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MARITIME REPORTER AND ENGINEERING NEWS

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Roy Campe, CTO, CMB.TECH

Hydrogen

Campe and his team pioneer the use of dual-fuel hydrogen on ships & boats and in ports

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Roy Campe shows Maritime Reporter around the CMB.TECH workshop in Antwerp. Photo: Greg Trauthwein | **Photo on the Cover:** courtesy CMB.TECH

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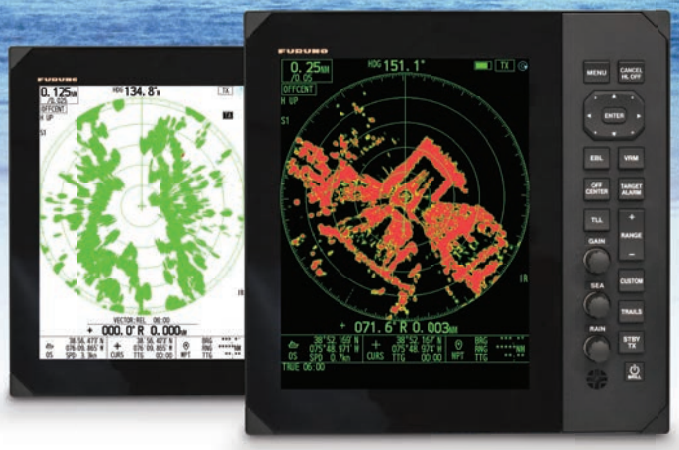

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It's all about the Molecule

Photo Justin Zurre

Having sat in this seat for 30+ years, it always amazes me what I don't know. The world is obviously a big place, a big place made to seem much smaller with the quantity and rapidity of information flow, for better or for worse. That said, it's impossible to keep up with all of the evolving activities of companies leading the various sectors, if for no better reason than the vast majority shun media coverage unless it's pre-planned, paid or otherwise orchestrated by corporate policy.

That's why my visit late last year with **Roy Campe, Chief Technology Officer, CMB.TECH** – this month's cover story – at the organization's hydrogen refueling station in Antwerp stands out as a breath of fresh editorial air, where Campe took me on a whirlwind trip through his career and his mission to effectively future-proof the CMB fleet of ships and port equipment.

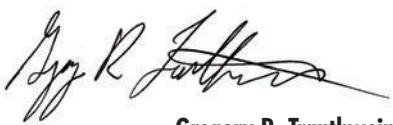
Not only did he let us inside the journey to dual-fuel hydrogen, he wanted to share with us and the rest of the maritime world insights not simply on the press release inspiring successes, but also on the number of hurdles and challenges that have been crossed; as well as the ones that remain.

Until Campe started with CMB in 2015, he was an industry outsider with volumes of fluid, flow dynamics and aerospace industry experience; but zero maritime experience.

He speaks rapidly yet cohesively as he explains the journey to becoming an alternative fuel leader in conservative maritime sector, logging world-firsts in the use of hydrogen as marine fuel, a story we present in eight full pages starting on page 22.

The path toward decarbonization is a long one, fraught with many bumps, hurdles, walls and unknowns. There is palpable uncertainty regarding the introduction of alternative fuels in the maritime sector, and for good reason as the maritime environment is tough, remote and unforgiving. While diesel remains the dominant form of fuel and will continue to be for a very long time, change is happening now, a change that will only increase in speed with the confluence of legislative mandate and technology development.

While "HYDROGEN" is the bold headline on the cover, make no mistake: Campe and the CMB.TECH team are fuel agnostic. He is not committed to any single alternate fuel, and is clear that it is not necessarily the CapEx cost of the new and emerging technology that is the driving force when making decisions, rather the cost, availability and reliability of 'the molecule.'



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Tip #55

Maritime Micro-Learning for Mega-Benefits

By Murray Goldberg, CEO, Marine Learning Systems

In our industry as in most others, we typically see online training content presented as large, comprehensive courses that trainees are required to do from start to finish. However, an alternative approach called microlearning has recently garnered a lot of attention. This method, characterized by short, focused learning modules, is a practical solution to many training hurdles. Let's dive into how and why microlearning can be beneficial for maritime training.

In our industry, the details are important. This is where microlearning shines. By breaking down complex procedures and rules into bite-sized pieces, it allows the learner to focus on one single, digestible topic at a time. This typically makes it much easier for learners to absorb and retain critical information. This is especially beneficial for seafarers who need to quickly grasp safety protocols and procedures to ensure safe voyages.

Another appealing aspect of microlearning is its flexibility in terms of time. Because microlearning modules are self-contained bite-sized learning pieces, they tend to fit neatly into the hectic schedules of maritime professionals who often find themselves with little time to spare. Rather than repeatedly starting and stopping in the middle of a large course, a micro module can be completed in a short span of time and will stand on its own as useful, applicable learning.

This same "mini" attribute of microlearning also has the benefit of lending itself very well to just-in-time learning. This can be a huge advantage in our industry. Imagine an officer or crew member who is about to begin a task that they have not done for some time and feel a little rusty on. How likely is it that they will choose to re-do an hours-long course as a refresher, versus spending 5 minutes reviewing a micro-learning module that addresses the specific part of the process that they are unsure of? Making training appealing, accessible and student-focused (created and delivered with the needs of the student in mind as a core guiding principle) in this way greatly increases the likelihood that it will be used - which clearly will improve safety and performance.

There are other advantages as well. For example, when requirements change and we need to update our training, it tends to be less expensive to update the specific microlearning modules in question rather than to update and republish an entire course. Also, microlearning helps us avoid the burden of overtraining. For example, when a crew member moves from one vessel to another, microlearning makes it far easier and faster for them to be trained on the specific differences between the vessels rather than having to re-do an entire course where a large percentage of the material covered does not vary from one vessel to the other. And finally, micro-learning makes competency-based learning easier to administer and achieve as the learner can focus on those specific topics and learnings needed in their role and avoid having to cover (or figure out how to skip over) those which are not needed for his or her role, but were packaged together in a large course.

While the adoption of microlearning is only starting to take hold, I suspect it is more than just a fleeting trend in maritime training; it is a practical and efficient way to improve learning engagement and outcomes. Its ability to simplify complex information and fit into the work life of maritime professionals makes it an invaluable tool. It can help reduce costs, improve safety and performance, improve the learner experience, and reduce administrative overhead. And it brings us all closer to our shared goal: to nurture a culture of continuous learning and improvement, essential for maintaining safety and efficiency in the maritime world.

Thank you for reading and until next time, sail safely!

The Author

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Big Ships & a Fuel Cell Future

Fuel cells have the potential to play a big role in decarbonizing the maritime sector. Siemens Energy and Advent Technologies recently signed a Memorandum of Understanding (MoU) to collaborate on an integrated fuel cell energy solution that combines Advent's HT-PEM technology with Siemens Energy's experience in integrated electrification, automation, and digital solutions. The focus: decarbonizing industries with sustainable power, starting with marine applications and expanding to other industrial applications. ***Markus Wagner*** *of Siemens Energy and* ***Søren Kildedal*** *of Advent Techologies discuss the project and its prosepcts. [Answers from the* **Maritime Reporter TV** *interview are edited for brevity and clarity]*

By Greg Trauthwein

Watch the full interview @ MARITIME REPORTER TV

Can you give a by the numbers look at the resources for the project?

Søren Kildedal, Advent Techologies: It's not a single project, rather a collaboration on multiple projects. From Advent's side we bring a lot of know-how because we already have a solution on the market today. Together with Siemens, we'll ensure to have the next generation for higher power demands. We are dedicating around 50 R&D personnel for this development.

When talk turns to hybrid propulsion and alternative fuels, there are many options under study. Looking at the fuel cell energy solutions, can you discuss the strengths and the weaknesses?

Kildedal: With the methanol fuel cells, it's possible to go to net-zero emissions. They're very high efficiency, it's compact, it's noise free, and vibration free. A difficulty is that you need to store a lot of energy. Another weakness is there's a lot of capital investment at start-up compared to traditional internal combustion engines.

Markus Wagner, Siemens Energy: There is always some point, when it comes to bigger devices, where it makes sense to use a fuel cell. [For large ships} it's not possible to cross the ocean with only a battery installation, because the batteries are simply too heavy. When you choose a hydrogen carrier, you quickly come to methanol because the energy containers are around four times higher when compared to compressed hydrogen tanks, for example.

When talk turns to alternative fuels and power, it's generally agreed that there is no silver bullet solution. For the technology in the confines of these projects that we're discussing, what types and sizes of vessels are we talking about?

Wagner: I would say 'the big ones' traveling long distances. If you use methanol, you need to find a way to get hydrogen out of it and, and you'll need space for the reforming process to get the hydrogen. And if it comes to very small vessels, it could be an option to go with pure compressed hydrogen to save the space for the methanol. The methanol reformer is the thing with the Advent solution that we found very attractive, as they've built these modular small systems with an integrated reformer.

I know we're just at the beginning of this collaboration, but what do you see as the greatest challenge or hurdle for a successful conclusion?

Kildedal: I think it's getting the very conservative marine industry to adapt to new technologies, giving scale and helping to significantly reduce the cost of production of the systems.

Wagner: I think one big thing is the availability of [sustainable] methanol.

The maritime industry is conservative, for good reason. Are there any case examples within maritime, even if they're outside your organization, that you can point to as a success or, at least, we're going the right path?

Kildedal: In 2015, we did our first marine installation on a

Photo courtesy Advent Technologies

Søren Kildedal, Technology Solution Director, Marine (Advent Technologies)

Photo courtesy Siemens Energy

Markus Wagner, Project Manager Fuel Cell Solutions (Siemens Energy)

ferry that got class approval. We have done a few others since then, and right now we are doing an installation, together with Siemens Energy, on a yacht in Italy.

Wagner: We have seen a lot of successful solutions based on methanol in the shipping, but mainly based on compressed hydrogen. But we realized that there are a lot of concerns regarding compressed hydrogen because it's dangerous, and you have to do a lot to make the system safe [and compact] on the vessel.

