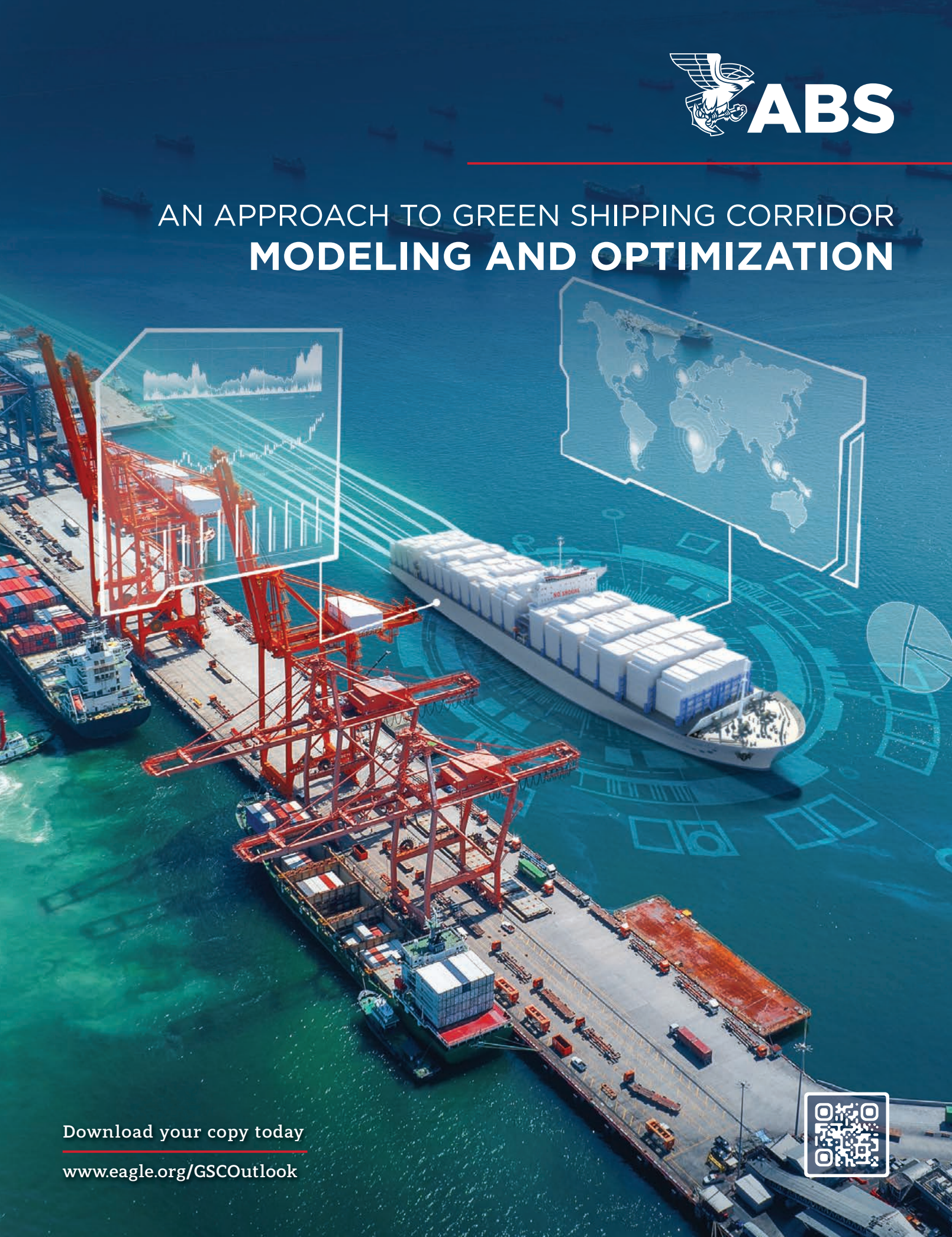
Renewable Energy Group

[1] Product is produced from renewable oils and fats. Methanol used to make biodiesel and hydrogen used to make renewable diesel and SAF are typically made from conventional natural gas but can be produced from renewable resources.

ABS

AN APPROACH TO GREEN SHIPPING CORRIDOR

MODELING AND OPTIMIZATION



Download your copy today

www.eagle.org/GSCOutlook

NO.5 / VOL. 85 / MAY 2023

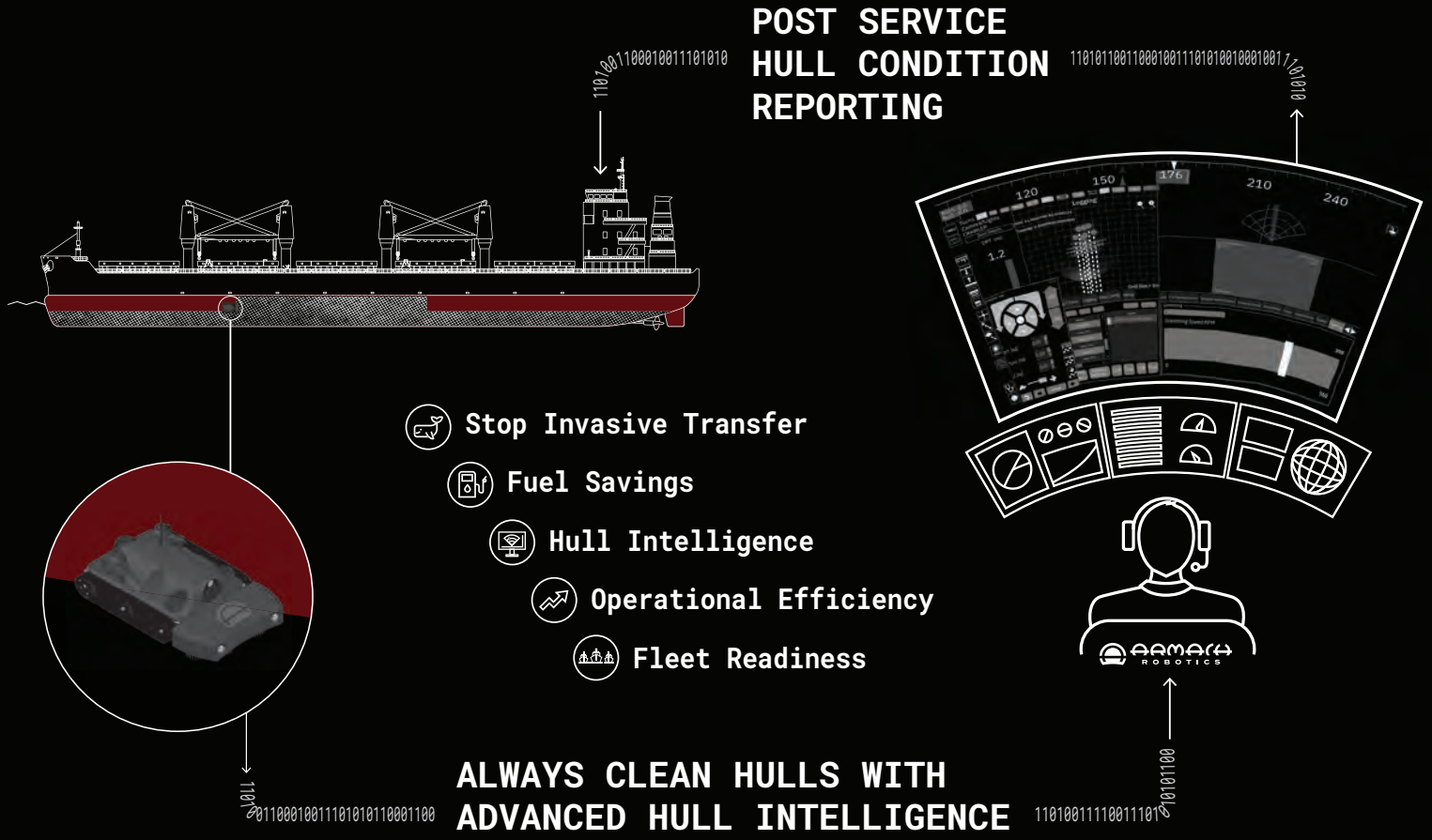
Departments

Photo on the cover:
MOL's Wind Hunter melds sail and hydrogen technology.*Image courtesy MOL*

Photo this page:
ScoutDI has performed initial tests of its drone's SLAM capabilities in the cargo tank of the Altera shuttle tanker Beothuk Spirit. *Image courtesy ScoutDI*

EverClean

Armach’s end-to-end solution to always clean hulls.



Experience the benefits of always clean hulls with Armach Robotics’ EverClean custom end-to-end solution.

Visit Armachrobotics.com/everclean to learn more.

Authors & Contributors

Bartlett

Frith

Galdorisi

Goldberg

Laursen

Lewis

Lundquist

Tomic

van Hemmen

Bartlett
Paul Bartlett is a maritime journalist and consultant with experience in ship finance and due diligence for banks and law firms.

Frith
Jake Frith is a commercial marine journalist who closely follows developments in all forms of maritime innovation, with particular interest in robotics, hull design and electrification.

Galdorisi
George Galdorisi is a retired naval aviator. He enjoys writing, especially speculative fiction about the future of warfare. The opinions expressed in his article are solely those of the author. Reference to any specific commercial companies, products, process, or service does not imply its endorsement by the Department of Defense or Department of the Navy.

Goldberg
Murray Goldberg is CEO of Marine Learning Systems, maker of MarineLMS.

Laursen
Wendy Laursen has 20 years of experience as a journalist. She has a Master of Science research degree in marine ecology as well as diplomas in journalism, communication and subediting.

Lewis
Philip Lewis is Director Research at Intelatus Global Partners.

Lundquist
Edward Lundquist is a retired naval officer who writes on naval, maritime and security issues.

Tomic
Bartolomej Tomic is managing editor of OEDigital.com.

van Hemmen
Rik van Hemmen is the President of Martin & Ottaway, a marine consulting firm that specializes in the resolution of technical, operational and financial issues.

MARITIME REPORTER AND ENGINEERING NEWS

MARINELINK.COM

ISSN-0025-3448
USPS-016-750
No. 5 Vol. 85

Maritime Reporter/Engineering News (ISSN # 0025-3448) is published monthly except for March, July, and October by Maritime Activity Reports, Inc., 118 East 25th St., New York, NY 10010-1062. Periodicals Postage Paid at New York, NY and additional mailing offices.

POSTMASTER:

Send all UAA to CFS. NON-POSTAL AND MILITARY FACILITIES send address corrections to Maritime Reporter, 850 Montauk Hwy., #867, Bayport, NY 11705.

SUBSCRIPTION INFORMATION

In U.S.:
One full year (9 printed issues) $90.00;
Two years (18 printed issues) $150.00

Rest of the World:
One full year (9 printed issues) $140.00;
two years $180.00 (18 printed issues) including postage and handling.

CONTACT INFORMATION:

Email: mrcirc@marinelink.com
Web: www.marinelink.com
t: (212) 477-6700
f: (212) 254-6271

Member BPA WORLDWIDE BRAND REPORT

Business Publications Audit of Circulation, Inc.

LEAVE NOTHING BEHIND

with a COMPAC Open Seawater Lubricated Propeller Shaft System

Eliminates Oil and Grease Discharges *(Seawater Lubricated)*

Delivers the Lowest Operating Costs for Ship Owners

Designed to Meet Extended Shaft Withdrawal Criteria

Proven Performance with 500+ Ships Fitted with COMPAC

WHAT ARE YOU LEAVING IN YOUR WAKE?

THORDON

THORDON BEARINGS INC.

GREEN AWARD

GREEN MARINE PARTNER

Want to learn more about a Seawater System? Watch our new video at the link below!

info@thordonbearings.com | www.ThordonBearings.com/Seawater

ZERO POLLUTION | HIGH PERFORMANCE | BEARING & SEAL SYSTEMS

No matter where you sit on the 'decarbonization' fence, you must admit that, at the very least, it is fascinating to sit back and watch the continued evolution, invention and re-invention of technologies that are designed to help ships run clean. From air lubrication (aka. 'bubbles') to sails; from bio-diesel to ammonia; to advanced coatings and hull scrapers; the amount of money being invested in alternative fuel and propulsion technologies is large and growing.

On the cover this month, and featured starting on page 34, is Mitsui O.S.K. Line's (MOL) investment in wind power as a means to help it reduce its own carbon footprint. While the ship featured on the cover, the wind- and hydrogen-powered Wind Hunter, is many years from reality, MOLs Wind Challenger is literally making waves today.

Late last year Oshima Shipbuilding delivered Shofu Maru, a 100,000-ton coal carrier equipped with the Wind Challenger hard sail wind power propulsion system, transporting coal, mainly from Australia, Indonesia, and North America, as a dedicated vessel for Tohoku Electric Power Co.

The introduction of the Wind Challenger is expected to reduce greenhouse gas (GHG) emissions about 5% on a Japan-Australia voyage and about 8% on a Japan-North America West Coast voyage, compared to a conventional vessel of the same type and size, and as of this writing the real-world data continues to come in for analysis by MOL.

Radical new designs and technologies are the future for sure, but as Wendy Laursen reports in her deep dive into voyage optimization (p. 30), the use and application of data and analytics are increasingly the low hanging fruit to help vessel owner/operators squeeze fuel and emission savings from existing ships. While 'big data' has become somewhat trite, when you get beyond the jargon there are plentiful solutions today that deliver real value and ROI, particularly as the democratization of data helps the capabilities emerge from the dreaded data siloes.

Utilizing new tricks and tools to squeeze additional life, revenue and savings from existing vessels, is essential, as the reality is the vast majority of ships and boats in the global fleet run today on fossil fuels, and will for many more years to come. The 'path to zero' is neither short nor cheap, and likely fraught with equal doses of failure and success. As Paul Barlett opines in the opening of his energy transition piece (p. 26), *"Protesters cause disruption but, for the moment, hydrocarbon energy underpins life as we know it."*

Gregory R. Trauthwein
Publisher & Editor
trauthwein@marinelink.com

MARITIME REPORTER AND ENGINEERING NEWS

MARINELINK.COM

HQ
118 E. 25th St., 2nd Floor
New York, NY 10010 USA
T +1 212 477 6700

CEO
John C. O'Malley
jomalley@marinelink.com

President and Chief Operating Officer
Publisher & Editorial Director
Greg Trauthwein
trauthwein@marinelink.com

Offshore Energy Editor
Bartolomej Tomic
tomic@offshore-engineer.com

Production Manager
Irina Vasilets
vasilets@marinelink.com

Production & Graphic Design
Nicole Ventimiglia
nicole@marinelink.com

Corporate Staff
Manager, Marketing
Mark O'Malley
momalley@marinelink

Accounting
Esther Rothenberger
rothenberger@marinelink.com
212-477-6700 ext 6810

Manager, Information Technology Services
Vladimir Bibik bibik@marinelink.com

Circulation
Kathleen Hickey k.hickey@marinelink.com
212-477-6700 ext 6320

Sales
Vice President, Sales
Terry Breese
breese@marinelink.com; +1 561-732-1185

Lucia Annunziata
annunziata@marinelink.com;
+1 212-477-6700 ext 6240

John Cagni
cagni@marinelink.com; +1 631-472-2715

Frank Covella
covella@marinelink.com; +1 561-732-1659

Mike Kozlowski
kozlowski@marinelink.com; +1 561-733-2477

Gary Lewis
lewis@marinelink.com; +1 516-441-7258

International Sales
Scandinavia & Germany
Roland Persson
Orn Marketing AB, Box 184 , S-271 24
Ystad, Sweden
roland@orn.nu; +46 411-184 00

Germany, Austria & Switzerland
Tony Stein
tony.r.stein@btinternet.com
+44 1892 512777

Founder:
John J. O'Malley [1905 - 1980]
Charles P. O'Malley [1928 - 2000]
John E. O'Malley [1930 - 2019]

FURUNO
When you're serious

Serious Radar. Simply Reliable.

Being aware of your surroundings is paramount. Your primary line of defense is a Radar you can count on, from a company you can depend on.

FAR15x8 Series
Black Box Radar

FR19x8VBB Series
Black Box River Radar

FAR22x8BB Series
Black Box Radar

Tranquil conditions can quickly change. Evade the ravages of Mother Nature with the world's most relied upon Radar.

Unmatched detection at every range	Available in Conventional or Solid-State Models	Unique features including ACE (Automatic Clutter Elimination)	Identify hazards quickly with Target Analyzer™ and Fast Target Tracking	X-Band or S-Band Configurations Available

UHD
Ultra High Definition Radar

TARGET ANALYZER

Learn more at www.furunousa.com

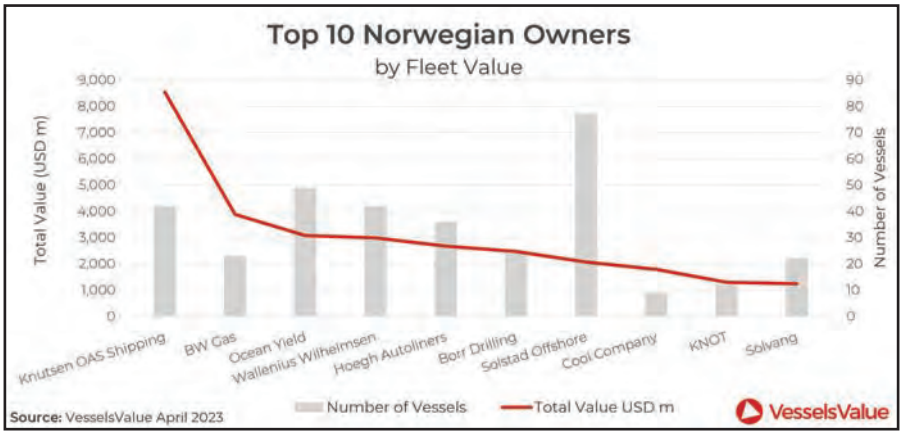
Powered by VesselsValue

Norwegian Shipowners

Historically, Norwegian shipowners have been world leaders in the identification and adoption of new and emerging technologies. Courtesy of VesselsValue, have a glance at the growth and trajectory of the Norwegian-owned fleet.

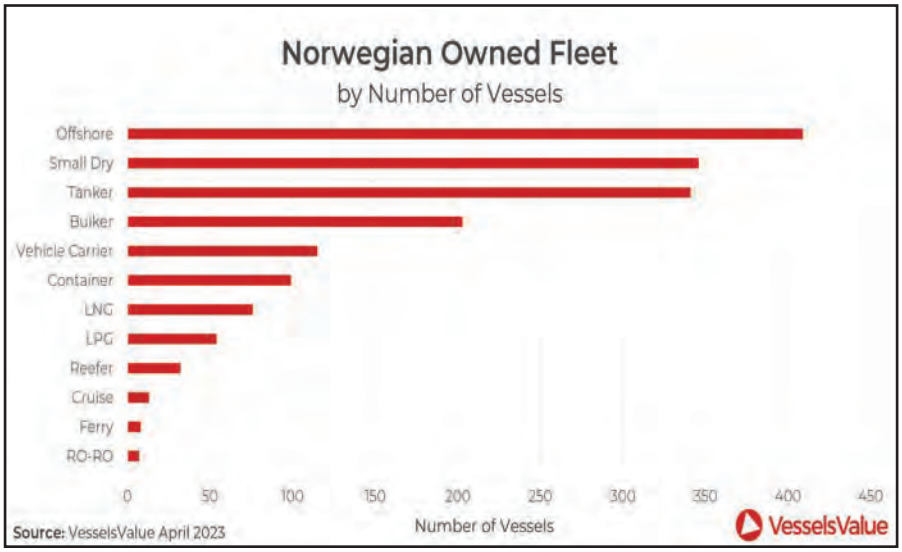
Top 10 Norwegian Owners

Company	# Vessels	Vaule ($)
Knutsen OAS Shipping	42	8,537
BW Gas	23	3,879
Ocean Yield	49	3,077
Wallenius Wilhelmsen	42	2,987
Hoegh Autoliners	36	2,674
Borr Drilling	24	2,466
Solstad Offshore	77	2,066
Cool Company	9	1,783
KNOT	12	1,292
Solvang	22	1,240



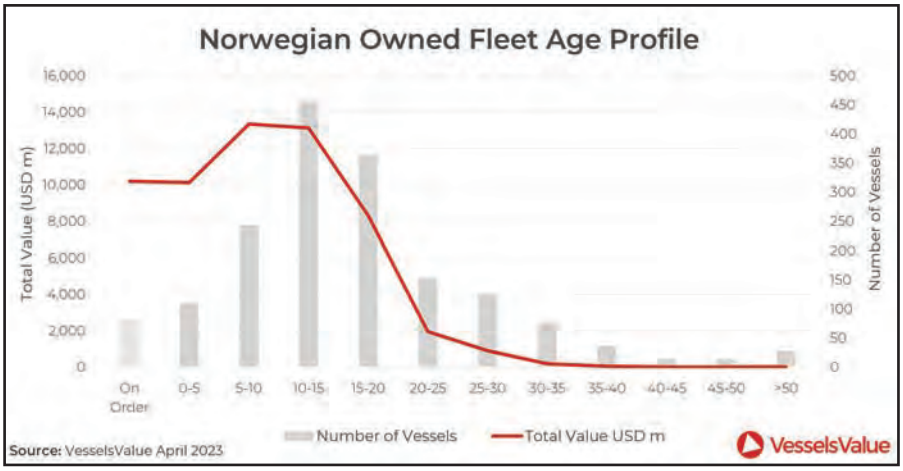
Norwegian Owned Fleet, by Value

Type	# of Vessels	Value ($)
LNG	76	14,434
Offshore	409	12,340
Tanker	341	11,505
Vehicle Carrier	115	7,839
Bulker	203	4,322
LPG	54	3,061
Container	99	1,642
Small Dry	346	1,365
Cruise	13	803
Ferry	8	732
Reefer	32	108
RO-RO	7	53
Grand Total	**1,703**	**58,205**



Norwegian Owned Age Profile

Age Group	# Vessels	Total Value ($)
On Order	83	10,198
0-5	110	10,127
5-10	243	13,345
10-15	456	13,132
15-20	365	8,297
20-25	153	1,953
25-30	125	903
30-35	77	177
35-40	36	46
40-45	14	10
45-50	13	6
>50	28	11



SIGN UP TODAY

The 24th edition of Europe's largest commercial marine and workboat exhibition, is a proven platform to build business networks.