I'm certainly not looking for you to speak for ship owners, but can you generalize the hurdles that you face in making ship owners comfortable with these new emerging technologies?

Wagner: One of the pain-points we encounter when we get requests for fuel cell systems is simply not having much knowledge and experience on the systems. The CapEx is the biggest pain point, but you have to consider the OpEx, too. If you want the system for 15 years for example, you probably will be spending less money than if you are using an internal combustion engine based on methanol, for example. If you have a fuel cell system with no moving parts, it's much lower in maintenance costs.

It's not that complicated: for a methanol-based fuel cell system you need air, you need a DC connection, you need a communication connection, and you need some cooling water, and that's it. We created a solution where we have an internal water cycle, so the water we produce from the fuel cell [is caught and used again, eliminating the need to carry water].

Photo courtesy Siemens Energy

Predictability, or "Call your Designated Responder Early and Often"

By Rik van Hemmen

Predictability is the aim of every human, company, or society.

Humanity simply strives to increase its level of predictability whether as a person, or as a group of people. When humans attain a certain level of predictability, their hope for the future goes up and their level of anxiety goes down.

Oddly, conservatives and progressives both strive for predictability, they just do it in different ways. A conservative will say: If nothing changes, then my predictability for the future will go up. Meanwhile, a progressive will say: If I carefully change things that are not predictable, my level of predictability goes up.

Progressives and conservatives also know why the other is wrong. A conservative will say: "Once things change, predictability will go down", and a progressive will say: "If we do not change things that are not predictable, predictability will go down." In effect, predictability and decision making are closely tied together. One can make better decisions when the future can be predicted more accurately.

Predictability can be improved in many ways. Science is pretty good at predicting certain things. Engineering also does a decent job at predicting certain things. Societies actually exist to increase predictability, whether it relates to managing disasters or with social programs such as social security.

OPA 90 was actually created to increase predictability. The entire structure allows stakeholders to proceed with a level of predictability in a situation where predictability can appear to be sorely absent.

When predictability increases, it becomes easier to make decisions and that will help to gain control of a disaster.

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OPA90 has been successful in that regard, but due to its measurable success, its predictability is actually going down.

This is a strange conundrum that occurs occasionally. It is equivalent to the much-repeated argument that since we did not continue to fly to the moon, we lost the skills to fly to the moon, and today have to recreate or reinvent solutions that existed 50 years ago. In 1970 we could predict confidently that we could fly to the moon, but in 2024 that prediction is much more tenuous.

Since there are few large oil spills today, we have entered a similar conundrum. We do not really know if we can manage a large oil spill today, there are exercises, but exercises are not the real thing.

A real oil spill is unpredicted and unpredictable, and while we hope everybody will show up in time we do not really know if this will occur. Moreover, since we have not had a significant number of serious oil spills recently, shipowners and operators now start to imagine that a small oil spill will not turn into a big oil spill. However, this ignores an underlying reality. Small disasters that are not rigorously managed can turn into big disasters.

If this were to occur, the salvors and response contractors will be called in after the small disaster turned into a large disaster. From their point of view this may not be a bad deal, because big disasters make more money than small disasters, but, from an overall disaster management point of view, this approach is, well, disastrous.

Imagine the following scenarios:

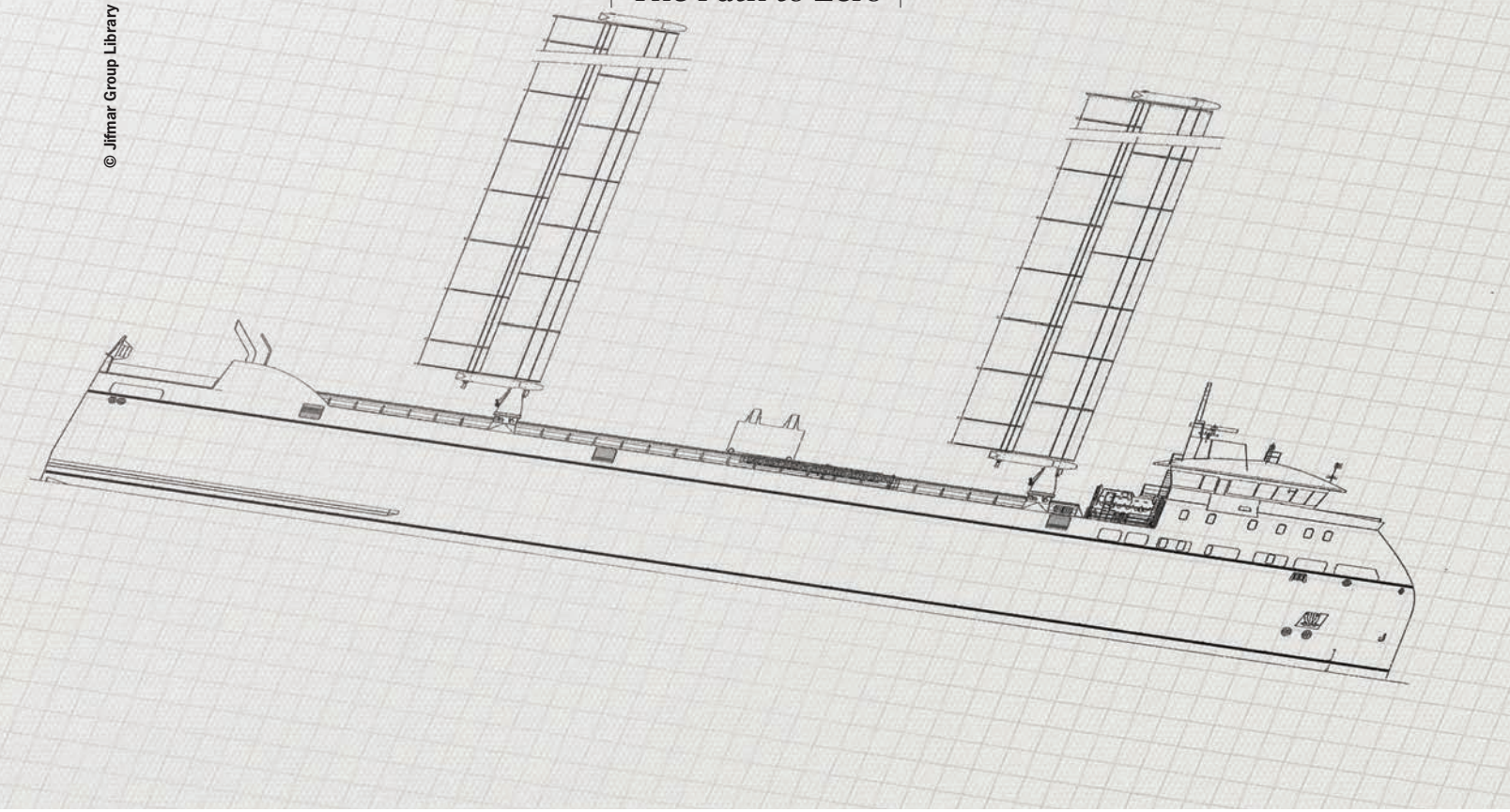
- **Scenario 1.** A vessel has a soft grounding. It is expected the vessel can be refloated on the next high tide without external assistance. At the next high tide, the vessel is being refloated under direction of the Captain and use of her own engines and ancillary equipment, but during the refloating the vessel passes over an abandoned anchor and tears out the bottom. Fuel oil spills and the vessel is flooding and settles down. The Owner now has to call the QI and the designated Salvage and Marine Firefighting contractor (salvor). They cannot immediately be on site and now the USCG becomes uncomfortable. The spill continues and eventually the salvors and spill contractor secure the vessel and cargo and pick up the mess. In the post mortem analysis everybody is embarrassed since the response was less effective than desired.
- **Scenario 2.** A vessel has a soft grounding. It is expected the vessel can be refloated on the next high tide. The Owner

calls the contact numbers for the designated spill contractor and the designated salvor. One answers immediately and the other takes a bit of time to contact but joins the discussion before the next high tide. At the next high tide, the vessel is being refloated, but during the refloating the vessel is dragged over an abandoned anchor and tears out the bottom. Fuel oil spills and the vessel is flooding and settles down. The designated spill contractor has already talked to the local spill contractor who is aware that there may be a call out and the salvor has already contacted their local resources for the same reason. When it became apparent they were needed, they were ready to roll and during the salvage operation and clean up operation everybody, the ship owner, the salvor, the spill response contractor, and the USCG looked good.

- **Scenario 3.** A vessel has a soft grounding. It is expected the vessel can be refloated on the next high tide. The Owner calls the contact number for the designated spill contractor and the designated salvor. One answers immediately and the other takes a bit of time to contact but joins the discussion before the next high tide. At the next high tide, the vessel is refloated, and no spill occurs. The vessel has no damage and continues its voyage. The salvage and spill contractors stand down, but everybody has become a little smarter. The vessel owner and its personnel know how to contact the spill contractor and the designated salvor and how to instruct them. The contractors get to exercise their first level response and make fixes as needed. The USCG knows that in a real disaster the initial system response will kick off reliably and Scenario 1 is less likely to occur in the future.

In other words: Increased predictability has been achieved. I am not suggesting in any way, shape or form that all the response personnel and equipment needs to be loaded up and sent to the casualty. What I am suggesting is that dropping a nickel on your designated responders early does not have to cost a lot, and in the long run saves money and makes everybody look good.

For each column I write, **MREN** has agreed to make a small donation to an organization of my choice. For this column I nominate the **Cornell Lab of Ornithology ...** ***www.birds.cornell.edu/home*** ... I like my birds clean.



Americas Cup Innovation & a Carbon-Free Shipping Future

By Giorgio PROVINCIALI, *CTO of AYRO and Former America's Cup Performance Predictions Leader*

The Golden Gate Yacht Club (GGYC) represented by BMW Oracle Racing and the Société Nautique de Genève (SNG), the Americas Cup defending champion, represented by Team Alinghi were entwined in a 2.5-year legal battle over multiple court cases, including hearings in the New York Supreme Court and the Appellate Division of the New York Supreme Court, prior to the 33rd edition of the race, due to take place in 2010.

The parties disagreed about the location, format, and restrictions on boat design, all of which were changed by the courts prior to the race. The lifting of restrictions on boat design gave BMW Oracle Racing the possibility to create the most advanced carbon fiber trimaran the world had ever seen, which, with a team of skilled and experienced professional sailors went onto claim the Americas Cup for an American team for the first time since 1992.

The February 2010 one-on-one match race was initially hard fought, but in the end, the United States of America could be proud of BMW Oracle Racing and its success in bringing the Americas Cup home. It was, however, a unique new rigid wingsail design based on an aircraft wing that propelled Ellison's high-tech trimaran across the finish line eight and a half minutes before the defenders showed up in the Alinghi 5 catamaran, fitted with more orthodox, albeit race-bred, sails.

The use of a rigid wingsail contributed to the biggest Americas Cup win since 1988, which is quite a legacy. But the adaptation and commercialization for merchant ships of that original

wingsail design since 2018 by French tech startup AYRO has the potential to leave a much larger legacy; by providing a new approach to wind assisted propulsion that can significantly reduce the impact of modern shipping on the environment.

The Inception of OceanWings

The original Americas Cup rigid two-element mainsail was pushed by the design team and renowned naval architecture firm VPLP Design, along with its co-founder Marc Van Peteghem, were tasked with the job of integrating it on the BMW Oracle Racing trimaran. Drawing inspiration from his experience and achievement, Marc embarked on a journey to adapt this high-performance wind energy system for commercial vessels. His vision was clear: to reduce the use of fossil fuels and, by extension, shrink the carbon footprint of shipping.

This vision resulted in Marc becoming the co-founder of AYRO in 2018, and the subsequent birth of OceanWings, the company's unique wingsail solution engineered to combat the climate-related challenges that loom over the maritime industry. While five years in the making, OceanWings arrive at a time when regulatory pressures are mounting to accelerate the shift towards sustainability within the sector.

At the heart of AYRO's pioneering wingsail technology lies a dynamic interplay between primary and secondary sail components. It's a symphony of movement and interaction that sets OceanWings apart, eclipsing the performance of conventional sails and single element wing-sails. The key is a cleverly designed slot gap that orchestrates the flow of air between these two sail elements, igniting a powerful acceleration along the wing's leeward edge, known as the extrados. The principle takes a cue from aircraft wings in motion and the result is balance and incredible performance even at narrow apparent wind angles.

This is crucial for ships in motion, where apparent wind takes precedence over true wind. AYRO's wingsails generate propulsive force even when the apparent wind angle is as low as five degrees, so they can adapt to 95% of conditions found at sea. And in that remaining 5%, the system efficiently mitigates the added drag from inactive wing-sails, automatically switching to flag mode to ensure minimal impact on the vessel and enable safe operations and navigation under engines alone. Critically, despite originally being developed to be handled by some of the world's most skilled and experienced yachtsmen, OceanWings operation is fully automated, requiring a ship's crew only for supervision.

Scaling Down for Commercial Ops

While technology or ideas coming from the yachting world to ships would normally mean a scale up effort, the

work to make OceanWings suitable for commercial vessels was actually a scale down of the original design. The wingsail on BMW Oracle Racing's 2010 trimaran was an incredible 68 meters tall.

Today's largest OceanWings are 37 meters tall with a projected area of 363 square meters. Steel ships are of course much heavier than a state-of-the-art carbon fiber tri-maran, however there is more real estate, so AYRO was able to build a smaller wing under the expectation that at least two and anywhere up to eight would be deployed.

Working out the complex interplay between multiple wingsails was a key aspect in the development of OceanWings.

This research was also supported by efforts made in the design of the Canopée, which is the first ship to use OceanWings wingsails on a commercial voyage.

Working closely alongside the Canopée's owner Jifmar Offshore Services, the VPLP Design team thoroughly analyzed the vessel's behavior in relation to the use of its four OceanWings.

Their goals went beyond simply identifying the optimal wing positions; they delved into the forefront of Computational Fluid Dynamics (CFD) advancements, encompassing the detailed modelling of the intricate interaction among multiple OceanWings.

Comparing the performance assessment of a single wingsail on a vessel differs from evaluating the performance of a more intricate configuration comprising multiple wing-sails.

Further insights from the Energy Observer catamaran – an OceanWings testbed that has travelled more than 20,000 nautical miles under wingsail propulsion since 2019 has played a role in enhancing the control algorithms that govern the automation of the wing-sails.

Hybrid is the Way Forward

Fast forward to October 2023 and the Canopée sets sail for French Guiana on its maiden voyage – marking it as the first modern wind assisted modern ship in commercial operations. Its job is to deliver Ariane 6 rocket parts to the launch site, so it will spend most of its life on a fixed trans-Atlantic route between Europe and South America.

Modelling, and data from Energy Observer and live sea trials aboard Canopée have put the fuel consumption and GHG emissions savings at around 30%, with peaks in excess of 50% in favorable wind conditions. That's 30% less fuel and 30% less carbon when measured against a similar vessel using heavy fuel oil on the same route. These savings are available now.

While it's possible for the Canopée to voyage at more than 9 knots just using its wingsails, scenarios where this is a viable mode of operation will be few and far between. Instead, the value of its OceanWings comes from using the wind to reduce the work its engines need to do, with the result being a very positive

impact on operational efficiency.

This hybrid assisted approach will be necessary going forward if the shipping sector is to ever become truly carbon neutral. Future fuels, such as methanol will play a significant role, but their mainstream availability will likely be limited for several decades, and they may cost four to six times more than heavy fuel oil does today. The financial factors will certainly slow adoption, but the cost challenges can be mitigated when wind power enters the equation. In fact, AYRO's research shows that OceanWings are capable of delivering 50% savings on fuel consumption, which would be a huge advantage for ship owners when choosing, or finally being forced to adopt costly future fuels like methanol.

True Decarbonization

Mitigating the far-reaching consequences of global warming stands as one of humanity's most pressing challenges. Currently, ships are responsible for about 3% of total carbon emissions and are expected to represent up to 17% of human CO^2 emissions by 2050 if no action is taken. Fortunately, the industry has already been set on a carbon free trajectory.

In July 2023, IMO Member States adopted the 2023 IMO Strategy on Reduction of Greenhouse Gas (GHG) emissions from Ships, with enhanced

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targets including a common ambition to reach net-zero GHG emissions from international shipping by or around, i.e. close to 2050, a commitment to ensure an uptake of alternative zero and near-zero GHG fuels by 2030, as well as indicative check-points for international shipping to reach net-zero GHG emissions for 2030 (by at least 20%, striving for 30%) and 2040 (by at least 70%, striving for 80%).

Wind assisted propulsion combined with future fuels can steer the maritime world towards a more sustainable and environmentally friendly future. But it's important that the conversation includes the world's largest source of free energy, the wind.

By promoting wind propulsion as the technology available today that can unlock the most drastic savings, it's possible to look positively and imagine that the IMOs 2030 target could be met. Action on wind propulsion now will build a platform for making future fuels more viable and wind assisted hybrid propulsion should easily help the industry reach the 2040 target as ships begin to reduce their reliance on heavy fuel oil.

After this, with further developments and innovations from new ship designs to more digitalization combined with wind power and future fuels, true decarbonization in shipping by 2050 starts to look entirely plausible. And likely not a moment too soon.

All photos courtesy Mr. Dave Meron

U.S. Military's Path Toward Uncrewed

By George Galdorisi

For readers of ***Maritime Reporter and Engineering News,*** it is impossible to miss the impact of emerging technologies on changing the character of warfare through the ages. From the time that our cave-dwelling ancestors figured out how to fasten a sharpened stone to the end of a sturdy stick, advances in weaponry have decided the outcome of battles and the fate of nations.

Today there are numerous technologies that have the promise to make an enormous impact on warfare in the third decade of the twenty-first century. Some of the most prominent include next generation fighter aircraft, quantum computing, stealthy bombers, artificial intelligence and unmanned technologies in all domains.

In the maritime domain, and especially for the U.S. Navy, unmanned systems – especially uncrewed maritime systems – offer the promise of providing the U.S. military with an asymmetric advantage over potential adversaries. Ukraine's use of weaponized uncrewed surface systems to attack Russian naval vessels has demonstrated just one use of these multipurpose platforms.

The U.S. Navy has taken several actions to define and accelerate its journey to have uncrewed platforms populate the fleet. These include publishing an UNMANNED Campaign Framework, standing up an Unmanned Task Force, establishing Surface Development Squadron One in San Diego and Unmanned Surface Vessel Division One in Port Hueneme, CA, and conducting a large number of exercises, experiments and demonstrations to evaluate uncrewed platforms, including the recently completed Integrated Battle Problem 2023.

Indeed, in its vision for the "Navy After Next," the Navy's Force Design 2045 document envisions a fleet of 500 ships, to include 350 crewed vessels and 150 uncrewed maritime vehicles. This represents a once-in-a-generation shift in the composition of the Navy fleet and one that will place big bets on emerging technologies that can make uncrewed maritime vehicles more autonomous.

This U.S. Navy emphasis on uncrewed maritime vehicles was on full display at a major international military-industry event. Held in Honolulu, Hawaii at the Hilton Hawaiian Village in mid-November of this year, TECHNET Indo-Pacific drew over 4,000 delegates from throughout the Indo-Pacific region. As in previous years, the conference featured keynote speakers as well as breakout panels.

Column space does not allow for a full description of all that occurred at this three-day event, so I will focus on the keynotes and panels that concentrated most-intently on uncrewed maritime vehicles.