Seawork delivers an international audience of visitors supported by our trusted partners.

Seawork is the meeting place for the commercial marine and workboat sector.

- 12,000m² of undercover halls feature 500 exhibitors with over 70 vessels, floating plant and equipment on the quayside and pontoons.
- Speed@Seawork on Monday 12 June at the Royal Yacht Squadron in Cowes offers a sector specific event for fast vessels operating at high speed for security interventions and Search & Rescue.

  Speed@Seawork
  Sea Trials & Conference
- The European Commercial Marine Awards (ECMAs) and Innovations Showcase.

  ecm awards
  european commercial marine
  In partnership with SIEMENS
- The Conference programme, chaired by industry experts, helps visitors to keep up to date with the latest challenges and emerging opportunities.
- The Careers & Training Day on Thursday 15 June 2023 delivers a programme focused on careers in the commercial marine industry.

sea WORK MARINE CIVILS

IN PERSON ONLINE

13 TO 15 JUNE 2023 Southampton United Kingdom

For more information visit: seawork.com
contact: +44 1329 825 335
or email: info@seawork.com

#Seawork mercatormedia

Media partners

MARITIMEJOURNAL BOATINGBUSINESS

Tip #47

THE ELUSIVE TRAINING ROI

By Murray Goldberg

The maritime industry is a safety-critical sector that is responsible for the wellbeing of countless officers, crew and passengers. As technology advances and the industry grows, it is crucial that we prioritize high-quality training and assessment and utilize analytics to continuously improve our training programs. But how do we know when we have done enough or spent enough on our training programs? One answer is through a Return on Investment (ROI) calculation. And while it may be difficult to pin down an exact ROI for our efforts, there are some basic principles we can use to help us know when we need to do more or when we have reached the point of diminishing returns.

We are all well aware of the benefits of high-quality training. It reduces the risk of accidents and incidents which can lead to loss of life, damage to property, and environmental disasters. Effective training and assessment also contribute to the overall efficiency of the maritime industry. Well-trained crew members can optimize the use of resources and reduce operational costs.

Although we all likely agree with the above, it is difficult to quantify the exact ROI of high-quality training. Still, several indicators suggest that the investment is worthwhile. For instance, a reduction in accidents and incidents can lead to significant cost savings in terms of repairs, legal fees, and insurance premiums. Additionally, the improved efficiency resulting from better training can increase profitability. Finally, training analytics can be used to identify gaps in training and assessment, allowing for targeted improvements that yield a higher ROI.

Despite the difficulty in determining definitive ROI calculations, there are some simple approaches we can use to obtain some measurements of ROI on training programs. Let's look at some common-sense, usable approaches that we in the maritime industry can use to effectively evaluate the ROI of training and assessment initiatives.

First, to determine the level of return, we need first to identify the return we hope to see. This means establishing clear training objectives that align with the company's overall goals around improved performance, reduced incidents, and increased operational efficiency. These objectives should be

SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) to facilitate easy tracking of progress and evaluation of results. By setting these measurable objectives, we can better gauge the effectiveness of training and assessment initiatives because we can look at their impacts in terms of specific goals.

One part of accomplishing the above will be to identify key performance indicators (KPIs). Each of these KPIs should be directly linked to the objectives of the initiative.

These may include metrics such as the number of accidents, incident rates, employee retention, and productivity improvements. Each of these have a cost. By monitoring these KPIs before and after the training, organizations can begin to assess the impact of the initiative on overall performance.

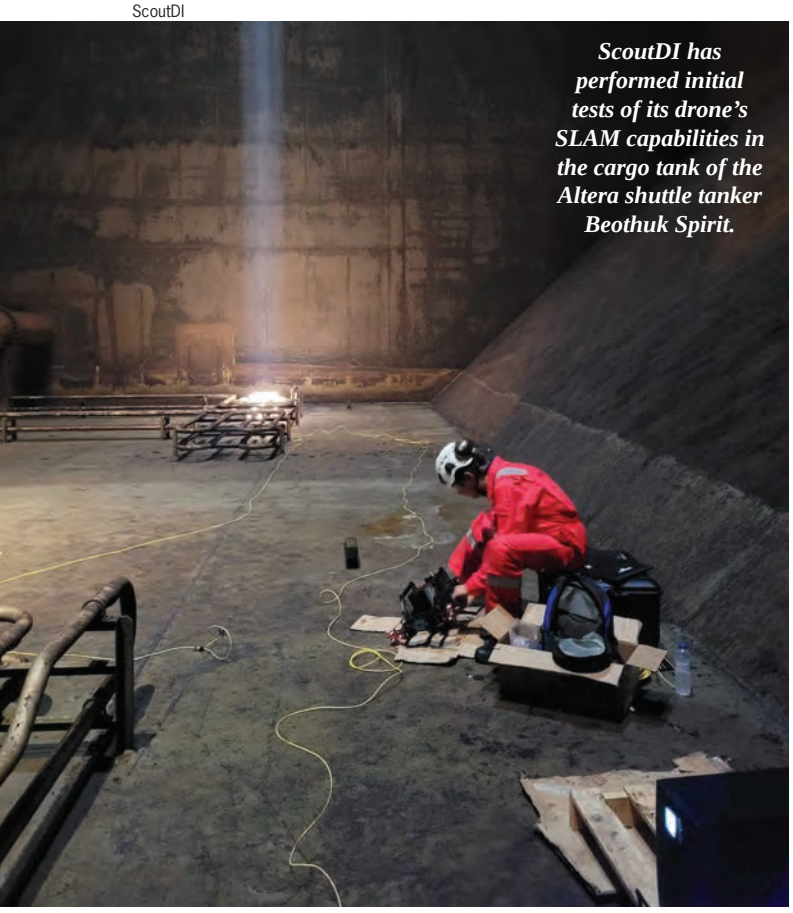
It is also important when considering the "R" part of ROI to remember that many returns will go beyond immediate improvements in workforce competency. These initiatives can lead to long-term benefits such as an improved level of professionalism and workplace culture. This leads to improved retention, recruitment, corporate reputation, and even regulatory compliance. Although these longer-term benefits are more difficult to quantify and to relate to specific investments, their return is real and it is crucial to consider them alongside the short-term benefits in order to obtain a complete picture of the value provided by the investment.

On the "I" side of the ROI calculation, it is important to evaluate both direct and indirect costs. As examples, direct costs include expenses related to the development and delivery of the training, while indirect costs might involve lost productivity due to employee absence during training or implementation of new procedures.

And finally, it is important to note that ROI is not a static quantity. To ensure the continued effectiveness and relevance of training and assessment programs, it is important to conduct regular evaluations of our initiatives. This includes gathering feedback from participants, monitoring changes in costs and KPIs, and adapting the program as needed based on the results. By consistently evaluating and adjusting our training and assessment initiatives, organizations can ensure we are maximizing the ROI of our investments in workforce development.

Thanks so much for reading and until next time, sail safely!

ScoutDI



ScoutDI has performed initial tests of its drone's SLAM capabilities in the cargo tank of the Altera shuttle tanker Beothuk Spirit.

REMOTE SURVEY: THE NEW END-GAME

More than remote witnessing, more than remote data analysis, remote survey techniques are now going to aid the shift to full vessel autonomy.

By Wendy Laursen

The technology that enables a robot to safely navigate an environment it has no prior knowledge of is called Simultaneous Localization and Mapping (SLAM). "It is the key to autonomy for any aspiring can-do inspection robot." That's according to ScoutDI, a participant in the REDHUS project led by DNV which is developing a prototype inspection drone.

SLAM is not a specific, copyrighted piece of technology. It is the collective name for the computational problem of constructing or updating a map of an unknown environment using technology, such as LIDAR and lasers, while at the same time keeping track of your location within it. Typically in flight a drone prioritizes object detection and avoidance; afterwards it undertakes the computation-intensive work of developing a fully detailed map. But the better it gets at doing this in flight, the better it is at operating in spaces it has not visited before. Then all the pilot needs to do is supervise an inspection by pointing to locations in a 3D point cloud.

ScoutDI has performed initial tests of its drone's SLAM capabilities in the cargo tank of the Altera shuttle tanker Beothuk Spirit where it achieved with-centimeter accuracy in flight. It will ultimately be paired with DNV's corrosion, crack and deformation algorithms. The corrosion and crack detection algorithms are already at a level where they are comparable to human surveyors when detecting defects in images. A drone that can take pictures of developing conditions from the same distance and with the same lighting helps the process.

Other class societies are advancing corrosion artificial intelligence (AI) including ABS which recently completed a pilot project applying AI to the detection of corrosion and coating breakdown in partnership with Google Cloud and SoftServe.

China Classification Society is also developing systems for corrosion and for gathering hull thickness measurements so that a drone or robotic crawler can transmit it to a surveyor for real-time assessment. Xiang Linhao, an expert at the CCS Science & Technology Innovation and Test Center, says remote surveys are moving beyond "remote witness" mode to being a remote survey based on data, but this involves agreement between owner and class on aspects such as data acquisition methods, interface protocols and exchange formats. Once established, high speed, low latency and high-volume data transmission will enable the shift from traditional surveys to condition-based surveys and continuous status monitoring.

The hardware required for remote surveys should be technically applicable to existing and older ships, says Masuaki Urata, General manager, Public Relations Team at ClassNK. How-

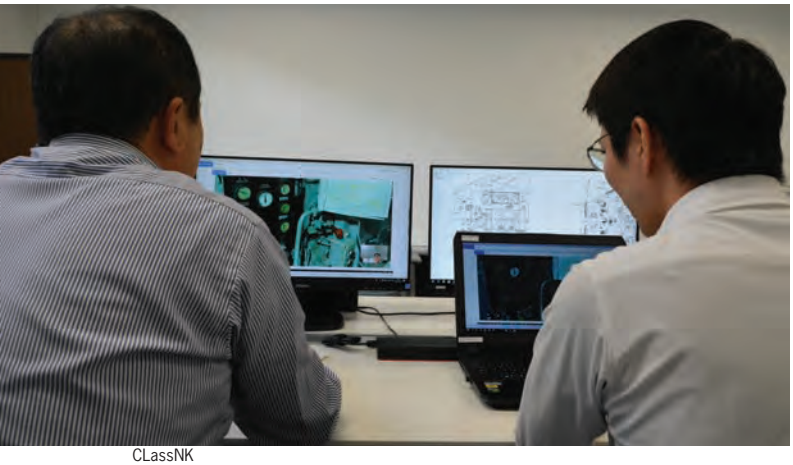
ABS recently completed a pilot project applying AI to the detection of corrosion.

ABS

ever, it is likely that newbuildings will contribute to the further expansion of remote surveys. A shipping company's decision to accept the CAPEX and OPEX for increased communication and other necessary items depends on various factors beyond remote survey functionality. The use of remote surveys also requires ship-side preparation and crew member proficiency.

Tihomir Kezic, Digital Solution & Transformation Director, Bureau Veritas (BV), says: "The transition from reactive and time-based maintenance to condition-based and predictive maintenance will bring tremendous benefits to machinery maintenance activities, with increased reliability and an upward trend in ROI for vessel owners."

New digital capabilities will also enable "infant failures" of machinery components to be spotted before they escalate and lead to catastrophic technical problems. Data sharing can also negate the need for opening machines for audit inspections.



CLassNK

Moving forward, digital twins of in-service ships will become more commonplace. The aim is to virtually reconstruct a 3D model of an existing ship using images collected by drones during surveys, together with scanning and photogrammetric technologies. This would allow for hotspots and other vulnerable areas to be recorded throughout the ship's inspection history using 3D visuals.

"3D models are important to fully understand the multiple phenomenon that can affect the condition of the ship's hull and machinery," says Kezic. "For example, they can help in carrying out Operational Deflection Shape (ODS) to determine the vibration patterns and dominant frequencies responsible for structural and machinery issues."

Joseph Morelos, Maritime AI Applications Innovation Leader at Lloyd's Register (LR), notes that using AI in advanced monitoring such as anomaly detection, fault detection and isolation, and diagnostics and prognostics can increase operational safety and productivity by preventing failures and collateral damage. "Class should make sure that the AI systems employed by the owners are effective, dependable and safe. Once these systems are proven they can be scaled to improve the operations, reliability and safety of the fleet, resulting in a common win for owners, OEMs, insurers, class and regulators."

To support this, LR has implemented assurance frameworks for maritime AI systems. In 2022, it announced a collaboration with the Alan Turing Institute which provides fast and cost-

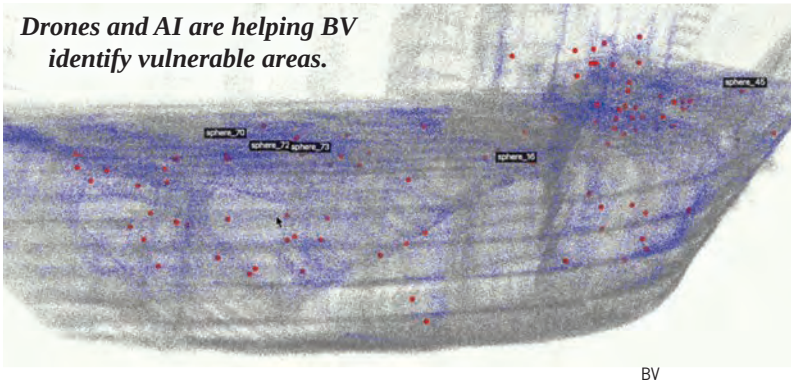
China Classification Society

effective independent assurance and testing of digital technology, using resources and expertise from both organizations. Streamlining the testing process for digital and AI-enabled maritime technology will rapidly speed up digitalization in the industry, incentivizing safe practice and improving affordability by reducing competitive advantage risks, says Morelos.

Korean Register (KR) is researching condition based maintenance technology for main propulsion engines, gensets, pumps, purifiers, piping, electric propulsion systems (lithium-ion batteries), and cargo control systems (high-voltage cargo switchboards). Gathering reliable data is a challenge, so KR has developed various simulated failure mode scenarios and has produced data on land-based test beds.

Michela Schenone, Marine Digital Solutions Manager at RINA, says interest in remote survey is growing, particularly with owners of newbuildings. The quality of data is also improving, and RINA is developing tools such as electronic log books for owners that will enable surveyors to be prepared onshore before a physical visit to a vessel. This is changing the way classification services are being provided. "It's a change in paradigm, because rather than waiting for a call, we are now proactively looking after the vessels to ensure the quality of our services," she says.

Schenone sees a further paradigm shift. "We are now setting the basis for autonomous vessels – vessels that are fully digitalized and fully remotely controlled." Class societies will be in the loop, she says, remotely and continuously monitoring vital equipment to ensure safe operations.



Drones and AI are helping BV identify vulnerable areas.

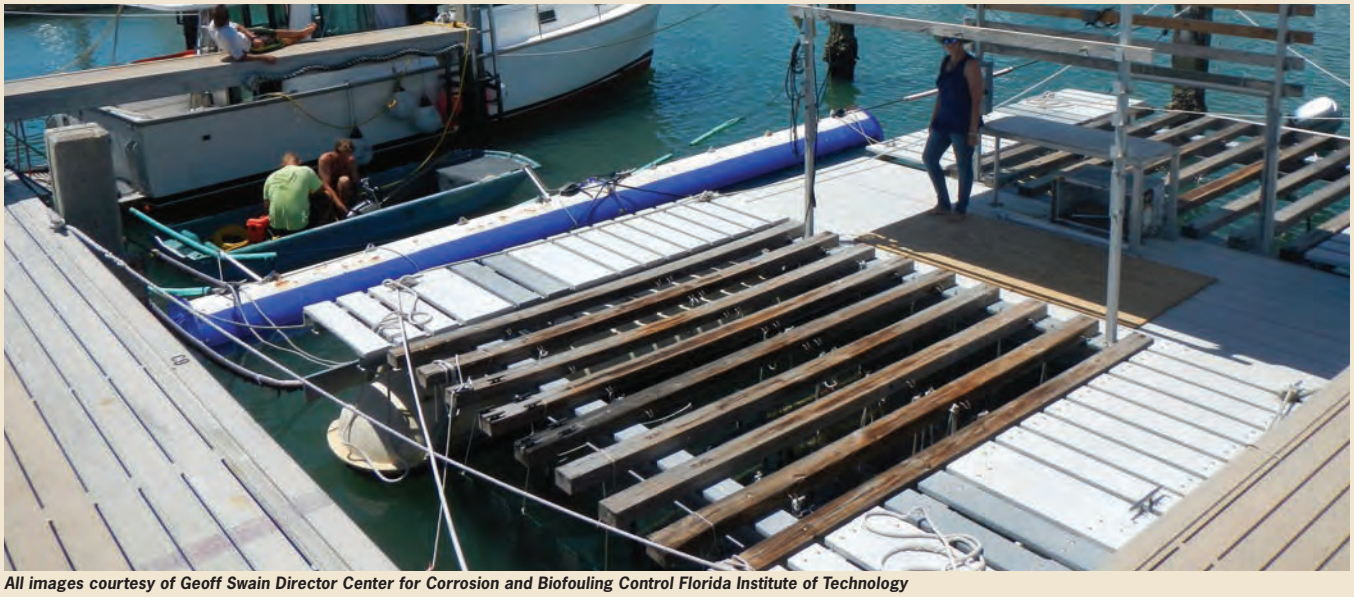
BV

Collaborations Foster Innovation to Manage Biofouling

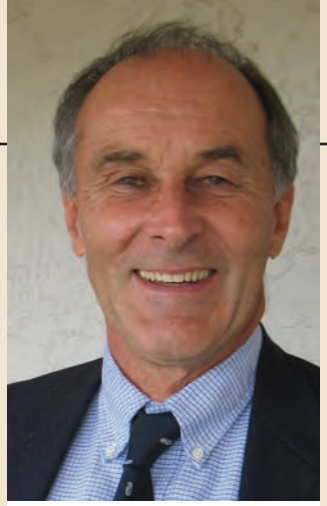
Managing biofouling on ship hulls has been a topic of interest since the ancient Phoenecians 3300 years ago. Like many things in the marine industry, progress in this field has been the result of a slow, steady churn of technological improvements, punctuated by periodic significant advancements (e.g. copper sheathing, anti-fouling & fouling release paints). We are now in the midst of another advancement: hull grooming. Research funded by the US Office of Naval Research and defined by the Florida Institute of Technology (FIT)'s Melissa Tribou and Geoff Swain in 2009, hull grooming "refers to the gentle, habitual and frequent mechanical maintenance of submerged ships' hulls in order that they remain free from extraneous matter such as fouling organisms and particulate debris, with minimal impact to the coating." In hindsight, it seems remarkably simple - clean it regularly in a way that doesn't damage the paint. As it turns out, some of those adjectives (gentle, frequent, habitual) are not easy to achieve.

FIT's Center for Corrosion and Biofouling Control (CCBC) is a globally recognized research and education center that has worked across a broad spectrum of biofouling and marine corrosion issues since its inception in 1984. The Director of the Center, Dr. Geoff Swain, has a background in offshore sailboat racing, and has long recognized the value of clean hulls. Serious racers always make sure their hulls are freshly cleaned before a race, an approach counter to the shipping industry, who have opted for methodologies that seek to delay cleaning for as long as possible.