Rear Admiral Eric Ruttenberg, Reserve Deputy Commander, U.S. Pacific Fleet, delivered the event's opening keynote address. His presentation: "Indo-Pacific: The Stakes Could Not Be Higher: Implementation of Modern Technologies Must be Accelerated to Meet Military Needs," covered a wide range of challenges and opportunities facing the U.S. Navy in the Indo-Pacific region. A substantial portion of his remarks were focused on uncrewed maritime vehicles. Here are some of the highlights:

- The most pressing need for Pacific Fleet is innovation, and the velocity of innovation must accelerate.
- Pacific Fleet is looking for ways to get unmanned surface vehicles forward to desired areas of operations.
- Pacific Fleet's strong emphasis on unmanned will enable warfighters to conduct missions in a contested environment that manned systems cannot do due to adversary anti-access/area denial (A2/AD) capabilities.
- We must continue to evaluate unmanned systems in exercises, experiments and demonstrations.
- The Integrated Battle Problem series represents the pinnacle of experimentation and will continue into 2024 and beyond.

It is easy to see that the U.S. Pacific Fleet, which is responsible for dealing with the United States principal adversary in the region, is leaning forward to leverage uncrewed maritime vehicles to perform a plethora of missions for a number of reasons, among them: their ability to reduce the risk to human life in high threat areas, to deliver persistent surveillance over areas of interest, and to provide options to warfighters that derive from the inherent advantages of unmanned technologies.

Later that day, a panel of subject matter experts in the field of uncrewed maritime vehicles highlighted many of the strides the Navy has made in getting these technologies into the hands of Sailors and Marines who evaluated them in the operational environment. Among the highlights of this panel: "The Impact of Unmanned Maritime Systems on Asia-Pacific Navies:"

- International Maritime Exercise 2022, held under the auspices of Commander Task Force 59 in the Arabian Gulf, set the standard for uncrewed maritime vehicle experimentation and included operations with a number of regional partners. Navies of these nations explored the capabilities of USVs such as the Saildrone, the MARTAC MANTAS and Devil Ray, and many other USVs from participating nations.
- RIMPAC/Trident Warrior 2022 was a major coming out for uncrewed surface vehicles (USVs) operating with the fleet. As a result, the Integrated Battle Problems are increasingly evaluating USVs in broader and more intense set of missions.
- Australia has become a leader is USV experimentation. Autonomous Warrior 22 expanded the evaluation of USVs from Australia, New Zealand, the United Kingdom and the United States and featured 30 autonomous systems, including Saildrone, MANTAS and Devil Ray.
- The goal of Pacific Fleet is not to field fully autonomous systems at some future time, but rather to field semi-autonomous systems now.

These, as well as other, discussions during TECHNET Indo-Pacific made it clear that the Department of the Navy – and especially the U.S. Pacific Fleet – have a strong commitment to an accelerated development path for uncrewed surface systems so that they can complement the Navy fleet and perform missions that keep Sailors and Marines out of harm's way.

Said another way, the U.S. Navy's commitment to a future of unmanned maritime systems is an important arrow in the quiver of U.S military innovation and is likely to keep the Navy in the forefront of world navies for years to come and enhance its ability to provide for the security of the world's oceans.

A New Era for Great Lakes Freighters with Modern Marine Epoxies

By Justin Peare, *Marine Coatings Representative, Great Lakes Region &*
Matt Heffernan, *Commercial Marine Business Manager, North America,*
Sherwin-Williams Protective & Marine

The Motor Vessel Mark W. Barker – the first U.S.-constructed freighter of its kind in almost four decades – is an historic addition to Great Lakes shipping.

With dimensions of 639 feet in length and a width of 78 feet, the M/V Mark W. Barker – The Interlake Steamship Company's first new build since 1981 – distinguishes itself from the typical 1,000-foot-long freighters on the Great Lakes. Built by Fincantieri Bay Shipbuilding in Wisconsin, this bulk carrier is designed to navigate narrow rivers without compromising capacity (Figure 1). The vessel also features square, flat cargo holds (Figure 2) and a forward-placed unloading boom, which enhances operational flexibility.

Despite its unique size, the self-unloading freighter remains competitive with larger vessels, boasting a 26,000-ton cargo capacity. Its distinctive design contributed to the selection of advanced coatings systems to ensure durability. Initially built to transport salt, the M/V Mark W. Barker has showcased its versatility since launching in 2022 (Figure 3), carrying various bulk and break-bulk cargoes, from iron ore pellets to oversized items like steel bars and wind turbine parts.

"This boat will continue to find unique cargoes that haven't traditionally been moved," said Rick Hanning, fleet engineer of The Interlake Steamship Company, which operates 10 Great Lakes vessels and is headquartered in the Cleveland area. "It has a special ability to navigate rivers and ports – and its cargo hold is unlike any other on these waters."

Guarding the Freighter

The M/V Mark W. Barker required a coatings system as distinctive as its design and historic significance. The coatings specification for the ship was developed through collaboration

Figure 1. The M/V Mark W. Barker is specifically designed to navigate the occasionally narrow rivers and confined ports scattered across the Great Lakes region.

Figure 2. Distinguished by its square-shaped cargo holds, the vessel can transport a greater freight load than some larger vessels.

Figure 3. The Interlake Steamship Company representatives christen the M/V Mark W. Barker in Cleveland in September 2022.

All images courtesy of The Interlake Steamship Company

between The Interlake Steamship Company and the product team at Sherwin-Williams Protective & Marine, ensuring a tailored and effective solution.

"We focused on where other boats were having issues," said Hanning.

To protect the ship's underwater hull from numerous hazards, the team chose Sher-Glass FF. A glass flake-reinforced epoxy coating, it offers enhanced impact and abrasion resistance, as well as improved durability, edge protection and corrosion resistance.

"Shipping on the Great Lakes can be a contact sport, and this product adds resilience to the ship, which promotes a long lifespan," said Hanning.

In a controlled shipyard, applicators began with an SSPC-SP 10 blast, followed by the application of two coats of Sher-Glass to the hull, with an average dry film thickness (DFT) of 18 mils per coat. This coating – directly applied to steel – eliminates the need for a separate primer, saving time. Specifically designed for immersion service, it features pre-wetted glass flakes for consistent mixing and application, allowing prolonged exposure to liquids.

The M/V Mark W. Barker's distinctive hull, named in honor of The Interlake Steamship Company's president, features the organization's signature red.

Interior Fortifications

To meet the demands of the uniquely shaped cargo holds, the project team sought a coating system capable of withstanding many types of materials. Beginning with an SSPC-SP 10 blast, applicators sprayed Zinc Clad III HS, a zinc-rich epoxy primer, onto the cargo hold walls. This three-component, polyamide epoxy coating delivers exceptional performance and protection with its high zinc content, offering corrosion

Figure 4. The vessel's cargo holds feature flat bottoms that accommodate the use of heavy machinery, which necessitated advanced coatings systems to protect these areas from damage.

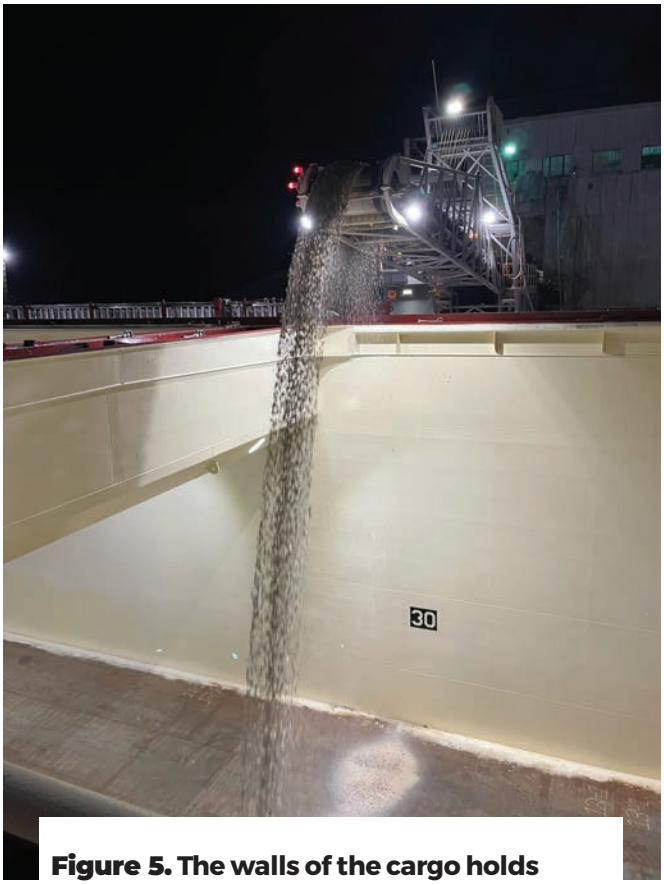


Figure 5. The walls of the cargo holds benefit from a zinc-based coating that provides durability in an area exposed to stressors that include loose cargo loaded from a few dozen feet.

All images courtesy of The Interlake Steamship Company

and cathodic protection to the steel substrate.

The primer is also stable and durable in challenging environments with mechanical stress – standing up to the front-end loaders in the vessel's cargo holds (Figure 4) and the impact of cargoes loaded from significant heights (Figure 5). The coating's self-healing properties provide protective qualities when subjected to minor abrasions or scratches, enhancing overall longevity.

Adding an extra layer of protection, SeaGuard 6000 was applied to the walls of the cargo holds. A versatile two-component, modified epoxy coating, it combats corrosion and excels in both saltwater and freshwater environments. The coating also adheres well in moisture-rich and low-temperature conditions – critical for ship maintenance during cold-weather months.

SeaGuard 6000 was the "workhorse on the rest of the boat," said Hanning, "especially areas not exposed to major UV light," which included living and common spaces, and floors – with Seaguard 1000 serving as the topcoat throughout.

SeaGuard 1000 – a single-component, high-gloss marine enamel coating – boasts fast-drying, rust-inhibitive properties, and enduring color stability. Even when exposed to exterior conditions, it maintains vibrant color, acting as a protective barrier against humidity and corrosive elements. It not only prevents substrate deterioration but also resists yellowing.

The vessel incorporates a distinctive tunnel below its cargo holds, spanning nearly the entire length of the ship. Cargoes enter through small channels at the holds' bottom and are transported to the top for unloading on a rubber belt. A unique coatings system was crucial to withstand corrosive bulk cargoes, particularly salt, in these tight areas. Despite its typical use in tank linings, Nova-Plate 360 was chosen to protect the tunnel's floors and walls, showcasing its versatility and effectiveness in addressing the boat's specific challenges.

"Cargoes are introduced into a very small area," said Hanning, "and that's incredibly hard to fix once corrosion starts – so it's essential to keep it intact."

Nova-Plate 360, a versatile flake-reinforced novolac-based coating, excels in abrasive environments, offering robust corrosion protection. Infused with PTFE (Teflon) to enhance abrasion resistance, it provides an additional layer of defense, extending coated surfaces' service life.

After an SSPC-SP 10 blast and the application of zinc primer, Nova-Plate 360 was applied, incorporating stripe coating where needed. Single-leg sprayers were used to apply a single

Figure 6. The M/V Mark W. Barker sports exterior topcoats in The Interlake Steamship Company's distinctive red (hull) and brown (freeboard).

coat with a DFT of 20 to 25 mils. Aluminum oxide was added for slip resistance and texture in wet flooring areas. The coating's low surface energy also facilitates easy cleaning during shutdown periods.

In the freshwater setting of the Great Lakes, where freighters typically skip ballast tank coatings, the project team chose SeaGuard 6000 due to the potential corrosive impact of certain cargoes, especially salt, which could inadvertently enter a ballast tank during unloading at a dock.

"Salt can work its way in anywhere," said Hanning. "The coating puts us in a winning position against corrosion."

Applicators sprayed the two coats over an SSPC-SP 10 blast to the tanks. After a one-year survey, no signs of rust or failure had occurred.

Outer Protection

The M/V Mark W. Barker's freeboard – the hull section above the waterline – features The Interlake Steamship Company's distinctive brown coloring, achieved with a topcoat of Acrolon 218 HS. Above the waterline, most exposed areas received a coat each of SeaGuard 6000 and the Acrolon 218 HS topcoat (Figure 6).

Acrolon 218 HS, a fast-drying polyester-modified acrylic polyurethane coating, provides excellent application properties – delivering smooth and uniform coverage. Formulated for exceptional color and gloss retention, it protects against weathering, UV radiation and other environmental factors, preserving the coated surfaces' appearance over time.

The M/V Mark W. Barker's unloading boom was also salvaged from a retired freshwater shipping vessel – preserving a bit of Great Lakes history. After rehabilitation, it received a coat each of SeaGuard 6000 and SeaGuard 1000.

Setting Sail

The project team predicts the vessel will remain operational for at least a decade before dry docking – nearly double the typical expectancy for most hulls.

Throughout this period, the M/V Mark W. Barker will navigate the Great Lakes (Figure 7), playing a vital role in transporting essential cargoes and components for a range of domestic industries.

"This boat is a gamechanger in American freshwater shipping and offers a glimpse into the maturation of our industry," said Hanning. "I'm confident this vessel will have a long life, and I'm proud the coatings play a vital role."

Figure 7. The M/V Mark W. Barker – built to navigate the rivers and ports of the Great Lakes with distinctive cargoes – is docked at a shipyard.

ROY CAMPE

Chief Technology Officer CMB.TECH

In 2015 Belgian shipowner CMB tapped industry outsider **Roy Campe** *for a simple task:* **future proof the fleet.** *Campe, who came to the table with a background in aerospace plus air and fluid dynamics design, took the mandate and ran with it, building a team and delivering world firsts in the use of hydrogen as fuel in maritime.*

By Greg Trauthwein

ROY CAMPE, CTO, CMB.TECH

Photo credit: CMB.TECH

As maritime navigates a future premised on meeting and beating decarbonization targets, it's repeated often that no single technology or solution will serve as the 'silver bullet', and tapping research and knowledge across industry sectors is a must.

Enter Roy Campe, the CTO of CMB.TECH, an industry outsider that has come into the maritime sector at arguably one of the most transformational periods in its history. Campe has had a long and varied career, a career with his Masters in Aerospace Engineering from Delft University of Technology as a foundation, and an entrepreneurial career built on research and development, including a stint working for famed Dutch astronaut Wubbo Ockels plus vast experience in solving all sorts of engineering problems centered on air and fluid flows.

His stint with CMB started as many such positions do: making a career/life decision mixed with a chance meeting.

After 10+ years as first CTO, then Partner with Actiflow BV, Campe thought "OK, it's been 10 years, I'm getting married … what's next?"

What's next was short stint at Ghent University, working for more than a year in an incubator that helped to grow technologies centered on offshore energy, offshore wind and renewable energy. "That's how I met the CEO of CMB [Alexander Saverys], who explained his challenge like this: 'I have a fleet of more than 100 ships, and the majority of them will sail for 20 to 25 years. The energy transition will have a big effect on my shipping business; I want somebody to look into how I can future-proof my fleet,'" Campe recalls.

And thus was born the matching in 2015 of Compagnie Maritime Belge (CMB) – a traditional, 125-year-old shipping company with 150 seagoing vessels and six divisions – with Roy Campe, a maritime industry outsider with an ironclad technology development track record and business sense to deliver. "So three weeks later, I started here in Antwerp."

Jumping In

Campe admits that at first it was "a bit weird" to be positioned on the technical team, and his colleagues cast a wary eye, premised on the fact the man tasked with future proofing a fleet had never, in fact, sailed onboard a commercial ship.

So in those early days, off he went on a two-week trek onboard a CMB container ship sailing to and from St. Petersburg, where he was able to witness first-hand the operations, processes and challenges.

"People approach us and ask 'can we do a retrofit?' The answer is 'no'. the cost of the engineering alone is a big factor, but also the fact that dual fuel is best suited to consider from the initial stage of the design – particularly with hydrogen, as the issue is the amount of storage required."

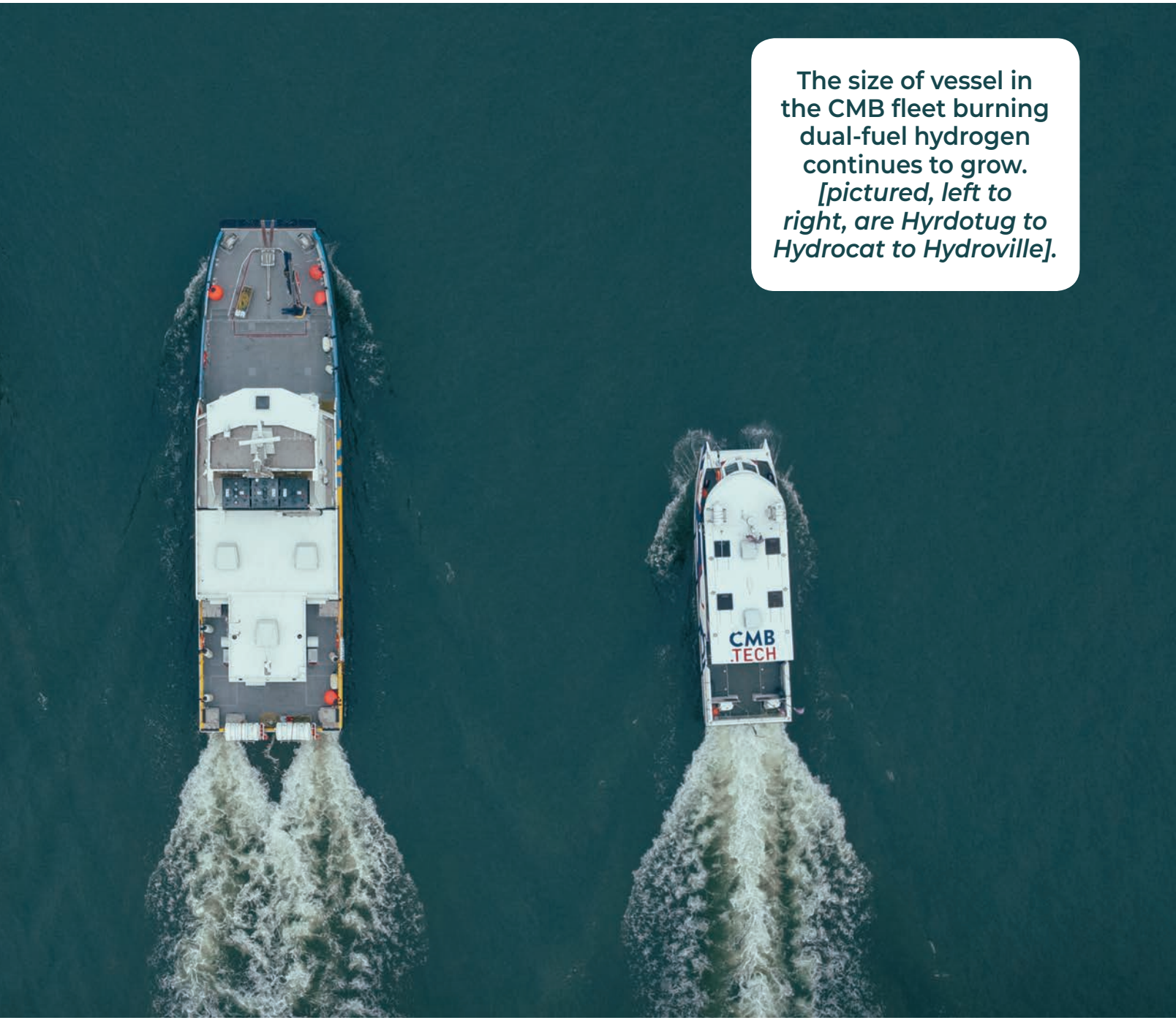
ROY CAMPE, CTO, CMB.TECH

"I was amazed that these ships have such big engines, that they consume so much fuel, but that it was so very hard to predict how much that fuel consumption would be," said Campe. The team tried to explain the impact of wind and waves in making fuel consumption so inexact, but Campe was having none of it.