Through a series of collaborative partnerships, with both the US Navy and commercial companies, the CCBC team has developed, tested, redeveloped, and retested numerous methodologies that can properly achieve the "gentle, habitual and frequent" requirement of underwater hull grooming. With lab facilities to conduct accelerated testing of cleaning tool-to-coating impacts, and a large-scale in-water test facility in Port Canaveral that enables testing on true fouling conditions, the team identified a soft brush design that was effective at keeping the test panels clear of fouling, without damaging the coatings. Large scale testing was conducted on both a copper ablative and a fouling release coating, and additional smaller scale tests were conducted on a number of other coating types. Consistently, the results showed that routine gentle cleaning kept the panels free of fouling. Equally importantly, when compared to panels left alone and then cleaned using traditional diver methods, the groomed panels were left in much better condition; the cleaning



All images courtesy of Geoff Swain Director Center for Corrosion and Biofouling Control Florida Institute of Technology



Dr. Geoff Swain

Melissa Tribou

methods necessary to remove the heavy fouling caused damage to those panels, while the groomed panels showed no damage and for the ablative copper, even a decrease in roughness.

Demonstrating that frequent, gentle cleaning is safe and effective at managing the biofouling on ship hulls is the first part of making hull grooming a commercial reality. The second part, and not an insignificant part, is developing a means to deliver the capability efficiently and economically. Dr. Swain's work and collaborations over the years have shown the impacts of fouling growth on fuel consumption, so there is an economic incentive to a hull grooming regimen, but even considering that, the cost of simply using existing technology to clean 12 to 24 times more frequently is not realistic. Nor do shipowners have time in their schedule to allow their ships to be tied up pier side more frequently to accommodate these cleanings. A new approach was needed.

Industry had already started to move towards more mechanized solutions 40+ years ago, but even those systems were still expensive and required significant logistical overhead to deploy and operate. Many systems still require divers to operate, although newer remotely operated systems are now starting to appear on the market. Even with small efficiencies and improvements, these systems are not well suited to support a grooming regimen for a ship. Smaller systems, with autonomous capabilities and no need for logistical support, are necessary for grooming to advance. In the early 2000s the USN's Office of Naval Research (ONR), invested in research to develop robots to advance the technology. Much of the aforementioned testing was completed using a small, crawling ROV with brushes installed on it, proving that a robot can perform the cleaning. This solution still required a pilot to operate the ROV, and the ability to navigate the system on a ship hull was marginal, limiting the efficiency of the system.

With funding from ONR through a Small Business Technology Transfer (STTR) contract, Greensea Systems, Inc. partnered with the CCBC to advance the concept of an autonomous grooming robot, through the concept of hull relative navigation. The technical details of the hull relative navigation and autonomy have been detailed in other articles in this publication, but it's important to highlight these advancements. With a robot able to identify features on the hull that it can reference as it travels, coupled with precise information about distance and direction traveled, an accurate hull map can be built, completely independently of any global position information. This is necessary because a grooming robot can't afford to miss any spots on the hull, nor can it take the time to repeatedly go over the same spots to guarantee coverage. The large-scale test facility in Port Canaveral was an excellent location for this development work as it allowed for testing in a controlled environment, while also allowing for operations on fouled surfaces. Additionally, CCBC was able to test materials for the robot tracks to ensure an optimal solution was found (adequate traction, but non-damaging), as well as conduct routine cleanings of the panels with the Greensea hull crawler. Working in this relationship with FIT enabled Greensea to rapidly advance autonomous technologies, successfully complete the STTR and continue the relationship with the Navy. The CCBC continues to work with the Navy and across industry to develop and advance the technologies around in-water cleaning, including coating testing and cleaning tool development and testing, and continues to enhance their standing as a global leader in the field.

Part of the STTR requirements were for Greensea to demonstrate a path to commercial viability for the autonomous technology. In putting this plan together, Greensea's CEO Ben Kinnaman recognized the value in delivering a scalable intelligent robotic service solution, resulting in the development of the Armach cleaning robot used to perform EverClean the maritime industries first always clean hull service.

The Author

Lander

Karl Lander is the Director, Regulatory Compliance and Outreach at Armach Robotics. He joined Armach following 4+ years with Greensea Systems, where he was Director, Hull Robotics.

HyBlend

Chickens and Eggs in Technology Adoption

© alison1414/AdobeStock

By Rik van Hemmen

I will readily confess that 20 years ago I was not convinced that EV's were the answer to sustainable energy. Instead, I had long been a fan of hydrogen. I was well aware that there were technical issues associated with hydrogen, but was equally aware that, for total sustainable energy, a transportable fuel is needed and hydrogen seemed to be the way to go.

I envisioned hydrogen generation from sustainable sources (wind, solar, etc) and the use of hydrogen with fuel cells in cars, ships and with gas turbines in airplanes. I knew battery technology had technical limits (and also always will) and the development of hydrogen as our standard fuel would bypass that problem. Everything could run on hydrogen (or derivative synthetic fuels like e-methanol) and since hydrogen can be stored, it would deal with the inherent variability of wind and solar.

I was wrong. Actually, I continue to be right, but missed a very important issue in major technology adoption.

Major technology advances are rare. Humanity has probably encountered no more than a dozen of those.

Some of which are:

1. Fire
2. Agriculture
3. Written word
4. Sail
5. Steam
6. Fossil fuel economy, and now …
7. Sustainable energy

These technology advances are extremely cathartic and often are not easily adopted because, besides the adoption of the actual technology, there are also underlying associated problems that need to be solved and they always take on a chicken

and egg character.

Take fire. When humanity invented fire, almost certainly a conversation as follows ensued:

"Look I can make fire"

"So what?"

"Well now you can cook food and it will taste better"

"Well maybe it tastes better but I am not sure I want to spend the effort to gather fuel, I think I will rather spend more time eating raw food than gathering fuel and have less time to eat food."

There is an adoption hump there. Often those humps are emotional (I don't like new stuff), but too often they occur because two things need to come together at the same time to accept a new technology and its benefits.

If fuel for cooking fires is very readily available, cooked food will catch on immediately. If fuel is scarce raw food remains in the diet.

This is the chicken and egg issue.

I will even substitute sustainable fuels for the fire discussion:

"Look I can make sustainable energy"

"So what?"

"Well now you can live like before and not wreck the world"

"Well maybe it saves the world, but I am not sure I want to spend the effort to use sustainable fuel, I think I will rather burn oil than look for sustainable fuel and have less time to take advantage of the things that fossil fuels allow me to do."

In other words: If sustainable energy is readily available, people will use it. If not, they will stick with fossil fuels.

While I technically preferred hydrogen over batteries, I did not pay sufficient attention to the chicken and egg problem with regard to sustainable energy. Hydrogen is simply not available to the public, but electric is available at every home. This allowed EVs to first gain a toehold and today this is developing into a ubiquitous world wide battery and charging network. Hydrogen may technically be better than batteries, but a hydrogen network cannot be developed without cars using hydrogen and hydrogen being readily available simultaneously.

Toyota actually has tried to establish a start-up hydrogen network in California with its Toyota Mirai program. Technically it works quite well, but is not gaining rapid customer acceptance since there are only a few hydrogen fuel stations in the state.

This chicken and egg realization has led me to surrender to battery powered EV's. I simply could not think of a way that hydrogen could be generally introduced into the world's sustainable energy infrastructure to an extent that electricity already has been introduced.

But then I came across the HyBlend project. Once all energy (electricity, heating and transportation) can be generated sustainably (a technical reality as long as we keep pushing efficiencies and include nuclear), we will have the ability to generate hydrogen from water during peak production hours and the ability to generate power from stored hydrogen during peak demand hours. And this is not just on the electric grid, it will apply along the entire energy infrastructure. All we have to do is distribute it widely and, strangely, HyBlend could provide the mechanism for that.

HyBlend is a DOE program that injects green (sustainably generated) hydrogen into the national gas pipe line network. When I heard about this as an engineer, I was incredulous because hydrogen will leak through conventional gas pipe seals and it seemed to me it would require an entirely new gas pipe line network down to every home and outdoor gas BBQ. However, in mixture and at relatively low pressures that issue is manageable with most existing gas lines as long as the amount of hydrogen in the natural gas is around 5%.

Upon initial inspection, once may think that, at best, it will only reduce the greenhouse effect of all the natural gas we use in the world by 5%.

However, here come the eggs (hydrogen fueling stations) for my hydrogen chickens (Toyota Mirais).

This hydrogen can be generated all over the country wherever there is sustainable power and some water. In Howell, NJ such a plant already exists. It takes sustainable energy and feeds it into the local gas pipe lines. However, if any of that hydrogen is needed to power a car, ship or plane, it is only a diverter valve away anywhere this hydrogen is generated. Instead of locally injecting it into the gas line this green hydrogen could be compressed or turned into e-methanol, and would be widely available as a storable transportation e-fuel.

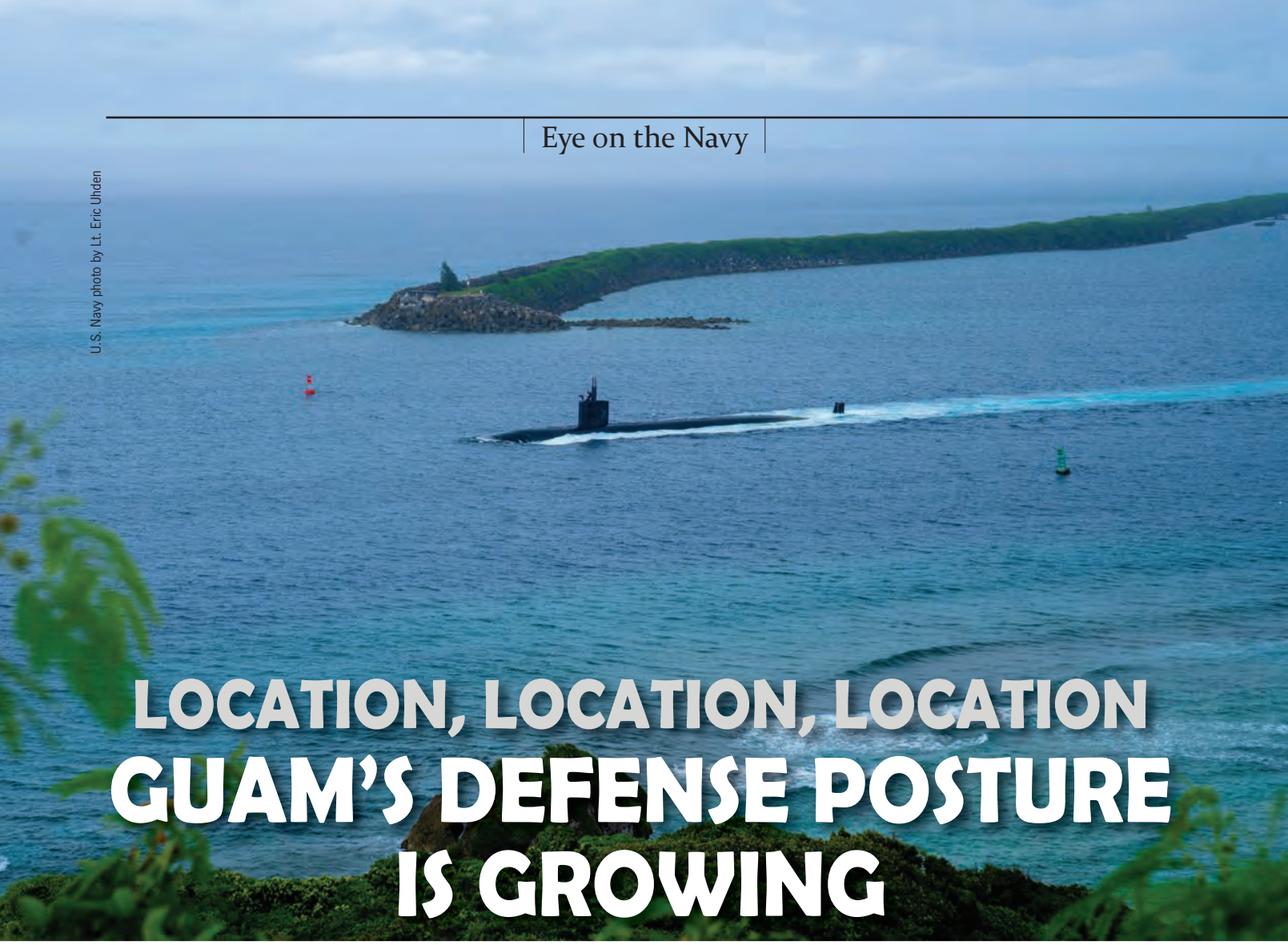
In other words, this relatively simple program that initially might displace only 5% of all natural gas, could actually result in a national e-fuel supply network that will be the egg that is needed to make the chicken exist.

Even more interesting, this program will actually displace natural gas, because once we have ample sustainably generated transportable e-fuels (whether compressed, piped or liquid) together with an improved electrical grid, we no longer need natural gas at all. At that point the options will be endless, and consumer acceptance will be almost automatic since the chicken and egg issue has been removed.

I used to think that sustainable energy will be one of humanity's major technology advances, but it may well turn out that Hyblend was the actual invention that made it happen.

Meanwhile, never, ever, ignore Chicken and Egg issues in design.

For each column I write, **MREN** has agreed to make a small donation to an organization of my choice. For this column I select Menhaden Defenders. During a delightful wide ranging lunch on all subjects that interest me, its fearless leader, Paul Eidman, introduced me to the Hyblend concept. **www.menhadendefenders.org**



U.S. Navy photo by Lt. Eric Uhden

LOCATION, LOCATION, LOCATION
GUAM'S DEFENSE POSTURE IS GROWING

By Edward Lundquist

With the rise of China and her global ambitions, the military importance of Guam in the Indo-Pacific theater has become apparent. The force levels on the island had drawn down from a peak of about 26,000 at the height of the Vietnam War to a tenth of that—just 2,500 people in the early 2000s. Today, that's changing. Guam's defense posture is growing.

Guam's proximity to major population centers in East Asia underscores its strategic importance. The island is just 1,400 miles from Tokyo, Manilla or Port Moresby.

All of the armed services have a presence on Guam. The Coast Guard has upgraded its presence with the establishment of Forces Micronesia/Sector Guam, and now has four fast response cutters and an ocean-going buoy tender homeported there to support missions in Oceania. The Army established a missile defense capability to protect the island following threats by Kim Jong-un. The THAAD battery is expanding to include more sensors, interceptors and command and control capability to provide 360-degree protection for the island. Anderson Air Force Base remains one of the largest military airfields in the theater and is ready to support surge operations for bombers, logistics aircraft and fighters.

While the Navy's Ship Repair Facility at Guam has diminished since the end of the Cold War, the Naval Base at Apra Harbor still provides much needed logistics support for transiting ships. And today a squadron of nuclear-powered attack

Image above: The Los Angeles-class fast-attack submarine USS Springfield (SSN 761) departs Apra Harbor, Guam, Oct. 5. Springfield is one of five submarines assigned to Commander, Submarine Squadron (SUBRON) 15. SUBRON 15 is responsible for providing training, material, and personnel readiness support to five forward-deployed Los Angeles-class fast-attack submarines and is located at Polaris Point, Naval Base Guam.

U.S. Navy photo by Mass Communication Specialist 2nd Class Joshua M. Tolbert

The Seawolf-class fast-attack submarine USS Seawolf (SSN 21) sails into Apra Harbor, Naval Base Guam, Aug 25. Seawolf is a nuclear powered fast-attack submarine and is the lead ship of its class.

submarines are based at Guam, supported by two submarine tenders that provide a full range of intermediate maintenance and repair.

The most dramatic change is taking place where the Marine Corps is building its first new base-- Marine Corps Base Camp Blaz (MCBCB)--in 70 years. When complete, 5,000 Marines currently forward deployed to Okinawa will be relocated to Guam. In addition to those Marines who will be garrisoned there, military forces throughout the Indo-PACOM area of responsibility will take advantage of the world-class training facilities being built there.

MCBCB's Skaggs Urban Training Complex will feature a "military operations in urban terrain" (MOUT) training facility. Repurposing 130 buildings that used to be a family housing area for Anderson Air Force Base, the "MOUT Town" can replicate any kind of urban training environment, complete with stores, churches, schools and even embassies. The training will be recorded and then played back for the participants to evaluate how well they performed in different scenarios.

"We'll have a live-fire range, a grenade range, a breacher course and a combat-vehicle operators training course," said Lt. Col Christopher Driscoll, the chief of staff for MCBCB. "With the MOUT facility, as well as the surrounding to 2,000 acres, we will be able work a regiment through here with within a fully secure area."

The submarine force recognizes the critical location of Guam as a base of operations. "It's a strategic forward location; it's a tremendous logistics hub; and it's close to our allies and partners in the area," Capt. Carl Trask, commander of Submarine Squadron 15.

The submarine facilities at Polaris Point are also being upgraded to handle the new Virginia-class submarines. "We're going to be building a new pier, maintenance facilities and training center to support the Virginia class boats," said Trask.

Unlike other submarine homeports that have shipyards or intermediate maintenance activities, Guam's submarines are supported by two submarine tenders, which are also the last two tenders in the U.S.

As the U.S. Navy has pivoted to the Indo-Pacific and increased the number of submarines based here and deployed in theater, the workload warranted having another tender in Guam to get the mission done.

"We have two so they can be expeditionary," said Trask. "USS Frank Cable is in Vallejo, California, undergoing a normal drydocking period for maintenance; while USS Emory S. Land is here supporting the maintenance on my submarines."

The tenders have repair and maintenance technicians from every specialty in the Navy. "We perform the expeditionary rearm and reload mission to provide whatever a submarine might need, and in many cases, what a surface ship might need anywhere in the theater," said Emory S. Land Commanding Officer Capt. Brent Spillner. "We can fix just about everything on a submarine, from propulsion plant and non-nuclear work to the mechanical end of combat systems. The combat systems electronics work is usually handled by contractors, but we're standing by to support that effort, too, as required."

Despite being a relatively small island, it serves as a central point for defense related activities across a vast area, including the Commonwealth of Northern Marianas Islands (CNMI) to the north, and the three "compact of free association" (COFA) countries in Micronesia: Republic of Paula, Federated States of Micronesia and Republic of Marshall Islands. Like Guam,

U.S. Navy photo by Mass Communication Specialist Seaman Darek Leary

CNMI is sovereign U.S. territory.

"We do quite a bit of training here with various partners throughout the region. It's not nearly as far as going to Hawaii, which means more time training and less time in the transit," said Rear Adm. Benjamin Nicholson, who has serves as Senior Military Official for U.S. Indo-Pacific Command representing Guam, Commonwealth of the Northern Mariana Islands (CNMI), Federated States of Micronesia (FSM), and Republic of Palau; Commander, U.S. Naval Forces, Marianas; Commander, Task Force West and Commander, Joint Region Marianas.

There are significant training opportunities in CNMI. The Mariana Islands Range Complex (MIRC) encompasses 501,873 square nautical miles of open ocean and littorals and 64 nautical miles of land to provide multi-domain warfighting training.