"They said, 'Oh, Roy, it's so difficult to predict.' To which I said 'I've done that all my life; simulating fluid flows and wind flows. You can perfectly calculate that."

This started the growth of the R&D team under the CMB.TECH brand as Campe started modeling the fleet and its performance. This is also when he ran into, and crossed his first hurdle: attracting the technical talent that he wanted, that CMB needed, to drive change in an industry that "is not sexy anymore," making it hard to recruit.

"I want to have good engineers, because that's how we can make [the CMB fleet and business] future-proof." Today the CMT.TECH team



The size of vessel in the CMB fleet burning dual-fuel hydrogen continues to grow. *[pictured, left to right, are Hyrdotug to Hydrocat to Hydroville].*

Photo credit CMB.TECH

has grown to 90 people across several world regions, and this technical talent base is central to Campe completing his mission.

Seeing is Believing

With his technical team building and running at speed, CMB CEO Saverys asked him to build a ship powered by hydrogen. "Everybody said, 'Roy, it's crazy. Don't do it, it will never work.' But for me, that's fun. I'm an entrepreneur, it's something new, let's look into it."

And look into it they did.

It all starts with the powerplant, and specifically the CMB.TECH team took a marinized Volvo Penta engine and modified it so that it would be compliant with class and flag to burn both hydrogen and traditional diesel when and if needed. He credits Lloyd's Register and the flag state in working with his team on the concept and approval. There are myriad hurdles to jump once you get past the powerplant and vessel design, everything from permitting to answering questions on fuel supply. But lo and behold, with the backing of a progressive owner, the insight of a talented technical team and collaboration and support from industry – the engine makers, class, flag and even the port, a mere 18 months later in 2017, the first vessel – Hydroville – was ready.

But Campe knew that this small demonstrator vessel was not the endgame in future proofing the CMB fleet, rather the first step in a much longer journey to parlay the technology and apply it to much larger vessels with higher speeds and longer voyages. As an executive with an entrepreneurial heart and a technologist soul, Campe knew that designing and building a future fuel vessel simply for the sake of doing it was not sustainable, as it had to be cost effective. "Looking into the cost [of Hydroville], we paid as much on engineering than on the cost of the vessel. If you want to make money, you need something that is scalable."

Next the CMB.TECH team targeted the Crew Transfer Vessel (CTV) used by the offshore wind energy sector, which is vibrant in the region, as a reasonable next step: larger vessels that made daily runs to and from offshore wind farms, and diesel-powered vessels serving renewable energy platforms simply didn't make sense nor prove good optics to the public at large.

"So then we started cooperating with Windcat, and after two years we have acquired Windcat, because we saw that kind of team should be part of the CMB group, it could be the start of a green fleet," said Campe.

As word started to get out, Campe and his team were fielding inquiries from around the world, as far as Japan, on the feasibility of hydrogen fuel for certain projects. And invariably they would ask about Hydroville, the first dual fuel hydrogen vessel, specifically if it was a money maker. "No, it's not the moneymaking, but it shows people [the concept and the potential], and especially in the maritime industry, seeing is believing," said Campe.

Fuel Agnostic

While the focus on CMB today is hydrogen, premised largely on the Hydroville project and last month's delivery of Hydrotug 1, the world's first hydrogen-powered tugboat, Campe is open to exploring the use of any and every fuel, as he reasons that decarbonization choices in the maritime sector will not come down to the cost of a specific technology or vessel, rather "the cost of the molecule [fuel]."

Hydrotug 1 is the first tugboat in the world to be powered by combustion engines that burn hydrogen in combination with traditional fuel. It is the first vessel that uses the BeHydro V12 dual fuel medium speed engines – each providing 2 megawatts – with the latest EU Stage V emissions aftertreatment. With these engines, the vessel uses clean fuels, resulting in an overall reduction of 65% of traditional fuel consumption and associated emissions in the tugboat's overall cycle. The Hydrotug 1 can store 415kg of compressed hydrogen in 6 stillages installed on deck and eliminates the emission's equivalent of 350 cars per year.

CMB.TECH and Boeckmans recently announced plans to build at Dung Quat shipyard in Vietnam four hydrogen-powered 5,000-dwt multipurpose cargo vessels. The first vessel is expected to be delivered in the second half of 2025, and are planned be deployed on major sea routes, including northern Europe, the Mediterranean, North Africa and West Africa.

The general cargo vessel, designed jointly with Handelskade, will contain diesel-electric engines placed under the ship's forward accommodation. This configuration will make the stern available for pioneering propulsion systems, such as hydrogen (but other alternative low-carbon engines can be installed as well). In addition, there will be ample space available for storage of these alternative fuel sources. Estimates are for emission reductions of 40% with diesel only (due to its newest design of hull, propeller and drive line, while the hydrogen technology can offer the zero emission target.

For the largest ships in the CMB fleet, the focus is on ammonia, as it is cheapest from a production point of view and the ship point of view, with bunkering technology in place plus it doesn't come with the storage issues inherent with hydrogen, particularly in large quantities.

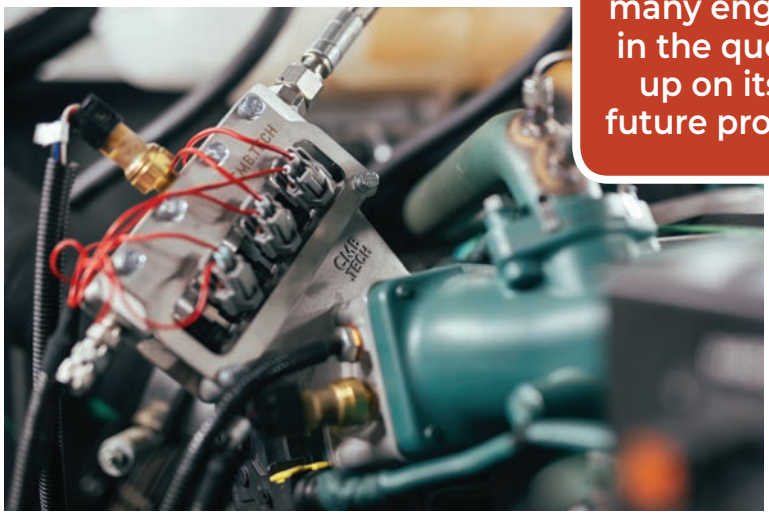
"So we started designing our cargo vessels and we decided, 'OK, let's start building ammonia ready ships,'" said Campe. The hurdle here, of course, being that the dual fuel ammonia engine is still in development, so CMB entered into an agreement with WinGD to develop the ammonia two-stroke large scale marine engines.

ROY CAMPE, CTO, CMB.TECH

The BeHydro Engine

The MAN Engine

The CMB.TECH team is fuel agnostic, and has formed partnerships with many engine makers in the quest to scale up on its quest to future proof the fleet.



The Volvo Penta Engine

Volvo D4 DYNO Engine on Hydroville.

All photos courtesy CMB.TECH

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Through all of the incessant chatter of future fuels, dual fuels and zero emissions, Campe and his team maintain both a solid technical and a business compass, as he knows that while news of 'world firsts' and 'fuel transition' are nice PR fodder, but in the end the technology must work lest it and the company wither and fad.

And while the focus in this context is the fuel, the full scope of Campe's team work includes everything from stem to stern, from new engines to new designs and new propellers … anything that can help the company be more efficient while maintaining reliability.

Campe sees the CMB way of putting technology to the test, on the water, working, as the very best means to actually learn about a particular technology's ins and out, plusses and minuses. "There's an overflow of information, but [for example] not many people know the cost of a [hydrogen] compressor; how it works; how you maintain it … what are the hiccups of the technology?," said Campe. "You need to practice it. I'm driving a hydrogen car and I know zero emission technology is fun. But I also know that my car has been in the repair garage for 5 months [due to the lack of a technician that knows how to fix it], and I know I have to calculate in my weekends how far can I drive on hydrogen so I can get back to refuel. I don't want to do that as a company. Everything that comes into a port, that's going to be our business."

> **"We decided it's better to have 3 vessels with dual fuel than to have one zero-emission vessel [with no market]. [A zero-emission vessel is] often a white elephant, it's too expensive, it's too difficult maintain, to obtain the molecule with great security of supply … it's crazy."**

The Path to Zero - or Not

It's important to stress again that Campe's view on new technology is not simply for the sake of technology, rather melding emerging technology that makes business sense. So when talk turned to zero emissions, Campe offers an argument against. "For me, zero emission is that step too big that nobody is willing to take it, or if they do it's to get subsidies. Subsidies are not scalable; they typically are for a one-off project, which [tends to] make it a very complex project," said Campe. "We decided it's better to have 3 vessels with dual fuel than to have one zero-emission vessel [with no market]. [A zero-emission vessel is] a white elephant, it's too expensive, it's too difficult maintain, to obtain the molecule with great security of supply … it's crazy."

Dual fuel is the clear path said Campe, a step evolution that mixes significant emissions reduction with the security of having well-proven fuel solutions onboard to ensure that the company's vessels – regardless of sector – can fulfill their contracts.

"That's the beauty of a dual fuel system; you can easily mix hydrogen into the engine, saving up to 80% of the emissions, but still having your fallback, still having an affordable platform which you can build, which you can find customers for," said Campe. "But if you build a zero emission ship with hydrogen technology that comes in at twice the cost, a higher charter rate and maintenance costs Customers are happy to pay a bit extra on the hydrogen cost, but they can't afford the full costs, because hydrogen is still more expensive than diesel making it difficult to make a business case."

In the end, Campe and CMB.TECH's vision can best be described as 'evolution' rather than 'revolution.'

"You have to do it gradually, and we see that for the money invested, we are going to have more users of that hydrogen fuel, thereby saving more emissions, making an easier business case for the hydrogen production, the hydrogen off-take. That's our philosophy."

At the same time, CMB's clients, too, are being pressed to reduce their emission footprint, and while Campe reasons that it might take some time today to find customers willing to pay the hydrogen premium, in the long run the emissions savings realized – and conferred to the client's CO2 balance sheet – will pay off.

"The decade will come where our customers have their CO2 reporting, we're seeing it already with the trucking companies. They'll say, 'Roy, I'm going to use your technology because I need to reduce 10%. I don't need to

But as important as the growth within the company is key, so too is the growth externally in the form of partnerships with OEMs and growth in technical capabilities. "Doing a prototype is easy, but to make money and operate something in the field, you need after sales care, spare parts. That's what our industry requires."

Going back to his own hydrogen fueled car and the difficulty in finding a technician to solve a problem, Campe said in the real-world maritime business, "You can't do that with a ship; it costs a lot of money daily."

But growth for growth's sake is not the end game for Campe, and in fact he sees the need to apply the brakes at times, as CMB.TECH's hydrogen remit extends beyond its ships and includes hydrogen fueled port equipment and trucks, with the hydrogen conversion taking place in-house. To grow the business and the network effectively, efficiently, there is a need for a network of technicians to service the equipment too, which only solidified Campe's rationale to center on combustion engines with dual fuel capability.

Even the guys who are doing maintenance on combustion engines are happy to look into [CMB.TECH's dual fuel hydrogen engine], because [with all electric engines] they feel like, "Hey, I'm going to lose my job. I know nothing about electrification, electric cars; so tell me, how does your technology work?" And then they see how simple it is: if this fuse is broken, just swap it with the new one; if the injector ring is clogged, just swap with the new one. It's a familiar technology and engine space. "So that's why we do it more gradually, because we have so much inquiries for new projects. I said 'no, focus on hotspots, because we are not able to train technicians everywhere a ship is coming in, this will need time.'"

Expanding too fast, too far would not only stretch the technician base that is required to service the equipment, it could stretch and break all of the back-end support needed to run a smooth operation, from building, supplying and staffing new workshops; to building and maintaining the procurement team that can not only create, but sustain the new network.

"This is the business what we do: port equipment, trucks and our ships. Yes, we are on a fast track for growth still, but it's more like controlling our growth, because otherwise, at 100 mph, we go into the wall. We don't want to crash."

As anyone may expect, the path for Campe and his team are anything but smooth sailing, with many hurdles still to cross. When thinking on the biggest challenges, he counts building out his engineering team – attracting and retaining the people CMB.TECH needs – and managing expectations as the biggest challenges.

"People see something and they think we can do everything overnight," said Campe. But what the industry is seeing, what CMB.TECH has done, is just the tip of the iceberg. Whether you're talking about a new hydrogen dual fuel vessel, as the shiny new workshop where CMB.TECH converts the port vehicles to hydrogen, the workload far transcend simply building the solution and "bringing in the molecule;" there permitting, contracts and maintenance, sourcing everything from electric to charging to the final audits.

"It's very easy to say, 'Oh, you have workshop where trucks come in and drive out [converted to hydrogen fuel]; hey, yeah, let's do that over there."

Organization of people, processes, technologies and suppliers must be organized well in advance – including legal and risk managers which now have to write contracts premised on the new technology – continually refining and improving the process.

And while CMB.TECH is open with its business model, Campe stresses that it is neither easy to follow or free.

"We have been doing this since 2017, and we are always thinking about how we can do it better," said Campe. "This is not free of... we don't give it away. We show people, but I know it's not that easy."

AURORA

The World's Greenest RoPax Ferry + a Floating Marine Technology Lab

By Eric Haun

A BOTNIA

THE ROUTE

Wasaline is the northernmost shipping line in the world that transports passengers and freight daily, operating the 3.5- to 4-hour transit between Vaasa, Finland and Umeå, Sweden. As such, the Aurora Botnia is built to 1A Super Ice Class.

The line is maintained via a unique cross-border cooperation between the city of Vaasa and the Umeå municipality. Kvarken Link, owned by Umeå Kommunföretag AB and the city of Vaasa, owns the ferry Aurora Botnia. NLC Ferry, a subsidiary of Kvarken Link, operates the route, and Wasaline is the brand name used by NLC Ferry.

WASALINE BY THE NUMBERS (2022)

- Passengers: 267,757
- Vehicles: 55,661
- Cargo Units: 22,191
- Busses: 413
- Departures: 1,133
- CO2 Emissions: -19.6%
- Revenue: 29.3 million euros
- Employees: 120-150

All images courtesy of Wasaline

Built by Rauma Marine Constructions, in Rauma, Finland, and launched in 2021, the 150-meter-long Aurora Botnia boasts a long list of onboard equipment that help it to earn its "green" designation, a label that is confirmed via a Clean Design notation from classification society DNV. The ship is also compliant with the International Maritime Organization's (IMO) 2030 greenhouse gas reduction target.

Wasaline CEO Peter Ståhlberg describes Aurora Botnia as "a masterpiece of cooperation" and noted that the vessel is over 80% domestic made.

"I'm really proud of the Aurora Botnia. It has been a dream job to make the design," Ståhlberg said. Starting from scratch, Wasaline was able to work with its supply chain partners in Finland and abroad to choose all of the technology it wanted on board.

At the heart of the vessel are four Wärtsilä 31DF dual-fuel engines that can burn liquefied natural gas (LNG) and/or biogas. The medium-speed four-stroke engines are part of a highly efficient hybrid solution that includes a 2.2 MWh battery energy storage system (ESS) from Swiss-based Leclanché. Denmark-based Danfoss provided liquid-cooled 6 MW AC drives for power and hybrid propulsion systems, and Finnish company VEO supplied a hybrid switchboard solution.

The vessel is equipped with a pair of 5.8-MW Azipod electric propulsion units from ABB (also in Finland), which claims the technology can unlock fuel savings of up to 20% compared to traditional propulsion.

Finland-based WE Tech Solutions developed the electrical design and vessel's power generation and hybrid propulsion system, propulsion switchboards, propulsion frequency converters, generators, energy management system, propulsion control system and bow thruster motors.

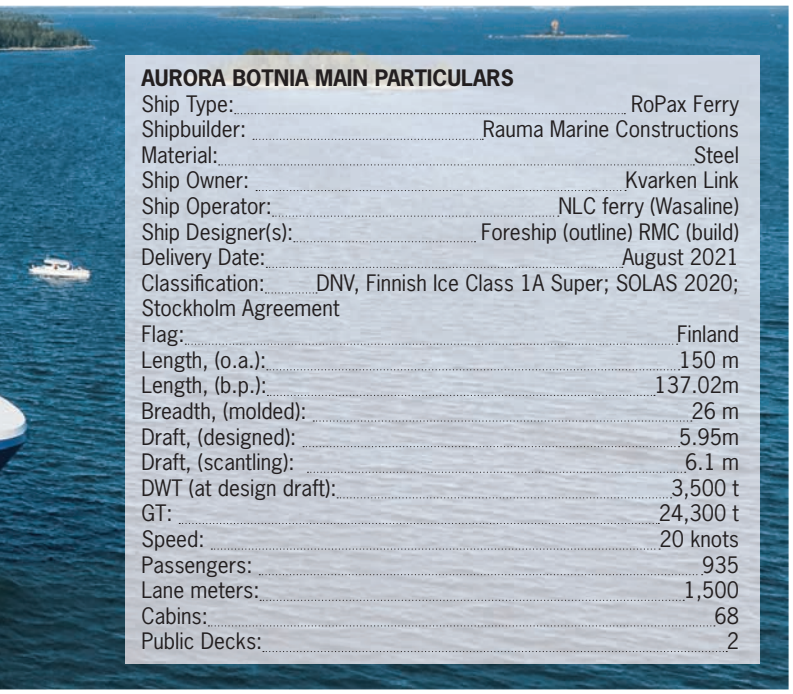
In addition to the engines, Wärtsilä also supplied its LNGPac technology for LNG storage, supply control and monitoring, as well as systems for thrusters and propulsion control, hybrid energy management, navigation and exhaust treatment (all the Wärtsilä equipment and systems are covered by a 10-year Wärtsilä optimized maintenance agreement).

Kenneth Widell, Senior Project Manager, Sustainable Fuels & Decarbonization at Wärtsilä, explained that the engines are most efficient when operating at higher power. The hybrid solution gives the opportunity to operate fewer engines at a higher power rating for better efficiency, while the battery pack is there for peak shaving and as spinning reserve to optimize engine operation. The batteries also provide power for maneuvering in port for the vessel's hotel load.

Ståhlberg said the vessel is also very well planned and built for efficient loading and unloading in port, where it connects to shore power for emissions-free stops. During the summer, the vessel makes four trips per day. During each 45-minute port call, the vessel unloads about 200 cars, 12-15 lorries and 900 people before taking the same numbers back onboard for the return voyage. Aurora Botnia has 1,500 lane meters of capacity, and its cargo deck are strengthened and designed with extra height for transport of larger and heavier cargoes such as wind turbine components.

Continuous Improvement

Through an agreement with Wasaline, Wärtsilä is able to utilize the vessel as an R&D test platform and technology demonstrator. "Aurora Botnia is a floating R&D laboratory and under continuous development and optimization," Ståhlberg said.