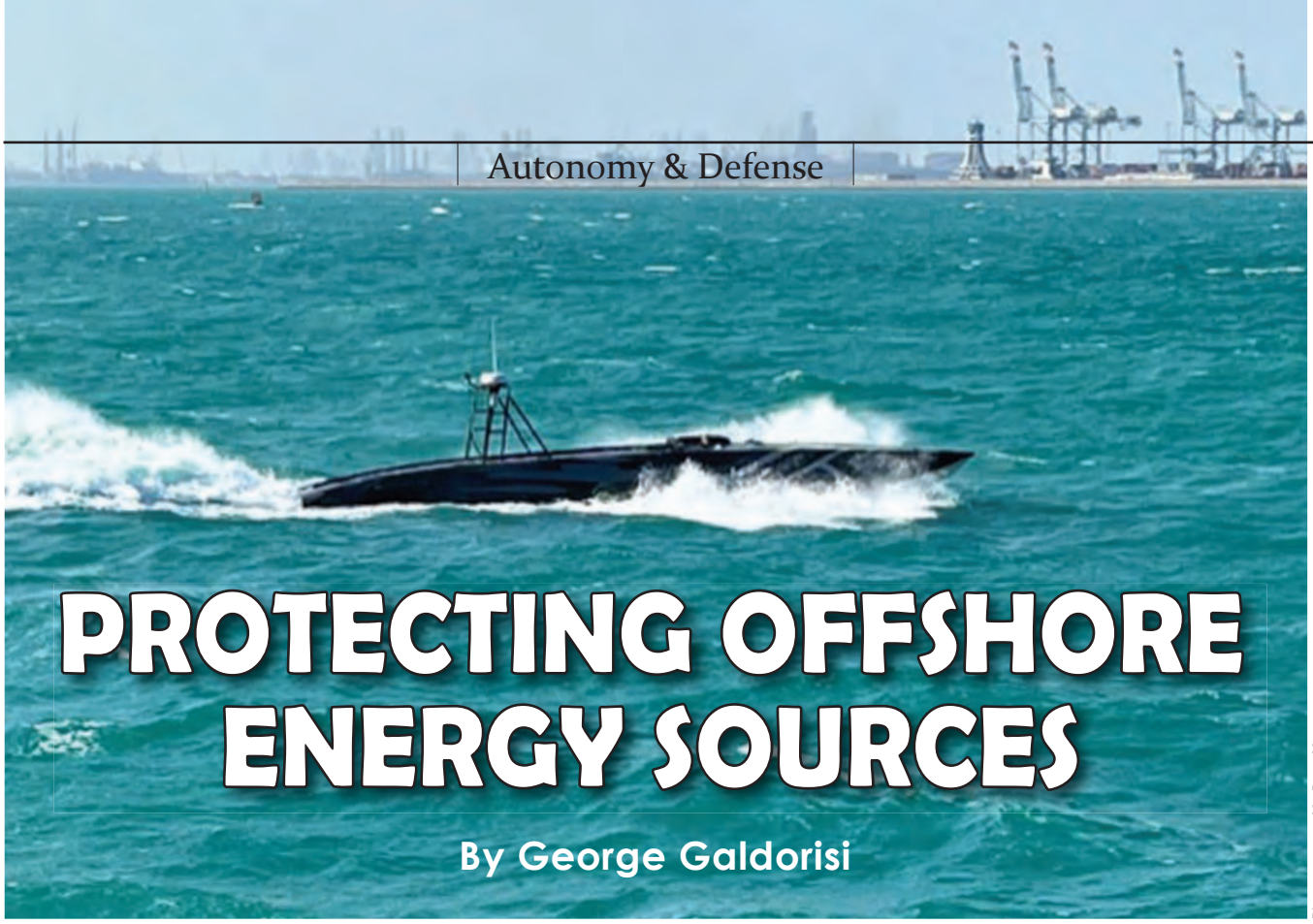
More than half of the island of Tinian in the in the CNMI is a military use area for training. Another island, uninhabited Farallon de Medinilla, is used for live-fire exercises and naval gunfire support.

During recent regional training exercises, the U.S. demonstrated the ability to surge forces to the COFA nations including Army live-fire Patriot surface-to-air shots from Palau; Marines Corps HIMARS (High Mobility Artillery Rocket System) firings from one of the islands in Palau; Navy Seabees renovating medical facilities; and Air Force F-35s, F-22s and A-10s flying from the airfield at Koror.

"These exercises showed our ability to take forces that were staged here and press them out to other locations, setup, and then be able to operate from there very quickly," Nicholson said.

"Altogether," Nicholson said, "these activities demonstrate America's resolve to protect sovereign US and COFA territory, ensure security and stability in the region, and assure allies and partners that the U.S. will defend them."

The Seawolf-class fast-attack submarine USS Seawolf (SSN 21) sails into Apra Harbor, Naval Base Guam, Aug 25, 2022.



PROTECTING OFFSHORE ENERGY SOURCES

By George Galdorisi

Photo courtesy Mr. Dave Meron

When most people discuss energy sources such as fossil fuel and green energy, it is from an "either-or" perspective. Some favor the former while others advocate for the latter. However, what is often lost in the arguments on both sides is that regardless of the type of energy being extracted or generated, those platforms that are offshore, especially oil rigs, oil and gas pipelines, and wind farms, are incredibly vulnerable to anyone who wants to attack these sources in wartime, or just to make a political statement.

One need look no further than the sabotage of Nord Stream gas pipelines that run from Russia to Europe under the Baltic Sea to understand the vulnerability of sea-based energy sources. Thus, the fossil fuel industry and the green energy industry do have one area in common – the need to protect their offshore platforms.

While the exigencies of climate change have led to major strides in the development and fielding of renewable energy sources such as solar, wind and others, for the foreseeable future, the world's energy needs will continue to be met primarily by oil and natural gas. Offshore energy production has been increasing over the past decade and now stands at over two-and-one-half million barrels of oil and almost three trillion cubic feet of gas a day.

For the United States, this massive production effort is sustained by hundreds of offshore drilling rigs, primarily in the Gulf of Mexico. According to Forbes Magazine, the Department of the Interior has opened up 25 regions in the outer continental shelf to oil and gas exploration. However, environmental concerns – impelled by major events such as the Deepwater Horizon disaster in the Gulf of Mexico – have served as a brake on U.S. offshore drilling.

While offshore oil and gas companies have been proactive in ensuring the safety of their offshore platforms, more remains to be done. Using current technology, this is dull, dirty and dangerous work that impedes comprehensive inspections of these production rigs. Today, platform operators depend on divers and remotely operated vehicles (ROVs) to perform these inspections.

This is good as far as it goes, but ROVs have a limited field of view, and putting divers in the water always involves substantial risk and increasingly high cost.

On the "green" side of the equation, offshore wind farms have seen explosive growth, and predictions of more wind farms in littoral waters point to exponential growth for this industry. Several offshore wind farms are in operation now, and more are planned. Sadly, there has been little dialogue as to how to protect these expensive offshore wind farms, and they remain highly vulnerable.

Maritime Tactical Systems, Inc. (MARTAC), a Florida-based manufacturer of unmanned surface vehicles (USVs), has fielded a family of low-cost, rugged and adaptable MANTAS and Devil Ray unmanned surface vehicles. Part of the attraction of using a USV such as MANTAS or Devil Ray to inspect offshore oil and gas platforms, pipelines and offshore wind farms is that these unmanned surface vehicles have seen extensive use in military exercises, experiments and demonstrations, as well

as hundreds of hours of use in a number of civilian missions ranging from commercial canal and dam hydrography, to commercial power plant inspections, to port and harbor security.

The MANTAS T12 (12-foot) USV has been equipped and tested with a wide variety of surface and below-surface sensors. Additionally, MARTAC has fielded T38 (38-foot) "Devil Ray" USV, capable of carrying even more sensors. This off-the-shelf technology can be used today to effect faster and more complete inspections of offshore oil/gas platforms along with their surrounding bottom mounted pipelines, as well as offshore wind farms, while dramatically decreasing the need for human divers. Three primary missions where those responsible for oil rigs, pipelines, or offshore wind farms would utilize this USV concept include:

- For underwater imaging, the Devil Ray can be equipped with Norbit iWBMS STX multi-beam sonar, a forward-looking or side-scan sonar, or any of many other commercial-off-the-shelf underwater sensors.
- For surface investigation the Devil Ray, which is already equipped with a Furuno DRS4D-NXT Doppler Radar and AIS, could also carry a SeaFLIR 280-HDEP Multi-Spectral Surveillance System, or alternately, the simpler FLIR M400, M500 or M364C-LR EO/Thermal cameras.
- Since one of the early indicators of material failure of oil rig components involves oil and other material from the rig seeping into the surrounding water, the Devil Ray can be equipped with water-monitoring sensors to include Acoustic Doppler Current Profilers (ADCP), Current-Temperature Depth (CTD) sensors, flourometers and others to detect changes in the water quality.

Depending on the mission, operators can control the Devil Ray remotely and direct its mission manually, or use the USV in an autonomous or semi-autonomous mode to search along a predetermined course through the use of pre-programmed waypoints. The video and sonar imaging from the MANTAS or Devil Ray can be sent directly to operators in real-time.

MARTAC has developed a concept of operations (CONOPS) for how Devil Ray would be used to help ensure security of these energy resources. For example, an operator might have a Devil Ray on patrol on a predictable pattern inspecting the asset above and below water. If the USV discovers an anomaly and links the video back in real-time, the operator will be alerted and can command the Devil Ray to linger in a particular area for more granular analysis using its integrated radar, camera and sonar sensor suite. If this investigation uncovers an area of concern, then a diver can be deployed to make a repair.

The same USV technology that is poised to assist the oil and gas and offshore wind farm industries is already being used to inspect critical infrastructure such harbors, ports, inland waterways, dams, levees, canals, bridges and other infrastructure that cannot be safely or effectively inspected by humans. For example, a MANTAS T12 USV was used to conduct inspections of the Keokuk dam and energy center, the Bagnell energy center, the Elkhart hydro dam, the Central Arizona Project canal and other infrastructure.

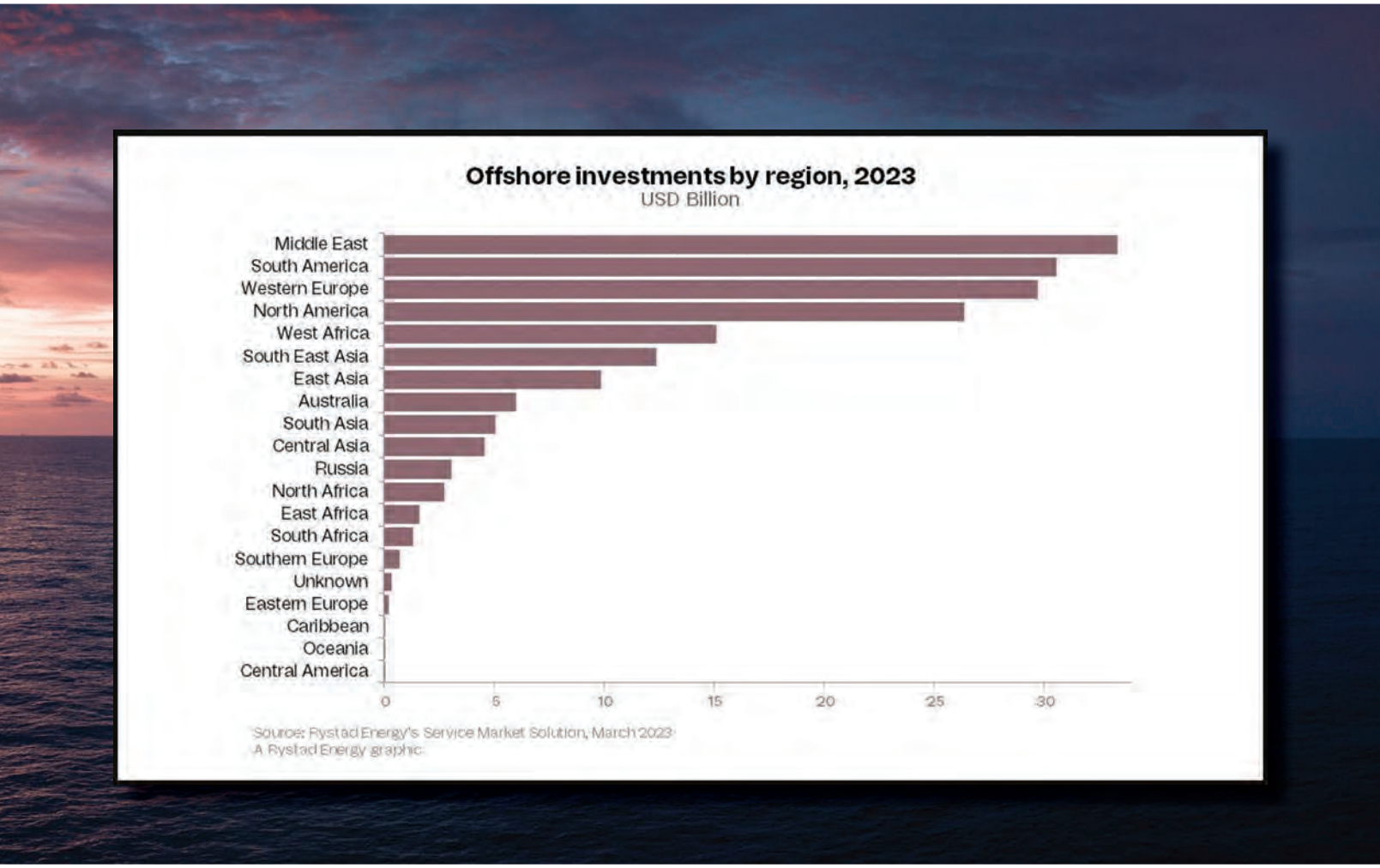
The enormous investment that energy companies have made – and will continue to make – in offshore oil and gas rigs and offshore wind farms is one that these businesses must protect against failure, sabotage, or other hazards. Current means of inspecting these rigs are slow, costly and hazardous. Employing commercial-off-the-shelf USVs like the Devil Ray can enhance the ability to deliver energy to the world.

The opinions expressed in this article are solely those of the author. Reference to any specific commercial companies, products, process, or service does not imply its endorsement by the Department of Defense or Department of the Navy.

MANAGING OFFSHORE OIL & GAS THROUGH ENERGY TRANSITION

Scientists warn that climate change is the greatest peril that humankind has ever faced. Yet oil and gas exploration is set to clock the highest growth for more than a decade this year and next. Protesters cause disruption but, for the moment, hydrocarbon energy underpins life as we know it.

By Paul Bartlett



"Offshore oil and gas production probably matters now more than ever," declared Audun Martinsen. The Rystad Energy Partner and Head of Energy Research told ***Maritime Reporter & Engineering News.***

"It is one of the lower carbon-intensive methods of extracting hydrocarbons and there is significant scope to decarbonize the production process further. Offshore operators should expect a windfall in the coming years as global superpowers try to reduce their carbon footprint while advancing the energy transition."

Martinsen was commenting after the Oslo-based firm revealed that offshore oil and gas investment is lined up to hit $214 billion in the two years ending December 2023, the first time it has reached this 24-month level since 2012-13. And offshore activity is expected to account for 68% of all sanctioned conventional hydrocarbons this year and next, up from a pre-pandemic average of around 40%.

There are many factors at work, but post-Covid recovery, China's re-opening, and Russia's invasion of Ukraine have driven energy security to the very top of the agenda in many countries. The war in Europe is causing a cost of living crisis in many countries, and widespread food shortages in others.

Rystad's analysis reveals that the Middle East is a hotspot for spending (see chart). Offshore capex across the region will exceed all others, driven by huge projects in Saudi Arabia, Qatar, and the United Arab Emirates, according to Rystad analysis. But strong growth is evident elsewhere , too.

South America, notably Brazil, is second, followed closely by Western Europe, specifically the North Sea. North America comes next, with more than $17 billion of capital investment expected this year.

WHAT'S THE PROBLEM?

There is clearly a public perception problem, not helped by the super-profits clawed in by the world's largest energy majors over the last two years. Electric cars may help by replacing gas guzzlers to some extent, but global lithium supplies could not sustain a long-term switch without new technologies.

> *The belief that nuclear power is somehow unsafe and dangerous is a myth not born out by facts of science."*
>
> **Dr Rory Megginson,**
> **Head of Analytics,**
> **Core Power**

Bluntly, there is no short-term option to hydrocarbons as a means of fueling the planet. So the challenge becomes hastening the transition; imposing as little further damage as possible in the process; and mastering a collaborative response, experts say.

Unfortunately, as they point out, many of today's demonstrators and protestors do not realize that hydrocarbons are fundamental to most aspects of everyday life – not just fuel for making steel, running most cars and buses, and heating or cooling homes. The petrochemicals sector provides key components for many everyday products – including plastics, fertilizers, rubbers, clothes, medical equipment, detergents, adhesives, pesticides, and paints and coatings.

Asked recently what she would say to a 'Just Stop Oil' protester stuck to a gantry, Lloyd's Register's Claudine Sharp-Patel thought about this long and hard. "I think I'd like to ask them where they got the glue," she said.

So, on the basis that we have no scalable options to hydrocarbons in the short run, what can we do?

NEW STRATEGIES

Wood Mackenzie has developed a new analytical tool, Lens, to help exploration personnel identify the most attractive opportunities in oil and gas that are likely to generate the best returns. The firm's Vice President of Exploration, Andrew Latham, described how access to data has facilitated for more effective decision-making.

The tool is designed to demonstrate how different exploration opportunities compare, Latham said, and how their economics stack up. The quest now, he says, is to identify 'advantaged' oil and gas. This means lower cost, lower carbon, better access to markets, better fiscal terms, and lower risks. Also, how much of this resource might be available given a certain price point, a given set of circumstances, and/or a specific timeframe?

Norway, with the largest sovereign wealth fund in the world, huge hydrocarbon reserves, and an abundant supply of renewable hydroelectricity, stands in pole position to spearhead the

drive for clean energy. State energy company, Equinor, aims to reduce net group-wide operated emissions by 50% by 2030 "and is focused on medium-term actions consistent with the goals of the Paris Agreement and a 1.5 degrees pathway", according to a statement.

However, commenting recently on the future, Equinor said: "Even in the most optimistic forecast scenarios for the green shift, the world will still be dependent on oil and gas for a long time to come. It is therefore essential that oil and gas that the world needs is produced with as low a carbon footprint as possible."

The company has adopted three 'pillars': carbon-efficient oil and gas production; expansion in renewables; and the development of new low-carbon technologies and value chains. As a leading developer of offshore wind, it is a pioneer in the rapidly developing floating wind sector, which offers scope to harness renewable energy in waters where the winds blow stronger and longer.

The company is nearing completion of the world's largest floating wind farm, Hywind Tampen, almost 90 miles off the coast in the Norwegian Sea. The 11-turbine facility, with a capacity of 94.6 MW, will provide renewable electricity for the Snorre and Gullfaks oil and gas fields nearby. Its first electricity was generated late last year and when the wind farm is fully commissioned in a few months' time, it will mean Equinor produces almost half of the world's floating wind energy.

THE N-WORD

Against this daunting backdrop, however, some experts claim that there are chinks of light. One of these is tried and tested technology which has received barely a mention until recently. Even in Norway where renewables are a top priority, nuclear power based on molten salt reactor (MSR) technology is now the subject of detailed research.

Concepts are being developed to provide carbon-free energy for hard-to-abate industrial applications. And, in a project developed by family-owned shipbuilding group, Ulstein, experts are working on generating power for a small fleet of expedition cruise ships. They could be deployed in high-north waters where conventional refueling would be impossible.

Meanwhile, in the UK, Core Power is pioneering the development of MSR technology for heavy industrial applications as well as the maritime sector. With offices in London and Washington DC, the company is working with international power, engineering and nuclear technology firms to generate zero-emission energy for floating industrial facilities, such as semi-mobile desalination plants, and power for deep-sea shipping.

Many advocates of nuclear power cannot understand the reticence to look at options. MSR technology is widely seen as safer than other forms of nuclear technology, they point out, because pressures are low and fuel is already in a molten state. In an emergency, it can be drained into a containment vessel before solidifying.

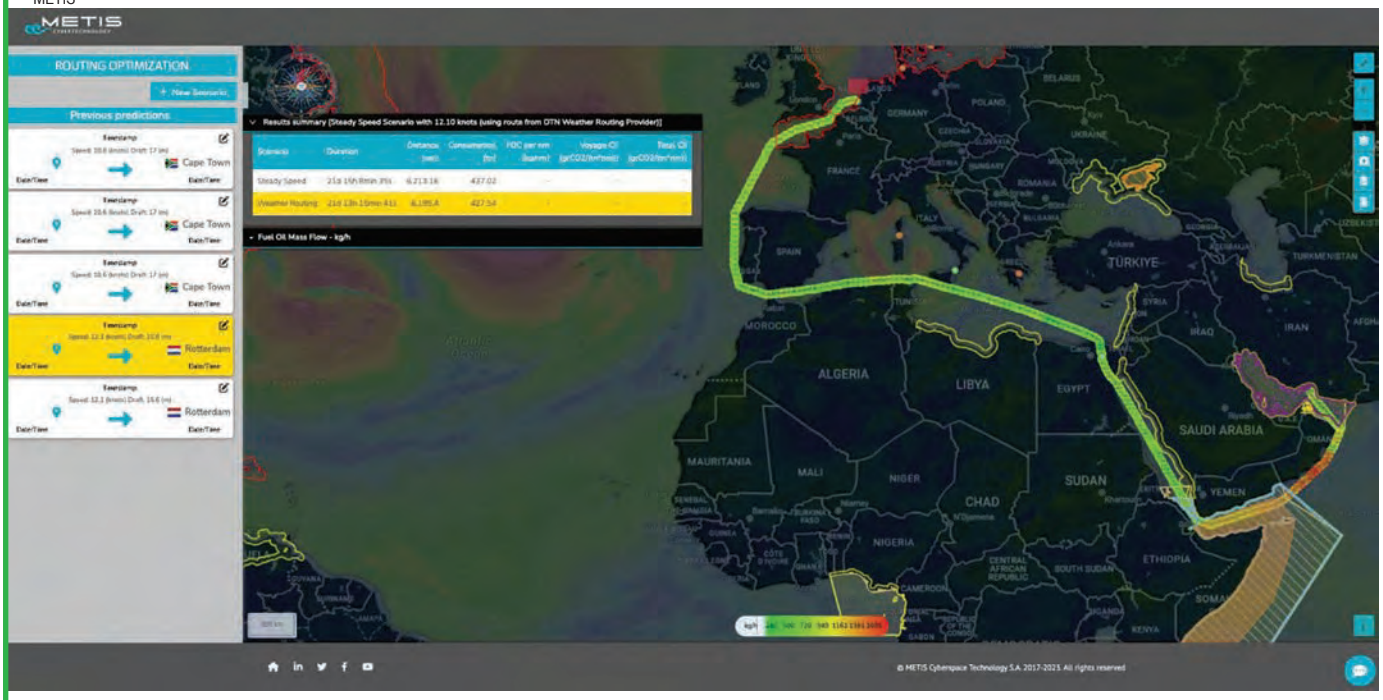
No surprise that Core Power's Head of Analytics, Dr Rory Megginson, is a staunch advocate of the carbon-free energy source and a proven technology, he stresses, that is available today. "The belief that nuclear power is somehow unsafe and dangerous is a myth not born out by facts of science," he said.

Megginson explained that green ammonia is likely to offer hard-to-abate industries, including shipping, an effective zero-carbon fuel at some time in the future. But as things stand, its production relies on the nascent science of carbon capture or the limited scalability of production from intermittent renewable sources.

On the other hand, MSR technology offers a large-scale source of clean energy suitable both for heavy industry and transport and, with one major advantage. Once installed, MSR technology would enable ships, steel mills, petrochemical plants and other heavy industries to use a constant source of energy supplied over a long period, perhaps 10-20 years.

And in shipping, the eye-watering cost of a global network of new bunkering facilities might not be necessary.

METIS



DATA-DRIVEN VOYAGE OPTIMIZATION:

THE DEMISE OF THE DATA SILO

We've had the means for a while, now we have the incentive to crush the data siloes that are holding back voyage optimization.

By Wendy Laursen

Like kids in the sandpit, owners and charterers are being forced to share, perhaps more than they really want to. The IMO and the EU, for starters, are setting data-driven decarbonization rules, and those in the sandpit are having to respond.

Ship managers and data analysis specialists are developing technical solutions to boost transparency with the aim of facilitating shared responsibility on CO2 emissions, but it's no easy task. Much of the detail in the EU ETS regulations have yet to be determined, and the new dynamic between shipowner and charterer resulting from the IMO's Carbon Intensity Indicator (CII) is still developing.

There have been attempts to construct data marketplaces, says Dor Raviv, CTO and Co-Founder of Orca AI. However, different solutions require different data elements. "Due to the lack of any reference data sets, innovative technologies are progressing slowly, causing engineers and developers to invest more time and energy to bring forth new products. To allow the industry to keep pace, a new outlook of openness instead of consolidation must be adopted."

Arnaud Dianoux, Founder and Managing Director of Opsealog, is calling for a data democracy.

Anil Jacob, Head of BSM's Fleet Performance Center, says voyage optimization is one of the most effective ways to improve operational efficiency.

Thome's Executive Vice Chairman Claes Eek Thorstensen says that it is always easier to use a single system.

Angus Whiston, Communications Director at DeepSea Technologies, says everything has changed with AI. Gradually, shipping companies are starting to see real benefit for the first time. "Let's be honest - in past years, what has been the true benefit of combining reams of high-frequency sensor data with years of weather data, AIS data, port data, etc? Almost without fail, the result of such projects has been internal confusion on a large scale and hundreds of wasted hours."

Speaking at a recent conference, Thomas Zanzinger, CEO of Ocean Technologies Group, warned participants that even if they were not on top of their data, there's a good chance others will be, which could lead to financial and reputational consequences for their businesses. He pointed out that growth in connectivity and the proliferation of application program interfaces is connecting previously disparate data sets.

Data holds the key to smarter actions but is hard to manage without the support of software, says Pelle Sommansson, Chief Product & AI Officer at ZeroNorth. "Platforms that can break down existing silos and create a single source of truth will be critical to driving efficiencies that generate immediate environmental and commercial impact, as they enhance collaboration and grant stakeholders across different departments access to a shared data reality."

Shipmanager Thome's Executive Vice Chairman Claes Eek Thorstensen highlights that it is always easier to use a single system that comprehensively caters to all aspects of performance monitoring and optimization. However, very few systems are complete and reliable in every aspect. Acquiring, processing, and analyzing real time performance data, in combination with AI, holds significant potential, but performance optimization systems are still maturing.

Part of that maturity involves breaking down data siloes built in disparate digital and manual systems. Some third party managers are developing their own solutions. Thome, for example, monitors its managed fleet centrally, with CII ratings dynamically projected based on factors such as hull resistance, weather, engine performance, vessel speed and dwt utilization.

Bernhard Schulte Shipmanagement (BSM) is currently expanding its digital platform to handle EU ETS compliance in a single source dashboard. Anil Jacob, Head of BSM's Fleet Performance Centre, says voyage optimization is one of the most effective ways to improve operational efficiency. AI and machine learning will help improve numeral weather predication models, and developments in Artificial Neural Networking will improve performance models for vessel. This will provide more accurate results for different loading conditions, speeds, or trim. "The more accurate the vessel modelling, the better the voyage optimization result will be."

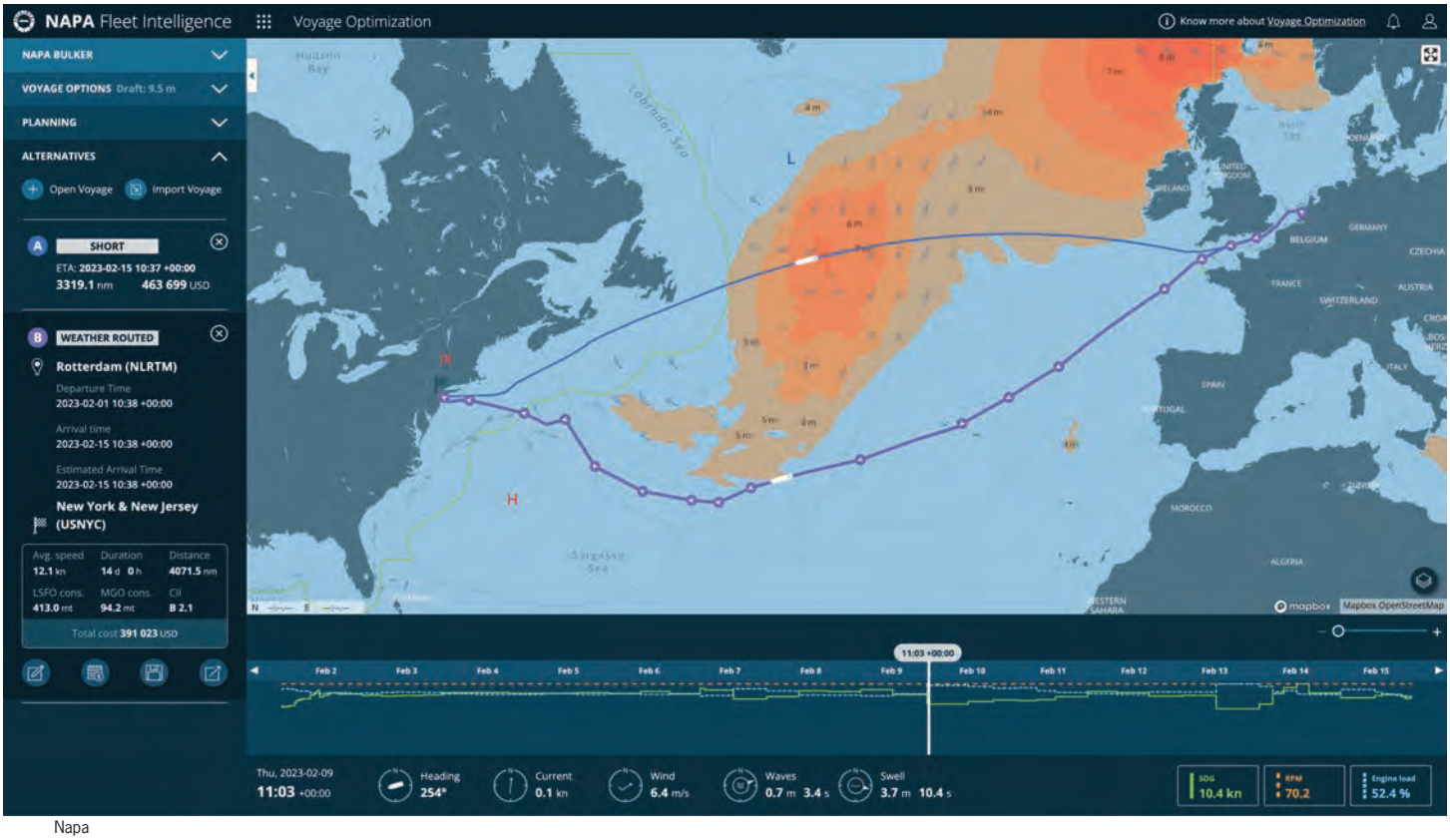
NAPA's new CII tool uses a ship's digital twin, combined with data on its past and current routes and performance, to predict its CII rating for each sea passage. Some requirements vary with ship type, though. For example, NAPA has worked with INPEX to factor in optimization of LNG carriers that are partly fueled by cargo boil-off gas.

Vessel Performance Solutions notes that an LR tanker can reduce its CII rank by 7% just by correcting for cargo discharging and heating. Even though some corrections have a minor impact, they may still be important towards the end of the year when a charterer wants to maintain vessel speed without risking a drop in rank.

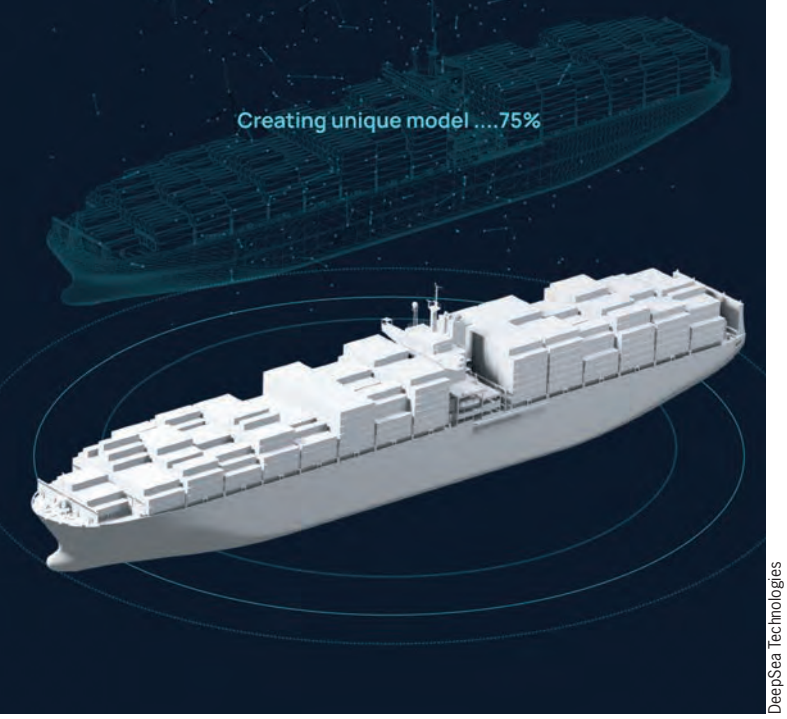
NAPA's new CII tool uses a ship's digital twin, says Pekka Pakkanen.

Pelle Sommansson, Chief Product & AI Officer at ZeroNorth says platforms that can break down existing silos and create a single source of truth will be critical to driving efficiencies.

Petter Andersen, SVP Shipping Digital at StormGeo, says having the right technology is only the first step.



Napa



DeepSea Technologies

But Thomas Hechmann, Growth Director, Coach Solutions, says the major change related to voyage optimization in connection with the implementation of CII has nothing to do with new data or even more data. “The biggest concern is always the right data. Can you trust that the vessel reporting is correct, and how do you validate the data in a smart way in order to avoid a massive workload for operators for manual validation?” Coach is a cloud-based system that can validate manual data collected onboard. It also allows the company to use its own operational and commercial knowledge when considering any optimization factor.

Crews are benefitting. METIS Cyberspace Technology says its AI-powered analytics analyze efficiency onboard and the changing operating environment, providing the officer of the watch with actionable insights and alerts throughout a voyage.

Petter Andersen, SVP Shipping Digital at StormGeo, says qualitative assessments by the crew, operator, and weather routing company are needed to ensure safety, fuel savings and emissions reductions. “Machine learning and AI can continuously improve how we predict the effect of winds and waves on the vessel’s speed. However, having the right technology is only the first step.”

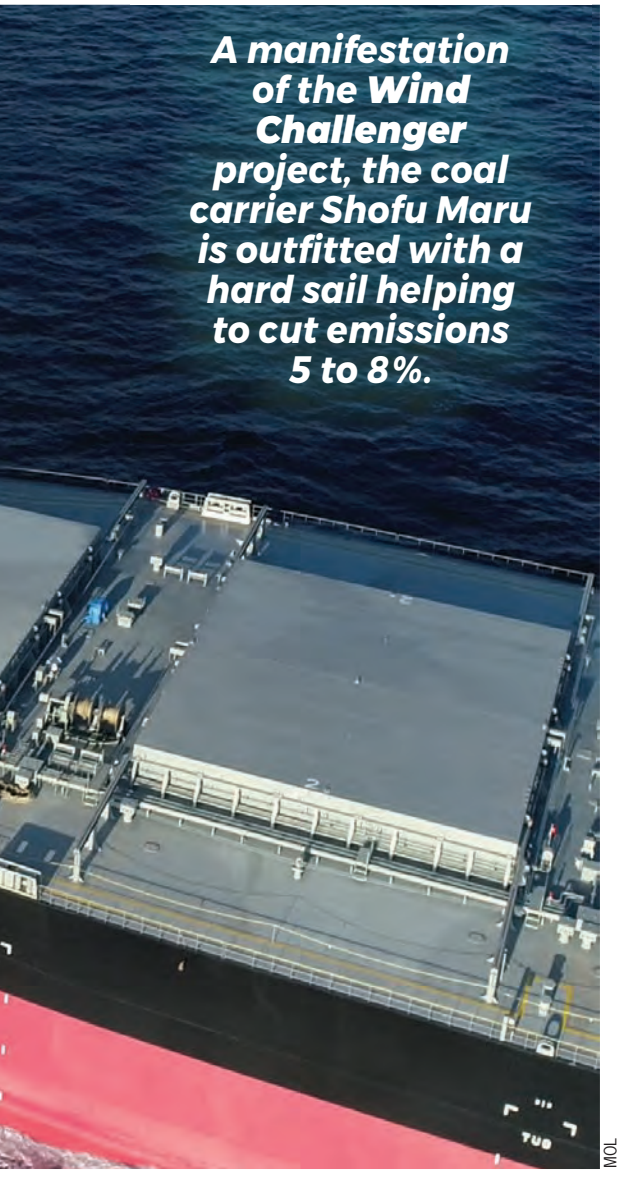
Looking beyond crew, owner and charterer, Arnaud Dianoux, Founder and Managing Director of Opsealog, is calling for a data democracy. “There is definitely a need for greater data sharing and integration in the maritime sector, but also along supply chains more broadly,” he says. “Greater collaboration also needs to happen between the different providers of digital solutions that act as suppliers for a given ship or company, to ensure seamless data integration. No single digital solution can achieve everything, so instead of looking for a silver bullet, shipping should aim to create a digital ecosystem.”

Looks like a new crowd just jumped in the sandpit.

GONE WITH THE WIND

Mitsui O.S.K. Lines *invests in a pair of wind propulsion projects –* **Wind Challenger & Wind Hunter** *– to help achieve its emission reduction goals.*

By Greg Trauthwein



A manifestation of the Wind Challenger project, the coal carrier Shofu Maru is outfitted with a hard sail helping to cut emissions 5 to 8%.

MOL

Japanese maritime companies historically have maintained strong leadership in both maritime technologies and environmental matters. Driven by new and emerging regulations aimed at decarbonizing the maritime sector, Mitsui O.S.K. Lines (MOL) has melded the two, partnering on a pair of ship innovation projects – Wind Challenger and Wind Hunter – that aim to harness the power of the wind as a means to help it meet and beat its own rigid emission reduction mandates.

WIND CHALLENGER

While next-generation maritime technology is most often seen in the R&D lab, Wind Challenger is sailing commercial routes today. In late 2022, Oshima Shipbuilding delivered Shofu Maru, the world's first vessel equipped with the Wind Challenger hard sail, designed to transport coal, mainly from Australia, Indonesia, and North America as a dedicated vessel for Tohoku Electric Power Co.

In a recent interview with *Maritime Reporter & Engineering News*, **Makoto Yamaguchi**, Chief Technical Officer, Director General, Headquarters of Technology Innovation, MOL, said that Shofu Maru is the result of an eight-year Joint Industry Project (JIP) with academia, including four years to take the 100,000-dwt bulk carrier from basic design to delivery. In addressing the primary challenges to bringing the project from the drawing board to the commercial waterways, he was blunt: “There was no past experience; everything was a challenge.”

In looking back on the project’s origin, he said the first hurdle to cross was taking into account the range of the ship’s motion plus the wind pressure and thrust generated by the hard sail. “The combination pattern of ship’s motion and wind force is almost infinite,” said Makoto Yamaguchi. “We solved the 'unknown' design matters one by one.”

As designed, Wind Challenger was expected to reduce greenhouse gas (GHG) emissions about 5% on a Japan-Australia voyage and about 8% on a Japan-North America West Coast voyage, compared to a conventional vessel of the same type. Shofu Maru has been operating since October 2022, and Makoto Yamaguchi said that “We are collecting and analyzing data. The sail is performing as we expected both mechanically and in terms of fuel savings.”

Wind Challenger is a system developed mainly by MOL and Oshima Shipbuilding, using a telescoping hard sail that harnesses wind power to propel the vessel. Controlled from the bridge or locally, it takes 10 minutes to fully deploy or retract the sail. The Wind Challenger sail is automated, designed to make it easy for a normal crew to use the wind to maximum efficiency. Via sensors, the sail detects the strength and direction of the wind and automatically rotates. When the wind is weak, the sail is extended (unfolded); when the wind is strong, the sail is retracted (curved sail).

Operated via a hydraulic system, the hard sail doesn’t pose any special or unique maintenance problems. The Wind Challenger system is intended for use by MOL, and Makoto Yamaguchi said the company has started to commercialize the engineering of the system, planning for larger scale production.

He could not disclose the total additional cost of this first R&D prototype sail for Shofu Maru, but noted that the investment in this first R&D prototype included additional investment in auxiliary equipment and systems,

It took four years, from basic design to production to the delivery of Shofu Maru.

Makoto Yamaguchi,
Chief Technical Officer
Director General, Headquarters of Technology Innovation,
Mitsui O.S.K. Lines (MOL)

MOL

such as updated weather routing systems.

The Wind Challenger Project started in 2009 with the "Wind Challenger Plan," an industry-academia project led by The University of Tokyo. Since 2013, the team was chosen to receive a subsidy on next-generation marine environment-related technology research from MLIT, and in January 2018, MOL and Oshima Shipbuilding took charge of the plan.

MOL is aiming to equip a second bulk carrier with the Wind Challenger system, and it is also examining the feasibility of adopting Anemoi Marine Rotor Sails in combination with Wind Challenger. Preliminary calculations show an expected 20% reduction in greenhouse gas (GHG) emissions using both sail types.

WIND HUNTER = ZERO EMISSION

The commercial realization of MOL's Wind Hunter is further in the future, as many more of the technological challenges need to be resolved: engineering feasibility studies; hard sail simulations and effects; efficient propeller and generator turbine specifications; and wind acquisition systems, among others.

The Wind Hunter project is a zero-emission hybrid: sails capture the wind when it is blowing strongly to propel the vessel forward. In between those gusts, turbines in the water spin and generate electricity and produce hydrogen, which is stored in a tank in the form of methylcyclohexane. When the wind is weak, the ship uses that hydrogen as a fuel cell delivering electricity, electricity which powers electric propellers that drive the ship forward.

To date, MOL has completed a demonstration test with a yacht in Omura Bay, and by 2024 it plans to begin construction of a hydrogen-producing vessel measuring 60-70m long, outfitted with multiple sails. By 2030, MOL expects to build a large zero-emissions hydrogen-producing cargo ship.

In between now and 2030, Makoto Yamaguchi admits there are many challenges to overcome.

"First, in the engine room, new technologies and components that are only available for use on shore are needed to be fully integrated onboard a ship," he said. Second is the design and construction of a tough and robust hull body with numerous hard sails. "Since wind makes energy, numerous hard sails must be also arranged effectively to make maximum effects of the wind, but also [maintain] the stability of the vessels," he said. Lessons learned on Wind Challenger will be applied to Wind Hunter, as it is planned for the Wind Hunter to utilize the same type of hard sail. Looking at the initial test vessel used on Omura Bay, Makoto Yamaguchi said that main findings including a greater focus on the propulsion equipment; ensuring that the equipment being fitted for the first time in a maritime application is well designed and integrated. Also, further risk assessment is needed for the hydrogen system as a whole.

Powered by wind and hydrogen, Wind Hunter presents far more challenges, namely the fitting of new tech that to date is only found in shoreside installations.

MOL

Hempel

CLEAN HULLS HELP MAKE GREEN SHIPS

As ship owner/operators eye increasingly stringent environmental and emission standards, partners like Hempel – which provide engineered solutions to help slash fuel burn and emissions and back it up with data – become increasingly important. ***Maritime Reporter & Engineering News*** *recently visited the Danish coating manufacturer's headquarters for a sit-down and update with Alexander Enström, EVP and Head of Marine, and Martin Wiese, VP of Sustainability, Hempel.*

By Greg Trauthwein

"Digitalization" and "big data" are oft overused jargon, but trite as they may be the fact remains that no time in history has the marine industry been so dependent on data to help it understand and crack the challenges of today and tomorrow. It's arguable that too much attention is paid – particularly in the trade press – to the challenges of the future rather than the problems of today, which is why it's refreshing to visit a Hempel: firmly rooted in helping shipowners with technical solutions to run more efficient voyages today; with a keen eye – backed by a strong R&D budget, – on the challenges ahead.

TRAVELING THE ESG PATH

Alexander Enström, EVP and Head of Marine, came up through the engineering ranks, a material chemist working in the R&D department, always focused on maritime applications. His first role in the company was developing antifouling coatings, and he made the jump to the business/client-facing side to better understand how customer needs drove product development.

According to Enström, Hempel sells nearly 100 million liters of maritime coatings per year, developed, sold and serviced by approximately 800 Hempel employees on the maritime side out of the nearly 7,000 employees at the group level. "We are particularly big on the dry docking, hull performance side, that's truly our passion to help the industry decarbonize," saying that Hempel has applied its premium technology brand Hempaguard on more than 3,000 ships, helping to save around 27 million tons of CO2 emissions.

While impressive, the Hempel story is more than coatings, performance and annual sales. To its core the company has dedicated itself to the decarbonization and ESG mantra, and effort championed by Martin Wiese, VP of Sustainability. When assessing his number one challenge, Wiese said that internal education – the creation of a common and well-understood ESG language company wide – is the critical building block to create a solid foundation for the strategy, and ultimately, the company's success.

"Consider how long it took to create the language of finance – revenue, EBITDA, capital, you name it. What we are trying to do now is to create a language of sustainability, which none of us really know."

Wiese sees the common language as the cornerstone for Hempel to not only commit to sustainability, but to act.

"Sustainability is not a function, sustainability is what we do as a company," said Wiese. "If we are to commercialize sustainability, they need to understand that lingo, fundamentally, across everything we do."

Ensuring that the entire organization moves forward in step is easier said than done, and while that challenge is formidable, "a second challenge is to connect the language to data," said Wiese. By this he knows the company must commit, act, communicate, and ultimately, back the actions with solid data that relate to how its coatings quantifiably help reduce fuel burn and emissions.

Enström concurs that data is central to the solution, but has a different take on the issue.

"We are in an incredibly competitive business, and for us the challenge is around education. We believe we have a solution that can help this industry decarbonize fast," he said. To that end Hempel is working intensively with first movers in

> *We are no longer a coating supplier that applies paint and waits for the next maintenance event. We are there all the time. We look at [our customer's] ships on our screens every day, and we partner with them on managing operations as well, from our lens."*
>
> **Alexander Enström,**
> **EVP, Marine Business,**
> **Hempel Marine**

Hempel

the adoption of new technology. "It really comes down to data transparency: how can those first movers that have seen the benefits, can also be seen by the rest of the industry. It's about education, transparency and truly understanding the big value that is there from a coatings perspective, and [showing] how the full industry can tap into that value."

Quantifying the data needs to be ship specific, said Enström, and it needs to be true data measure. "For us as an industry, the first step was, with other suppliers, to establish measurability."

It's a 'known known' that a cleaner hull moves more efficiently through the water, cutting fuel burn and emissions.

"A standard was established called ISO 19030 that helped us to align methodology, measure performance, which is linked to the coating performance. So our claims around savings is backed by a methodology and can be verified ship-by-ship." Hempel also offers services to collect data together with ship owners and operators to justify performance claims.

Another digitalization evolution that plays into coating performance is ship tracking, and Enström said Hempel tracks its customers ships – and in fact the world fleet – daily, to gather information on where they trade, and the type of waters they sail. "It's about verifying what we're saying, but also developing solutions that is possible to innovate much faster in the digital space. In [the ship tracking] sense, we are able to move to be a closer partner to our customers. We are no longer a coating supply that applies paint and waits for the next maintenance event. We are there all the time. We look at their ships on our screens every day, and we partner with them on managing operations as well, from our lens."

PENETRATING THE LAYERS

The process by which ships are owned, operated and maintained often involves multiple layers, and Enström estimates that only about 30% of the world fleet is "under the same roof" with all three stakeholders – owner, manager, operator. Though a minority, these generally are the early adopters of new technologies he said, as they are fully responsible for paying for fuel, adhering to CII, and responsible for maintenance.

"It's such a scattered industry," said Enström. "Key for us is linking these different stakeholders in an efficient way," as different companies in different countries having a hand in one ship presents a barrier for technology adoption.

But he's starting to see change.

"What we see right now is that it's not only the integrated companies that are adopting new technologies. With the new regulations, we see a much wider interest from [a variety of] companies. That makes me very positive that the industry will improve fast, because there are regulatory measures now that drives that consolidation and knowledge sharing."

Hempel

Sustainability is not a function, sustainability is what we do as a company. If we are to commercialize sustainability, they need to understand that lingo, fundamentally, across everything we do."

Martin Wiese,
VP of Sustainability, Hempel

Hempel

One recent success was with Ultrabulk in Copenhagen, where Hempel applied Hempaguard on one of its ships. “It's a relevant case, because they are the ship owner; they charter and operate a lot of ships and are an important stakeholder, because they pay for fuel. But traditionally, they will not be responsible for the coating purchase.”

“We see a big change: before, financial incentives drove technology adoption, but now it's sustainability incentives, said Enström. Wiese is blunt in his assessment: “this is critical for them to have a relevant business going forward.”

Wiese and Hempel were part of the Danish delegation to COP27, and he said of the experience “I hope to see more characters like myself getting involved in sustainability. We still need the policies, but we also need to have the commercial people, the technical people – we as a coating industry need to find our space there – starting to understand and discuss that language of sustainability, and also to start implementing.”

In fact, Wiese said Hempel’s participation at COP27, its participation at the IMO, its continued participation in the myriad of organizations and debates centered on the environmental issues for the coatings and the shipping industry as a whole, are critical pillars in building itself as a sustainable leader. “Sustainability leader to me means a number of things, one of them being that you take a responsibility as part of the industry,” said Wiese. “And in order to take that responsibility as part of the industry, you also need to engage in the debate on regulations and standards.”

But as important as the outward debate is, Wiese and his team have all eyes on Hempel’s own sustainability.

“First, we have been spending time on figuring out what are the most material elements [of sustainability] to Hempel,” said Wiese. Greenhouse gas emissions are a priority based on its own carbon footprint as a member of the chemical industry. “We have clear ambitions on our circularity as well as the biodiversity crisis which the world is facing, which means that we also have programs to systematically move ‘down the ladder’ in terms of the hazardous materials we're using.”

Hempel

Hempel’s **Three** Customer Drivers

*According to **Alexander Enström**, EVP and Head of Marine, Hempel Marine, there are three primary customer drivers.*

1. **Whole performance** is first, making sure that the ships go fast through water and continues to go fast through water with minimal fuel consumption.
2. **Protecting steel &corrosion protection** is second, making sure that the ships can have their commercial lifetime they are designed for and do not corrode and require massive repairs
3. **Cargo operational efficiency** is third. On many ships the cargo is in contact with our coatings. We need to make sure that that cargo can be offloaded without contamination, that the cargo holds can be cleaned fast, without cleaning agents, for fast turnaround.

Oslo Børs

Norway is Fertile Funding Grounds for Shipping Projects

With the world's largest sovereign wealth fund, Norway's financial muscle is beyond question. However, at a corporate level, the country's capital markets offer a range of benefits to overseas companies seeking equity, debt ... or both.

By Paul Bartlett

Øivind Amundsen is CEO of Oslo Børs and, as you would expect, a strong advocate of the Norwegian capital as a place to raise money for marine-related projects. The diverse nature of the companies which are listed on the Børs, part of Europe's largest stock exchange group, Euronext, since 2019, reflects what some believe to be the world's most attractive location to raise capital.

The Euronext group has its own appeal. Before the acquisition, the standalone Oslo Børs had succeeded in establishing a strong presence within energy, shipping, and seafood, Amundsen explained. Through the pandemic, however, cleantech and renewable energy companies have listed there.

Deep pockets are certainly part of the story. But Oslo's advantages go much further.

As part of Euronext, companies and investors have access to the trading platform Optiq, the largest liquidity pool in Europe. On the other hand, Oslo Børs contributes to the group with its experience and ways of working. With Nord Pool, Fish Pool, and Euronext Securities, Oslo helps to support the

stock exchange group's Nordic ambitions.

"The investor base in Oslo has a deep understanding and tradition for investing in the whole extent of the shipping industry," Amundsen explained in a recent interview. "Historically, the relationship between Oslo Børs and shipping goes back to its very roots. Many of the first companies listed and traded on the exchange were local family-controlled shipowners.

"This has contributed to develop the strong businesses and shipping/maritime clusters that we have in Norway today. Following this, an extremely knowledgeable ecosystem has developed. This is why Oslo Børs has succeeded in attracting international companies within shipping, such as MPC Container Ships (see below).

However, investors have a keen appetite not only for the large, well-established corporates such as BW Group, Kongsberg and Yara and companies owned by John Frederiksen, but also for smaller more niche ventures. TECO2030, for example, is developing hydrogen fuel cells and has successfully raised capital in Oslo via a series of private placements.

Other examples include offshore wind installation specialists Cadeler, Seaway 7 (Subsea 7), Himalaya Shipping, a niche dry bulk operator, Höegh Autoliners, Wilhelmsen, Fred Olsen's Bonheur, and so on.

"What really makes the investor community stand out … is that both retail and institutions see shipping as a mainstay investment, rather than a niche," Amundsen explained. "This provides availability of capital and liquidity throughout cycles and, in return, the companies are expected to be transparent and have a shareholder focus."

The strength and depth of the 'ecosystem' is another key element in Oslo's success. It is made up of a network of financing institutions such as the large Nordic banks, DNB and Nordea, Amundsen said, but also an unparalleled group of generalist and niche investment banks with a broad coverage of all shipping subsectors, and spanning both equity and debt markets.

"When it comes to shipping, you really do not see the same range or interest in New York or Singapore," he declared.

As a prominent player in the offshore wind sector, Norway's capital markets could prove attractive to US firms seeking equity and/or debt. Oslo Børs already has a strong track record in the sector, with early pioneers including Bonheur and, more recently, Edda Wind.

"Fixed-bottom and floating is certainly growing," Amundsen noted, "but is less prevalent in the capital markets as of now. Certainly Oslo Børs and the Norwegian capital market is the obvious place to float by way of private placement, IPO, or debt financing for any company related to offshore wind."

Case study:

MPC Container Ships

Feeder container ships may not appear the most likely shipping assets to appeal to Norwegian investors accustomed to offshore energy and aquaculture. But if MPC Container Ships' story is anything to go by, then it seems that Norwegian investors have a diverse appetite.

The company's EVP and General Manager Norway, Pål Sætre, believes that the country's close relationship with the sea can mean that with a good story, Oslo is potentially a very attractive arena in which to raise capital. Investors there, he says, have deep pockets for a good story.

The Hamburg-based company was established in April 2017 by sponsor and founding shareholder, MPC Münchmeyer Petersen Capital AG (MPC Capital). Today, as one of the world's largest owners of intra-regional container tonnage, it operates more than 60 geared and gearless ships in global feeder trades.

Shortly after inception, in April 2017, MPC Container Ships was listed on Oslo Børs' over-the-counter market. During the following 18 months, its principals set up a challenging timetable of over 750 investor meetings and by May 2018, MPC Container Ships was listed on the Oslo Børs' main market. By then, it had raised $460m in equity and $200m in bonds and had bought 69 container vessels, becoming the world's largest owner of intra-regional tonnage.

To be fair, fate has dealt the young feeder company a spectacular hand. The onset of the pandemic brought global supply chains to the public's attention as never before. Sætre notes that this was evident everywhere, even in prosperous Oslo where the grounding of the Ever Given in the Suez Canal caused delays on most shipped goods.

But as arterial container ships have increased in size and shoreside Covid-related congestion became a major issue in many regions, the importance of distributive feeder trades came into sharp focus among the world's public at large. In economic terms, these regional trades are essential and inelastic.

Shortly after inception, in April 2017, MPC Container Ships was listed on Oslo Børs' OTC market. During the following 18 months, its principals set up a challenging timetable of over 750 investor meetings and by May 2018, MPC Container Ships was listed on the Oslo Børs' main market. By then, it had raised $460m in equity and $200m in bonds and had bought 69 container vessels.

– Pål Sætre, EVP and General Manager Norway, MPC Container Ships

Between 2020 and 2022, MPC Container Ships' operating revenues shot up from $171.9m to $616.8m. Adjusted EBITDA soared from $16.2m to $451.5m.

Sætre points out several key features that set Oslo apart as a city in which shipping projects are well received. The investment community is accustomed to capital intensive sectors, notably both traditional and now sustainable offshore energy, and shipping is a key aspect of the country's everyday life.

Investors are more accustomed to and potentially comfortable with risks related to asset-heavy and volatile industries, he says. And he notes a strong current shipping presence, as it has been historically, on Oslo Børs.

However, it is the Norwegian ecosystem that sets Oslo apart, Sætre believes. Apart from knowledgeable investors, there is a vibrant network of shipping-related service providers including brokers, analysts, investment banks, mainstream banks and law firms.

This network, coupled with a swift and pragmatic approach to documentation and the overall capital raising process, means that companies aiming to tap Norway's investment community may well enjoy the fastest speed to market that can be achieved anywhere.

MOL

PIONEERING PROPULSION PROJECTS PUT NORWAY AHEAD OF THE GAME

This year's Nor-Shipping event will highlight many awe-inspiring technologies. But none is likely to outshine the remarkable progress that places Norway in the vanguard of propulsion and emissions technology development.

By Paul Bartlett

Even if we don't think about it much, oceans and seas play an essential role in life. Nowhere is this more evident than in Norway where almost everybody knows someone who works in the broad maritime field – in offshore, coastal, deep-sea, fishing, aquaculture, wind, and so on. And, of course, all the related shore services.

Many of the latest groundbreaking initiatives will be evident at this year's Nor-Shipping event in early June. However, since shipping's decarbonization will be discussed at the IMO's Marine Environment Protection Committee (MEPC) meeting one month later and subsequently at the next meeting of the Intersessional Working Group on Reduction of GHG Emissions from Ships later in July, the shipping industry's adoption of carbon-cutting technologies has never been in sharper focus.

Corvus

In an ocean shipping context, one of Nor-Shipping's most exciting events is likely to take place when Corvus Energy reveals the latest developments in scalable battery-fuel cell hybrids. The technology, developing fast with heavyweight partners, will be suitable for a wide range of ship types.

At the outset, these are likely to include offshore vessels, coasters, ferries, ropax ships, container feeders and chemical tankers. For larger vessels such as cruise ships, big tankers and bulkers, and arterial container ships, the technology will enable zero-emission operation in ports and emission control areas (ECAs) with scope for main propulsion systems down the line.

Development work, much of it under the radar, continues at Corvus Energy's 'centre of excellence' in Bergen, where research and development, manufacturing and test facilities are located close to the company's head office.

Toyota tie-up

Key partners include Toyota, which contacted Corvus Energy early in 2020, prior to a formal agreement being signed off later that year. Other partners include Norwegian state energy firm Equinor, LMG Marin, Maritime Cleantech, Norled, University of South-eastern Norway, and Wilhelmsen.

Thor Humerfelt, a Corvus' SVP and Product Architect, reveals

that cooperation with the Japanese vehicle company on fuel cell development and optimisation of the system for marine applications is central to the hybrid setup. Weekly meetings, tests and workshop activity continue both in Europe and Japan, he said.

The workshop, factory, instrumentation lab and test site are already there, Humerfelt explains, and have been used during prototype tests since late 2022. But the factory is to be upgraded to produce larger volumes from this fall onwards. After Nor-Shipping, the companies will be releasing details of several pilot projects over the summer.

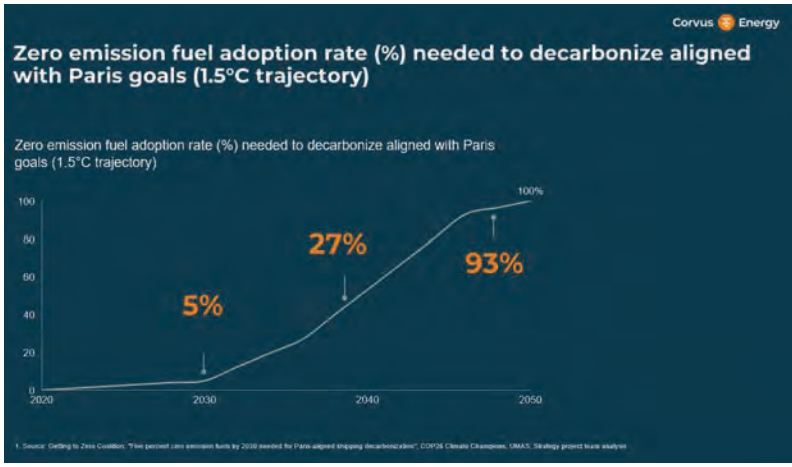
"There are no real limits to how scalable the battery/fuel cell solution could be," Humerfelt reveals. "However, the storage volume for hydrogen as fuel will be a limiting factor for deep-sea traffic at least on longer voyages.

"This will cause the transition to hydrogen to start on shorter routes … [however] new solutions for using ammonia, or other green fuels, that can be reformed to hydrogen will evolve and increase the range for deep-sea applications," he adds.

On regulatory and commercial issues, Humerfelt is upbeat. "We have had discussions with several of the major classification societies during development of the fuel cell technology, all with positive feedback.

"As proof of that, we received Approval in Principle from DNV in spring 2022. The inherently gas-safe design of our fuel cell falls straight into the design philosophy of IMO's IGF Code. We have had lots of interest from shipowners, designers, electrical integrators, and charterers. We are also receiving enquiries from financial institutions, much in parallel with the battery business."

Toyota



Decarbonizing Offshore

Since much of the global economy depends on hydrocarbon energy, and we still need to be able to make steel, fertilize crops and use petrochemicals to manufacture countless products used in everyday life, there is a limit to how far we can go on decarbonizing heavy industries within a certain timeframe. What we can do though, experts say, is make the actual process of oil and gas production less carbon-intensive.

The first power was generated from Equinor's Hywind Tampen offshore wind farm last November. When fully operational, the facility will meet about 35% of the electricity requirement at five offshore platforms, Snorre A and B, and Gullfaks A, B, and C. Until now, they have been powered by gas turbines.

However, pioneering vessel operators in the offshore field have been fine-tuning energy efficiency and carbon reduction strategies for some time. Solstad Offshore ASA, a leading offshore operator in Norway's west coast cluster, operates more than 80 vessels. It has been in the vanguard of sustainability initiatives for nearly 15 years, long before most others.

Since 2009, the company has instilled in its personnel, ashore and at sea, that efficiency gains and emission reductions are top of the right at the top of the KPI list. And the company was a trailblazer when it introduced a vessel-specific incentive scheme with rewards for seagoing personnel on energy-saving initiatives aboard ship.

Today, hybridization is top of the company's agenda. Ten of its offshore vessels have already undergone hybrid retrofits, focused on battery arrangements.

"The projects are expensive," admits Solstad's Chief Sustainability Officer, Tor Inge Dale, "but the CAPEX outlay is compensated by OPEX savings over ten years' time, mainly on client fuel savings but also on reduced engine maintenance cost."

Solstad is working closely with SEAM on the hybridization program. A specialist in hybridization projects, SEAM Project Manager Jarle Hemnes believes that multi-source energy systems are clearly the way forward in upgrading offshore vessels for the future.

"Of course, vessel modifications are not cheap," concedes Hemnes. "But we must prepare for the future. Hybrid energy systems provide a key strategy for this. They generate immediate emission reductions, increase energy efficiency, and cut costs. They can also prepare the ground for new fuels which, at this stage, are still under development. This, in turn, could save further capital outlay in the future."

Northern Explorer

"Seeing how ABB worked and supported the [Vision of the Fjords] project proved to us that we have a partner who is working hard not only to meet our expectations, but is going above and beyond what one can expect,"
– Rolf Sandvik, Northern Explorer

Brim Explorer

The Brim is a fully-electric, aluminium-hulled vessel providing whale-watching tours out of northern Norway's picturesque town, Tromsø.

Ambitious Entrepreneurs

Although many initiatives are undertaken by ambitious corporates, Norway also has a thriving community of entrepreneurial individuals who embark on creative projects that could expand rapidly as decarbonisation becomes more urgent. Rolf Sandvik and his Northern Explorer development project is one such example.

Sandvik was previously Chief Executive of passenger cruise company, The Fjords, where he oversaw the construction and introduction of two electric sightseeing vessels, Vision of the Fjords and Future of the Fjords, on Norway's Geirangerfjord, a World Heritage Site.

More recently, he embarked on the Northern Explorer venture, a completely sustainable cruise vessel that will operate with three ships in Norway. A letter of intent has been signed with Portugal's West Sea shipyard. Meanwhile, Sandvik's earlier experience with power and propulsion specialist, ABB, secured them a place on the development team.

"Seeing how ABB worked and supported the [Vision of the Fjords] project proved to us that we have a partner who is working hard not only to meet our expectations, but is going above and beyond what one can expect," Sandvik says.

Now the venture is in the process of raising capital and hopes to have the first vessel on the water by 2026. Sandvik and his colleagues have met more challenges than they expected – Covid, the war in Ukraine, steel prices, inflation.

But all funding options are open and, further down the track, a listing on Oslo Børs or an initial public offering could be possible. A key plus point is that the ship's energy and propulsion technology will be both scalable and transferable. In a few years' time, fjord transport in Norway could be mostly electric.

This is exactly what motivates Ágnes Árnadottir and her business partner Espen Larsen-Hakkebo, the entrepreneurial founders of the Brim Explorer enterprise. The Brim is a fully-electric, aluminium-hulled vessel providing whale-watching tours out of northern Norway's picturesque town, Tromsø. A second vessel, Berg, operates in Svalbard and Tromsø, and a third ship, Brisen, is deployed in Oslo. Two more vessels are under construction.

The electric drive technology has a range of benefits, Larsen-Hakkebo tells Maritime Reporter, that will ultimately become scalable. And the technology is developing fast. Electric power enables a direct drive to a larger propeller with propulsive efficiency of around 80%. Meanwhile, the carbon-fiber construction of the Brisen enables a slightly larger hull structure but a weight reduction of 20 tonnes.

These projects, amongst many others, will demonstrate shipping's ingenuity and, ultimately, its ability to adapt. Maritime history is dotted with sea changes in ship propulsion technology but none has been as fundamental or as urgent as the industry faces today. There is likely to be one clear message from Nor-Shipping this year – doing nothing is not an option.

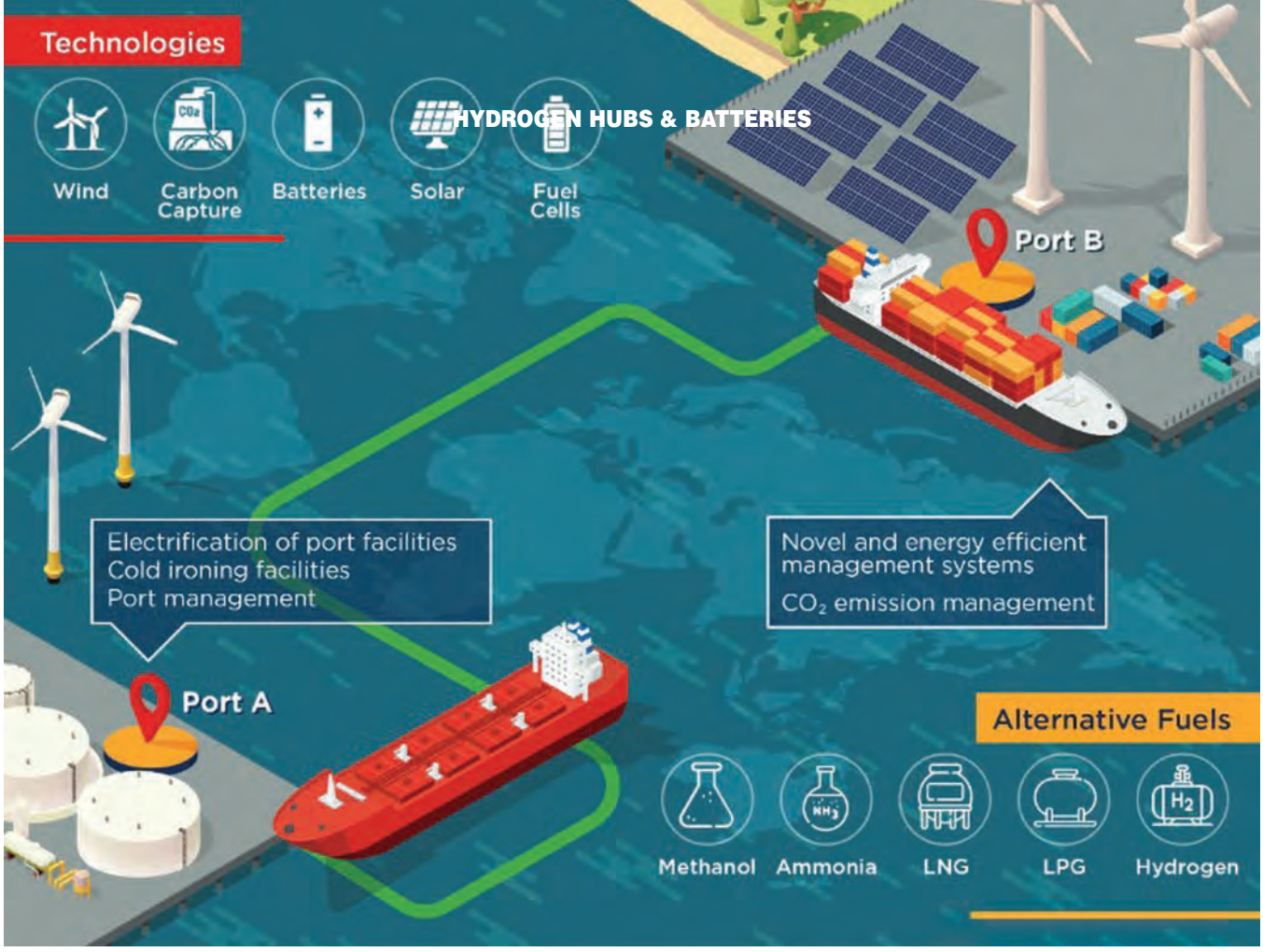
BREAKBULK

EUROPE 6-8 JUNE 2023

Rotterdam Ahoy
The Netherlands

THE DESTINATION FOR PROJECT CARGO

europe.breakbulk.com



ABS

"HYDROGEN HUBS" TO THE FORE

The path to decarbonization is defined by partnership and fueled by government funding. This month we examine the players, partnerships and evolution of Hydrogen Hubs in the Gulf of Mexico.

By Barry Parker

The Green Shipping Challenge, organized by the United States and Norway at COP 27 held in late 2022, brought about dozens of announcements on maritime decarbonization. Among these was a joint statement from the Blue Sky Maritime Coalition (BSMC) – a consortium of North American shipowners and ancillary service providers – and the American Bureau of Shipping (ABS) announcing an effort to create a corridor for the Gulf of Mexico and Lower Mississippi River region, joined by port authorities and stakeholder organizations from Houston and New Orleans in this initiative. There are multiple definitions of what, exactly, constitutes a 'Green Shipping Corridor,' as dozens of initiatives have been announced since the introduction of the concept at COP 26 in October 2021. They can be thought of as a port-to-port trade route (with actual port operations having a reduced or zero carbon emission profile) , hauling non-fossil fuel commodities produced with a reduced carbon footprint onboard vessels powered by alternative fuels.

The Green Shipping Corridor concept links together with a newly emerging concept – "Hydrogen Hubs" – which will be funded in the wake of the massive $1.2 Trillion Infrastructure Investment and Jobs Act (also known as the Bipartisan Infrastructure Bill) signed in 2021, which authorized spending of $7B on the establishment of regional clean hydrogen hubs. While the U.S. Department of Energy (DOE) expects to fund up to 10 such hubs through its H2Hubs program, 79 proposals were received to DOE's initial request for concept papers. Of these, 33 received a "thumbs up" encouraging them to submit more extensive proposals (due in April, 2023) for funding.

The corridors and hubs fit nicely together in the U.S. Gulf, which is known in the crude oil and refined products trades as PADD 3 (Petroleum Administration for Defense District). Natu-

ral Resources Defense Council, the influential advocacy group, in publications examining and promoting the hub concept reminded policy-makers (and infrastructure architects) "…that when targeted at the hard-to-electrify end-uses like steelmaking, marine shipping and aviation, green hydrogen has the strongest potential to support America's transition to a clean economy." In Green Corridors, a key element is the availability of alternative fuels on a particular trade route; with the U.S. Gulf's key role in hydrogen production, well known ports in the region were seeking to play a role.

In New Orleans, the H2theFuture consortium (led by the Greater New Orleans Development Foundation, or GNODF) is seeking to "…establish a world-leading clean hydrogen cluster in South Louisiana." The hub received a $50 million Federal grant in September 2022 from the Build Back Better program. Like the other hubs, the infrastructure includes a wide variety of components. The group envisions the use of offshore wind to power electrolizers that produce "green" hydrogen which might be used in the further production of green fuels. Among the industrial sectors that GNODF expects to see benefits are "coastal and river vessels" as well as "long haul transportation". If H2theFuture moves ahead, it will be tied to efforts at the Port of South Louisiana, a network of ports on the Lower Mississippi, to provide a fueling station, with a hydrogen fueling barge (dubbed H2P3) for an emergent fleet of hydrogen-powered river vessels, which could be built at yards in region.

According to H2theFuture: "The investment leverages the private-sector investment of the Marine Vessel (M/V) Hydrogen One, currently in development by international private partners led by locally-based firm Maritime Partners." The GNODF adds that: "By providing this new fueling asset for e-methanol-fueled vessels, this component project contributes to the overarching cluster strategy by enabling the maritime sector to initiate a transition towards green hydrogen fuels. The H2P3 project demonstrates the comprehensive, end-to-end value chain of the South Louisiana green hydrogen cluster."

The HyVelocity Hydrogen Hub (HV), a consortium of energy majors and important organizations seeking to "… accelerate the development of clean hydrogen projects in Texas, Southwest Louisiana, and the U.S. Gulf Coast," were one of the submitters that received encouragement from the DOE. The objective is to "…leverage the world's largest concentration of existing hydrogen production assets, infrastructure, and customers in the Gulf Coast region to produce clean hydrogen…" In an FAQ document on HV's website, they say: "The hub encompasses a variety of projects, including end-use applications, connective infrastructure, pipelines, shipping, and trucked hydrogen delivery."

The view from high up shows this hub to part of clean hydrogen network that will help decarbonize many sectors of the economy, on a national scale.

Corpus Christi, a leading participant in exports of U.S. crude (and distillate products) has also set its sights on the hydrogen future. Like the H2theFuture and the HV, it also received of vote of confidence from the US DOE. The port says: "The HCH2 Concept Paper, submitted to the DOE on November 7, names around 30 private sector team members as owners, developers and/or operators, off-takers, and end users of various hydrogen value chain projects and supporting infrastructure…" The list of potential collaborators on the infrastructure side includes Buckeye Partners (operators of a large tanker terminal in the port, as well as numerous other facilities, fed by a pipeline network), Magellan Midstream and Epic Midstream – both major pipeline operators. Commodity participants, if the port's efforts move ahead, include well known traders Trafigura and Sempra. They suggest that: "When it is to be exported from the hub by rail or ship, hydrogen likely will be reacted into ammonia, which is a larger, more stable molecule that can either be used directly as an energy source or processed to yield free hydrogen."

In conversations with Maritime Reporter & Engineering News, Sean Strawbridge, Port of Corpus Christi's CEO suggested that methanol (which can also be produced from hydrogen) would also be a potential fuel to be moved from the Hub at Corpus Christi (the leading port for U.S. crude exports). Strawbridge, who is the current Chair of American Association of Port Authorities (AAPA), provided a broader perspective on

Amogy's ammonia fueled tug.

Image courtesy Amogy

The Hydrogen One vessel.

Image courtesy e1 Marine

decarbonization, and the U.S. abundance of potential hydrogen production available, in the future, for export.

"Texas is the largest producer of wind energy, and the second largest producer of solar power in the nation," he said, adding that "many foreign nations are looking to the United States for the production of green fuels." The role for Corpus Christi is clear: "Crude oil has made us so prolific as a traditional energy export gateway, we think that leadership will also hold true as we transition to the export of hydrogen and its derivatives."

The maritime sectors will see a push by technology providers as hydrogen is seen as a viable fuel source for vessels (whether tied to methanol fuel production, or through use in fuel cells). Maritime Partners, the vessel owner involved with New Orleans' potential hydrogen hub, is behind Element 1, an Oregon-based small scale manufacturer of advanced hydrogen generation systems. Its e-1 Marine division has been actively marketing a technology where hydrogen fuel cells, which generate electricity similar to batteries, are fed hydrogen produced onboard in a process where water is added to methanol stored in tanks. Maritime Partners has also invested in ownership of Hydrogen One, a tugboat which will deploy the technology. The boat will be placed on long-term charter to a leading inland provider of barge transportation. Others efforts, not tied to specific hubs, are now gaining traction.

Ammonia power specialists Amogy (a 2020 startup based at the Brooklyn Navy Yard with a presence in Norway, as well), announced a demonstration project where an existing diesel-powered tugboat will be fitted with a mechanism feeding liquid ammonia (stored in fuel tanks) through "cracking modules" which supply hydrogen into a hybrid fuel cell system. The 1MW-rated powerpack will then provide electricity to motors driving the vessel's propellers. Current plans have the vessel (being converted at the Feeney Shipyard in Kingston, NY, to be classed by DNV) being deployed along the Hudson River. ABS announced its role in classification of a Glosten-designed research vessel (to be based in San Diego) that would "feature a new hydrogen-hybrid propulsion system that integrates hydrogen fuel cells alongside a conventional diesel-electric power plant, enabling zero-emission operations." Christopher J. Wiernicki, ABS Chairman, President and CEO, said, "This project will be closely watched by the industry as it breaks new ground and demonstrates the capabilities of this promising alternative fuel at sea."

Alex Parker, Managing Partner of Rose Cay, which actively invests in real assets for the energy transition, is both an owner and an operator of a fleet of 18 coastwise Jones Act vessels. The Rose Cay fleet was purchased in 2021, underwent material technical enhancement, and now transports energy products for Fortune 100 companies, along what could be future Green Shipping Corridors of America.

During a Capital Link conference regarding Jones Act M&A opportunities Parker said, "There is going to be a material Energy Transition and it is underway. The Inflation Reduction Act together with legislation funding hydrogen hubs, solidified Washington, D.C.'s commitment. The impacts will touch both the commodities being transported and the marine fuels being used." As an industry, the U.S. Jones Act community is actively preparing for the future of energy transportation and it is clear Rose Cay intends to be a leader. Rose Cay Maritime is included in a list of partner entities, in a recent announcement from another group, the Northeast Hydrogen Hub (with 100 partners from seven states in PADD 1A- New England and PADD 1B-mid Atlantic states). Parker told Maritime Reporter: "At Rose Cay Maritime, we are committed to serving our customers and American communities with safe, reliable, and environmentally responsible Jones Act transportation today and tomorrow, as the U.S. energy complex evolves. The hard-working men and women in the Jones Act trade stand at the ready to ensure our country's energy security throughout the Energy Transition."

The entire maritime supply chain will undoubtedly be monitoring the developments as the Green Corridors and Hydrogen Hubs move forward.

INLAND MARINE EXPO

IMX2023

CELEBRATING 10 YEARS

MAY 31 → JUNE 2

NASHVILLE

MUSIC CITY CENTER

The Inland Marine Expo celebrates the important work being done along inland rivers, Great Lakes, and intracoastal waterways of the United States.

This annual event invites maritime and logistics professionals to collaborate on making marine transportation even more cost-effective, safe, and environmentally friendly. Make plans to attend this year's Inland Marine Expo, now in Nashville, TN. **Pre-register online to save time & money.**

All-inclusive attendee registration covers:
+200 Exhibitors • Education Sessions • Networking
10th Anniversary Party • Awards Ceremony
Line Throwing & Competition

IMX is produced by
the WATERWAYS JOURNAL Weekly

REGISTER NOW. inlandmarineexpo.com

Armach's Robot Hull Cleaning Service Takes Next Steps Toward Commercialization

All images courtesy Armach Robotics

Maritime Reporter *recently caught up with Karl Lander, Director of Regulatory Compliance and Outreach at maritime tech startup Armach Robotics, to hear the latest progress on its unique, small platform, intelligence-driven hull cleaning solution.*

By Jake Frith

Companies like Plymouth, MA, headquartered Armach Robotics (Armach) are justifiably convinced that cleaning hulls is set for wider adoption in the coming years, as the principle of coating hulls with substances designed to be noxious to marine life becomes increasingly problematic. Not only is there the concern that these noxious substances are indiscriminate in the species they can harm, and so are not only poisonous to the critters that choose to adhere to ships' hulls, but there is also the concern, which has grown alongside better ship performance monitoring, that fleets are plying their trade with dirtier hulls more of the time than previously thought. This operation of vessels with partially fouled hulls, presents the dual environmental and operator cost risks of increased fuel burn, and the greater likelihood of invasive species transfer.

Karl Lander explains: "Hull cleaning systems are not going to replace biocidal hull coatings overnight. There will still be a need to paint hulls under the waterline in something that is unappealing to marine life. The difference is that now we will be able to augment these coatings with hull cleaning processes, so we can use harder, longer-lasting coatings which leach fewer toxins, are kinder on the environment, while offering the additional cost benefit of fewer ship lay-ups for recoating."

There is a critical aspect to when, in the fouling cycle, vessel operators choose to conduct mechanical hull cleanings. Broadly speaking, until now there were two ways of looking at it; proactive or reactive. Armach however offers an always clean approach through their new EverClean program which only tackles slime, the first step in the fouling chain, addressing only slime early and often with gentle soft brushes optimised for that task, and hence kinder on hull coatings than alternatives. This principle informs a big part of the EverClean always clean philosophy.

The weeds, and later even more problematic fouling species such as molluscs, simply cannot attach, unless slime is already present. Yet, as any small boat owner who owns a mask, flippers, and a scrubbing brush will tell you, slime can

be removed with one finger if caught early enough, but if left to the weed stage or beyond, removal becomes a real slog.

Armach is currently working on a Launch and Recovery System (LARS) for completely autonomous deployment in the future. This next step in the technology evolution will take even more people out of the loop, and make the systems even more autonomous. This autonomy is the key difference in what sets Armach's system apart, by harnessing the powers of autonomy and sensor control, to offer always clean hulls at scale commercially.

Armach has already successfully demonstrated over-the-horizon operation when an Armach Hull Service Robot (HSR), deployed in the water in Norfolk, VA, was monitored and controlled by staff at a command center in Plymouth, MA, using standoff command and control solution SAFE C2 from Greensea Systems who has enormous experience, and an enviable worldwide reputation for providing the very best intelligent control systems for underwater robots, indeed, this is how Armach came into being. Greensea was confident that its OPENSEA vehicle agnostic, open architecture control software would fuse their proprietary hull navigation solution from the HSR's myriad sensors, providing rock-solid vehicle control.

The Armach HSR is undoubtedly a clever machine. It uses six thrusters and a central vortex generator to obtain its variable pressure on the hull to optimize performance from its five brushes. This has a number of benefits over rival systems, not least that its non-reliance on magnets means it's equally usable on steel, GRP, or aluminium hulls. HSRs measure brush power demands on the fly, using it along with an array of other data, so that the vehicle 'knows' when it is cleaning an already relatively clean area, so it can move faster, with less pressure. When the HSR reaches a more heavily fouled area, it exerts more pressure, and takes a little more time, just like an intelligent human operator would. This agility and scalability is a clear benefit for the Armach EverClean approach.

Karl Lander was happy to share some valuable findings from early adopters of the program. "One very forward-thinking company, when it comes to decarbonization and ESG aspects, was running partially fouled hulls leading up to their scheduled dry dockings. This isn't a big revelation, as it is widely accepted in the shipping industry as an undesirable, but largely unavoidable, cost of operation. For this operator, however, performance monitoring had put a number on this, and as many operators are finding out, the actual number is much larger than the past estimates ever were. Cruise ship turnarounds are famously tight. Thanks to the HSR's intelligent navigation, the robot 'knows' the fastest way around each hull, and tweaks its route intelligently, according to what it encountered last visit, meaning tight deadlines are achievable with just 2 HSRs working as a team."

However, Armach is not just about hardware, as Karl Lander sums up: "In terms of the HSR itself, the hardware is fairly straightforward. The success is the combination of hardware with proprietary software. Armach is the culmination of years' of navigation, autonomy, and communication software development merged with hardware to create a service that meets the future needs of vessel owners now."

All images courtesy Yaskawa Environmental Energy / The Switch

SHAFT GENERATORS 101 – *WHAT ARE THEY?*

Yaskawa Environmental Energy / The Switch shines a light on how to produce electricity efficiently on ships.

A ship is like a floating city that needs electricity to power its operations and amenities on board. So how to generate that electricity while being mobile? That question has been challenging the shipping industry for more than 150 years, when exciting new technologies were being pioneered at the forefront of the new age of electricity. Fast forward to today, and the challenges surrounding the production of electricity on board vessels have been spurred again. The International Maritime Organisation's new regulations, among other new protocols, mean shipowners and operators must find ways to cut emissions and make their vessels more efficient.

Propulsion is one obvious area to look at for improvements, and the fuels that drive that. Shaft generators also play a key role in the modern propulsion system and so also require scrutiny.

Driving force

Everyone can visualize what a propeller shaft looks like and what it does, but what exactly is a shaft generator and how does it help to reduce fuel use and cut emissions? We are back to electricity production again, but these units, hidden inside the hull, are not as mysterious as they may sound.

Standalone generator sets (gensets) need an external fuel source in order to operate and produce electricity, and this is typically done through an auxiliary diesel engine separate from the ship's main engine.

Shaft generators cut out the need for gensets and their auxiliary engines as they connect directly to the propeller shaft and make electricity by utilizing the propulsion drive already supplied by the main engine. This is why they are called shaft generators. Gensets can then be turned off, which saves fuel and cuts emissions.

In addition, utilising the larger 2-stroke main engine in this way is much more efficient than the 4-stroke engines that typically power the gensets. Finnish company Yaskawa Environmental Energy / The Switch has developed a system that it says can cut fuel use by a further 2% to 4% more than conventional shaft generators.

A Little History

The first shaft generators were developed in the 1960s and took their place next to the gensets that had been shouldering the job of producing electricity on board vessels for the previous decades.

These first shaft generators were a big step forward and reduced the need to use gensets. But there was still one major drawback – they were directly connected to both the ship's propulsion shaft and the grid, but without a frequency converter in between.

That meant the shaft generator was limited as it could only cope with a constant speed from the ship's propulsion drive. When the ship's speed would change, the frequency of the electric current produced would fluctuate, making it unusable. And so the shaft generator had to be disconnected, making way for the genset to take over.

This frequency issue was resolved in the 1980s when frequency converters were introduced. The shaft generator then came into its own as it could cope with any speed from zero up to the ship's rated speed and feed a constant frequency to the ship's grid.

The conventional shaft generator and frequency converter combination can be used as the sole generating source of electricity on board a vessel or as a supplement to the gensets, reducing the need to burn fuel.

Shaft generators can also be used as a source of power to drive the propeller at very low speeds, which is useful when entering port to save on emissions. Plus, the system can be used for occasional propulsion power boosts of up to 15% if needed to break through ice or against strong headwinds.

However, despite these benefits, there are some key areas where conventional shaft generators fall short. This is where The Switch permanent magnet shaft generator takes things a step further, bringing savings that are becoming ever more potent as curbs on emissions grow tighter.

Conventional shaft generators still require a current to flow in a rotor winding to create the magnetic field, so there is always energy loss through heat. This heat loss means lower power conversion efficiency, resulting in higher fuel consumption in the main engine.

Permanent Attraction

The permanent magnet shaft generator uses Neodymium magnets. This means the magnetic field can be created more simply and efficiently, without the need for external power supplying a current to the rotor, and so immediately saving on the amount of fuel that needs to be used.

The simple mechanism also means there are almost no wearing parts, increasing reliability. The first permanent magnet shaft generator was installed by The Switch in 2014 and, with more than 100 in operation today, not a single failure has occurred, the company says.

The permanent magnets in these machines are also so strong the whole unit can be reduced in size, typically weighing up to 30–50% less than conventional machines.

The permanent magnet shaft generator's efficiencies are where the extra 2% to 4% reductions in fuel savings come from – over and above savings seen in conventional shaft generators. This reduction applies to emissions as well. Over a typical 20 to 25-year lifespan of a large vessel, these savings can bring a $2 million reduction in fuel costs and eliminate 5,000 tons of carbon dioxide emissions.

The first generator sparked into life in 1831 to light up inventor Michael Faraday's smile. If only he could see how far that attraction to magnets has come, as the need to cut emissions drives engineers to deliver exciting new technologies all over again.

The range of PM shaft generators made by The Switch.

New Products

Innovative products, technologies and concepts

Inside Schottel's New SRP-D

The performance of the Schottel RudderPropeller Dynamic SRP-D has been confirmed by external sources. Initial investigations into the effect of thruster response on DP positioning were carried out in cooperation with MARIN, based in the Netherlands, and Polish ship designer MMC. The results obtained demonstrated much-improved position accuracy and enhanced operability of the vessel. Further calculations made by DNV and simulations from a cooperation with VARD showed that the SRP-D improves the vessel's operational performance and environmental impact, showing too that the DP footprint can be significantly reduced, coupled with expected fuel savings of up to 30 percent depending on the operating point.

"The results presented in MARIN's dynamic DP simulations indicated a significant benefit as regards the operability of the vessel," said Michał Olko, VP and Chief Designer, MMC Ship Design. In addition to the embedded electric main drive (LE-Drive) and a propeller shaft with an eight-degree tilt, the SRP-D features a number of improvements, including reduced propeller acceleration/deceleration times and a high-speed azimuth steering system with reinforced gear components, thus achieving double the rotational

speed. The dynamic properties of the SRP were investigated within a time domain level three analysis commissioned by DNV. The simulation was performed on the numerical model of a real Service Operation Vessel (SOV) equipped with Schottel propulsion systems. Its position-holding capabilities were examined under extreme weather conditions: high winds, strong currents and effective wave heights of 2.5m and 3.2m. The results of the simulations at DNV showed a significantly improved positioning accuracy while halving the DP footprint. This permits successful gangway landing operations even in rougher conditions, thus increasing the service life of the vessel throughout the year. Furthermore, every single landing is performed more efficiently, saving time and fuel. Thanks to the lower gearbox that has an additional eight degrees downward tilt, the interaction between propulsion unit and hull and the propeller flow interaction are reduced. As established in the simulations, these optimizations result in an increased thrust efficiency during DP. Depending on the thruster's operational direction, simulation also revealed up to 50 percent less thrust loss and fewer forbidden zones.

"The CFD results of the inclined gear box clearly show a significantly reduced thruster hull interaction or Coandă effect for zero-speed station-keeping," said Karl Randle, Principle Naval Architect, VARD. "This is especially evident for inward flow directions and areas where the flow interacts with or flushes the skeg or other thrusters.

www.schottel.de

Permastar LED Floodlight

SONARAY, a manufacturer of proprietary LED lighting products, announced PermaStar, a high efficacy, 500-watt LED Flood Light that comes with a limited lifetime warranty. new flood light is durable with IP66 and IK10 ratings, and is available in a range of beam angles and produces up to 67,000 lumens in the 45-degree angle model. The PermaStar is also UL 1598A listed so it can be used outside in damp or wet environments. The PermaStar is constructed with a durable die-cast aluminum housing and has been treated with an anti-corrosive finish to further help it withstand extremely harsh environments. Available with beam angles of 22, 45, or 70-degrees.

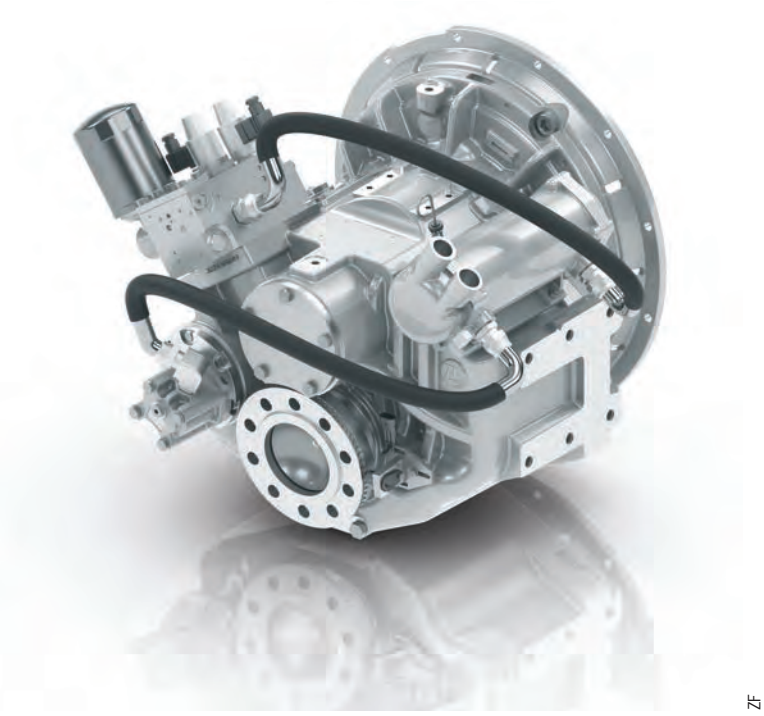
www.dascomamericas.com

SONARAY

NEXT-GEN "GREEN" PROPULSION PRODUCTS TODAY

For vessel operators seeking more environmentally friendly technologies, ZF Marine offers a variety of solutions that are commercially available now. As a developer of marine propulsion systems, the company has a broad portfolio of smart and hybrid-ready transmissions, fuel-efficient POD systems and advanced monitoring systems, designed to reduce consumption of expensive and harmful fossil fuels for nearly any type of vessel.

Whether operators are trying to reduce costs and carbon pollution, adhere to future emissions standards or simply meet customer requirements, incorporating hybrid technologies is one part of a larger strategy to meet these goals. But what can operators do now to make traction? Consider these eco-friendly solutions, which can be incorporated aboard existing vessels or in new builds:



ZF

- **Hybrid-ready transmissions and gear boxes:** ZF's systems are equipped with the necessary mechanical pieces to allow inputs from an alternative source, be it electric motor, a smaller engine or something else.
- **Smart transmissions:** ZF's products provide predictive maintenance features and remote monitoring, technology designed to vastly improves vessel operations and operational efficiency (fuel consumption).
- **Advanced monitoring systems:** ZF's systems provide live data and support predictive maintenance to ensure peak operational performance and optimal fuel usage.
- **POD 4600 Propulsion system:** Designed for vessels from 70 to 130-ft., ZF's POD 4600 system is up to twice as powerful while consuming up to 15 percent less fuel than a traditional shaftline propulsion system.

As an innovator, ZF Marine is rapidly developing new next-generation technologies that will come online in the next year and beyond that will further help operators achieve their goals of greener operations.

www.zf.com

THE MARITIME NETWORK

THE MARITIME INDUSTRY'S LARGEST SOCIAL MEDIA PRESENCE

Maritime Reporter **and** ***Marine News*** **magazines are members of the Marine Media Network, the industry's largest network of websites, publications, and social media sources.**

All data current as of 10/25/2021

MARITIME REPORTER AND ENGINEERING NEWS

59,236

Followers

THE MARITIME NETWORK

179,981

Members

@ShipNews

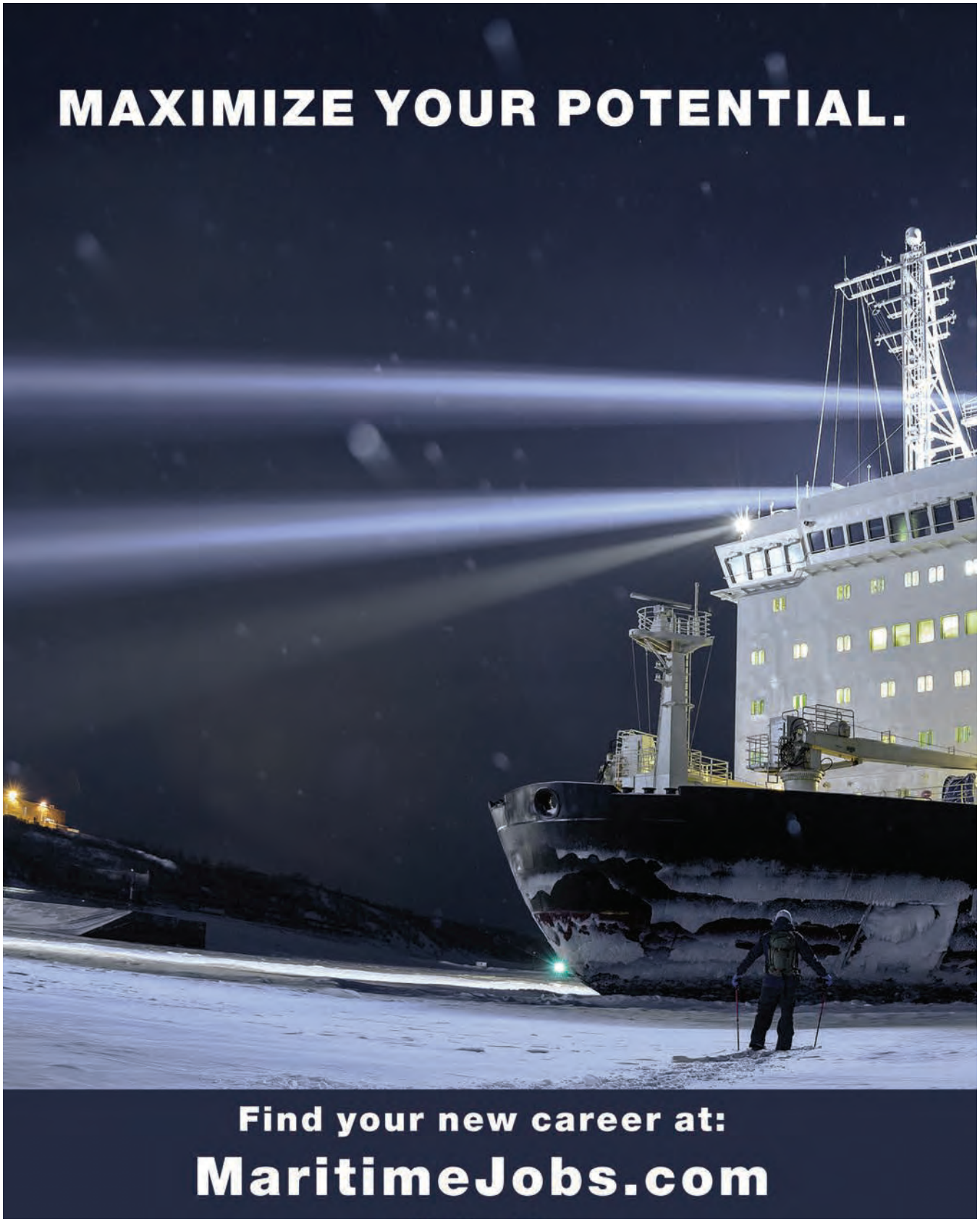
50,040

Followers

WWW.MARINELINK.COM

Employment

www.MaritimeJobs.com



MARKETPLACE

Professional

www.MaritimeProfessional.com

Products & Services

www.MaritimeEquipment.com

MARKETPLACE

Products & Services

www.MaritimeEquipment.com

Vessels, Barges & Real Estate for Sale/Rent

BUYER'S DIRECTORY

This directory section is an editorial feature published in every issue for the convenience of the readers of MARITIME REPORTER. A quick-reference readers' guide, it includes the names and addresses of the world's leading manufacturers and suppliers of all types of marine machinery, equipment, supplies and services. A listing is provided, at no cost for one year in all issues, only to companies with continuing advertising programs in this publication, whether an advertisement appears in every issue or not. Because it is an editorial service, unpaid and not part of the advertisers contract, MR assumes no responsibility for errors. If you are interested in having your company listed in this Buyer's Directory Section, contact Mark O'Malley at momalley@marinelink.com

ANCHORS & CHAINS

Anchor Marine & Supply, INC., 6545 Lindbergh Houston, Texas 77087 , tel:(713) 644-1183, fax:(713) 644-1185, david@anchormarinehouston.com

ENGINE ORDER TELEGRAPH

Prime Mover Controls, 3600 Gilmore Way Burnaby B.C. V5G 4R8 Canada , tel:604 433-4644, fax:604 433-5570, Michael.Combs@pmc-controls.com

INERTIAL SENSING SYSTEMS

Silicon Sensing Systems Ltd, Clittaford Road Southway, Plymouth, Devon PL6 6DE United Kingdom , UK , tel:+44 (0) 1752 723330, sales@siliconsensing.com

MEMS MOTION SENSING

Silicon Sensing Systems Ltd, Clittaford Road Southway, Plymouth, Devon PL6 6DE United Kingdom , UK , tel:+44 (0) 1752 723330, sales@siliconsensing.com

METEOROLOGICAL INSTRUMENTS

R.M. Young Company, 2801 Aero Park Drive Traverse City, Michigan 49686-9171 , tel:(231) 946-3980, vsherman@youngusa.com contact: Viola Sherman

NAVAL ARCHITECTS, MARINE ENGINEERS

JMS Naval Architects, 70 Essex Street, Mystic, CT , USA , tel:(860) 536-0009 EXT 2, fax:(860) 536-9117, RickF@JMSnet.com

NAVIGATION AND CONTROLS

Prime Mover Controls, 3600 Gilmore Way Burnaby B.C. V5G 4R8 Canada , tel:604 433-4644, fax:604 433-5570, Michael.Combs@pmc-controls.com

SENSORS

Silicon Sensing Systems Ltd, Clittaford Road Southway, Plymouth, Devon PL6 6DE United Kingdom , UK , tel:+44 (0) 1752 723330, sales@siliconsensing.com , www.siliconsensing.com

ADVERTISER INDEX

The listings above are an editorial service provided for the convenience of our readers.
If you are an advertiser and would like to update or modify any of the above information, please contact: productionmanager@marinelink.com

IGP

INTELATUS

GLOBAL PARTNERS

OFFSHORE WIND MARKET INTELLIGENCE

Intelatus offers solutions to grow your business globally.

- **U.S. Offshore Wind Market Report**
  The monthly report and database contains all of the latest developments and information on the projects that will lead the U.S. to deploy 30 GW of offshore wind by 2030 and 110 GW by 2050.

- **Polish and Baltic States Offshore Wind Market Report**
  Intelatus forecasts that over 30 projects accounting for over 30 GW of offshore wind capacity are likely to be committed by 2035.

- **International Wind Turbine and Foundation Market Forecast**
  We provide a forecast of the bottom-fixed offshore wind turbine and foundation installation vessel demand and identify supply gaps in the market.

- **Floating Wind Turbine Installation Vessels Market Forecast**
  Intelatus provides a forecast of floating wind turbine installation vessel demand and identifies supply gaps in the market.

Get all the information you need to access this growing multi-billion dollar market today!

VISIT US

WWW.INTELATUS.COM

ENGINEERED COOLING SOLUTIONS

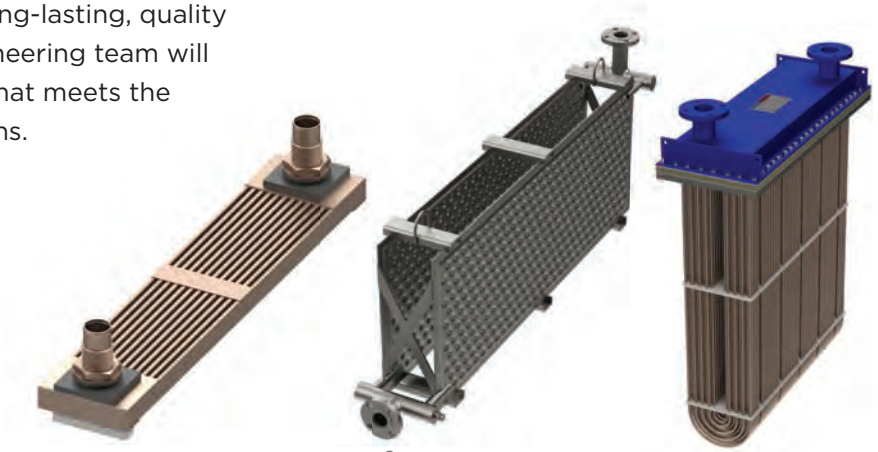
Join us at Inland Marine Expo Booth 515

OVER 70 YEARS COOLING THE MARINE INDUSTRY

R.W. Fernstrum is committed to providing long-lasting, quality marine heat exchangers. Our sales and engineering team will work with you to custom design a solution that meets the needs of your vessel and operating conditions.

FERNSTRUM®
R.W. Fernstrum & Company

fernstrum.com
906.863.5553
sales@fernstrum.com
ISO 9001:2015



GRIDCOOLER® Keel Cooler

Omega Laser Plate™

WEKA Boxcooler®