AURORA BOTNIA MAIN PARTICULARS

Ship Type:	RoPax Ferry
Shipbuilder:	Rauma Marine Constructions
Material:	Steel
Ship Owner:	Kvarken Link
Ship Operator:	NLC ferry (Wasaline)
Ship Designer(s):	Foreship (outline) RMC (build)
Delivery Date:	August 2021
Classification:	DNV, Finnish Ice Class 1A Super; SOLAS 2020; Stockholm Agreement
Flag:	Finland
Length, (o.a.):	150 m
Length, (b.p.):	137.02m
Breadth, (molded):	26 m
Draft, (designed):	5.95m
Draft, (scantling):	6.1 m
DWT (at design draft):	3,500 t
GT:	24,300 t
Speed:	20 knots
Passengers:	935
Lane meters:	1,500
Cabins:	68
Public Decks:	2

EQUIPMENT LIST

Main engines:	4 × Wärtsilä 8V31DF (4 × 4,400 kW)
Fuel type:	LNG, biogas, battery (Leclanche)
Total installed power:	17,6MW
Bow thrusters:	Wärtsilä FPP 2*1500kW
Propulsion:	ABB Azipods (2 × 5.8 MW)
Generators:	WEG
Engine controls:	Wärtsilä (Valmarine)
Radars:	Wärtsilä (SAM)
Depth Sounders:	Wärtsilä (SAM)
Auto Pilot:	Wärtsilä (SAM)
Radios:	Wärtsilä (SAM)
AIS:	Wärtsilä (SAM)
GPS:	Wärtsilä (SAM)
GMDSS:	Wärtsilä (SAM)
SatCom:	Wärtsilä (SAM)
Mooring Equipment:	Kongsberg
Fire extinguishing systems:	Marioff
Fire detection system:	Consilium
Heat exchangers:	Alfa Laval
Motor starters:	Promeco
Marine Evacuation System:	Viking Life Saving
Coatings:	Jotun
Ballast Water Management System:	Norwegian Greentech

As an example, Wärtsilä piloted a new ultra-low-emissions version of its Wärtsilä 31DF engine aboard the ship to help prove the technology before bringing it to market. On a weighted average, this new technology can reduce methane emissions by 41% compared to the standard Wärtsilä 31DF engine, the manufacturer said. Wasaline was able to reduce the Aurora Botnia's methane emissions by 10%.

In addition, Wärtsilä's data monitoring and analytics capabilities give insights into the vessel's performance, unlocking further operational and technical efficiencies. "It's not only about collecting data, it's also about the optimization of the operations," Widell said.

"These waters are very shallow, so depending on where you operate, wind, water depth, trim speed has a clear impact on the power requirement." Widell said. "If you can manage those parameters, you can optimize the operation."

The monitoring technology gives crew instant feedback on the decisions they make and their impact on emissions, Widell said.

Ståhlberg agreed and said the advanced onboard technology is a big motivator for the ship's crew, who continually work to find ways to improve operations and save energy. He cited a current crew-initiated project to use heat recovery and said captains and crew even compete to use as little fuel as possible during crossings. "When somebody [achieves] a record, there is cake in the mess room for the whole crew," Ståhlberg said. "It's a big event."

"Everybody at Wasaline is working toward [sustainability]," Ståhlberg said. "Everybody's committed."

Wasaline has been able to slash its emissions each year since Aurora Botnia entered service in 2021. During the vessel's first full year in operation, the ship primarily ran on marine gasoil due to higher LNG costs, and Wasaline was able to cut total CO2 emissions by 51.8% (calculations based on data from 2022 and 2013, the first operating year of Wasaline's previous ferry, Wasa Express, which burned heavy fuel oil and marine diesel). As of October, its CO2 emissions for 2023 were down about 22% compared to 2022, mainly due to increased use of LNG. And the company hopes to continue these reductions through further actions; Ståhlberg hopes Wasaline can be carbon neutral by 2030.

In October, Wasaline launched "Green Corridor Fridays", which saw the Aurora Botnia operate with certified biogas one day a week from October 13 through the end of December, in preparation for the EU emissions trading system that will come into force in 2024. With certified biogas, all Friday departures were climate neutral.

The move was taken to gauge interest from cargo companies and hopefully build future support for the endeavor, as biogas is more expensive than the LNG currently used as Aurora Botnia's primary fuel. For now, Wasaline will cover the extra costs, but it hopes customers will put their support behind more sustainable methods of transport. "It's a little bit chicken and egg. Everybody wants to go to green solutions, but nobody wants to pay for it," Ståhlberg said. "This cannot happen if a shipping company has to carry all this cost itself. It's impossible. We cannot do it."

Wasaline is also working with Wärtsilä to explore potential of converting two of the vessel's generators to run on e-methanol, which will soon be locally produced. "I see it as a very good option . . . It's fully realistic," Ståhlberg said. "When we built the ship, the whole design was created so that we can upgrade all the time."

AIMING FOR ZERO WASTE DISCHARGE TO SEA

Wärtsilä's MBR technology produces compliant effluent samples to the highest standards.

Photo credit: Wartsila

Advanced water treatment systems are just the start of the cruise industry's circular waste processing ambitions.

By Wendy Laursen

In recent years the specifications for most newbuild cruise ships have included the requirements for 'zero discharge'.

– **Martin Shutler,** *Principal Engineer, Product Development, at Wärtsilä Water and Waste*

Even with existing regulations, there is a noticeable absence of formal oversight for monitoring compliance with sewage and grey effluent discharge.

– Martin Saunders, *Managing Director of Rivertrace*

Advanced wastewater treatment systems (AWTS) were revolutionary in their day. Indeed, they still are today, but with 77% of the CLIA fleet (202 ships) already using them, and another 40 specified for vessels on order, even more ambitious waste management is coming.

Martin Shutler, Principal Engineer, Product Development, at Wärtsilä Water and Waste, notes that in recent years the specifications for most newbuild cruise ships have included the requirements for 'zero discharge' and a sewage effluent quality that meets the more stringent discharge requirements set for the Baltic Sea and Alaska. In these cases, all black and grey wastewater streams produced on board (including food waste reject water) are required to be treated in an AWTS in accordance with MEPC.227(64) including removal of nutrients such as ammonia, nitrogen and phosphorus as specified in paragraph 4.2.

In practice, this has meant systems with significantly higher treatment capacities to handle the larger volume of influent produced by including gray water as well as black water and careful consideration of membrane bioreactor (MBR) design to ensure the biological load is treated to the required standard, says Shutler, adding that the Wärtsilä MBR technology produces compliant effluent samples to the highest standards.

Gray water has long been an area of concern, as unlike black water, it is largely unregulated at present. The IMO is looking at greater regulation with its current review of MARPOL, and regulations to ensure that gray water is treated prior to discharge are expected.

"While some jurisdictions, like the US, have implemented laws mandating large cruise ships to adopt AWTS for both greywater and sewage, substantial regulatory gaps persist," says Martin Saunders, Managing Director of Rivertrace. "Even with existing regulations, there is a noticeable absence of formal oversight for monitoring compliance with sewage and grey effluent discharge."

This lack of monitoring poses considerable challenges in evaluating the effectiveness of onboard treatment systems, leaving operators uninformed about their vessels' environmental impact, says Saunders. Some OEMs also express concern about the prevalence of 'cheap and cheerful' treatment plants that may prove ineffective over time.

While, AWTS generally operate to a higher standard than many shoreside treatment plants, the EU also sees compliance gaps. Ships in EU seas should face dissuasive fines, not only for oil spills, but for sewage and garbage discharge as well, said the Parliament's Transport and Tourism Committee in November 2023. A new regime is planned.

Cruise lines are already addressing the risks posed by their older vessels. Scanship has a major retrofit project underway for a system capable of processing all wastewater generated by 6,000 individuals. The Scanship system handles black water, gray water, galley gray, laundry gray, dryer reject, bio resi-

Photo credit: VOW Scanship

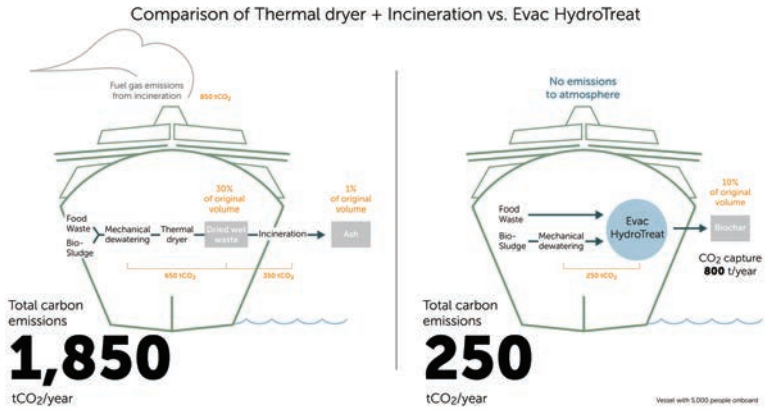
Photo credit: VOW Scanship

The Scanship AWTS is designed to handle all generated wastewater from the hotel area.

Image courtesy Evac

A recycling rate of 70% is technically and commercially feasible with today's technology.

– Björn Ullbro,
CEO of Evac Group



due reject and food waste reject.

With these varied sources covered, the industry is directing its attention to solid waste and dewatered sludge. A ban on sewage sludge discharge is also expected from the IMO's MARPOL review. This sludge is typically discharged overboard untreated. However, most new zero discharge cruise ships specify equipment for dewatering and drying this sludge (similar to food waste).

Wärtsilä's range of zero discharge systems includes a Micro Auto Gasification System that diverts dewatered waste from overboard discharge or incineration and converts it to syngas in a circular process that fuels the unit. This has been installed on Silversea Cruises' LNG-fuelled Silver Nova, delivered in 2023.

Evac is looking to the future use of nutrients as part of its commitment to a circular economy. The newly released Evac HydroTreat turns de-watered organic waste from black/gray water and food waste systems into biochar that is sterile and can be used for soil improvement or biofuel. The company guarantees significantly lower carbon emissions compared to conventional drying and incineration systems with no harmful emissions into the atmosphere, as there is no need to combust the waste. First orders of the technology have been delivered; it is also retrofittable.

Björn Ullbro, CEO of Evac Group, explains: "According to our recent study, the waste recycling rate on some of the world's largest vessels is around 20-40%. That means the vast majority ends up in landfills or, even worse, in the already threatened oceans." He says a recycling rate of 70% is technically and commercially feasible with today's technology.

Engineering processes continue to be improved. Valentin

RWO's CS-MBR system remove solids including bacteria, viruses and microplastics.

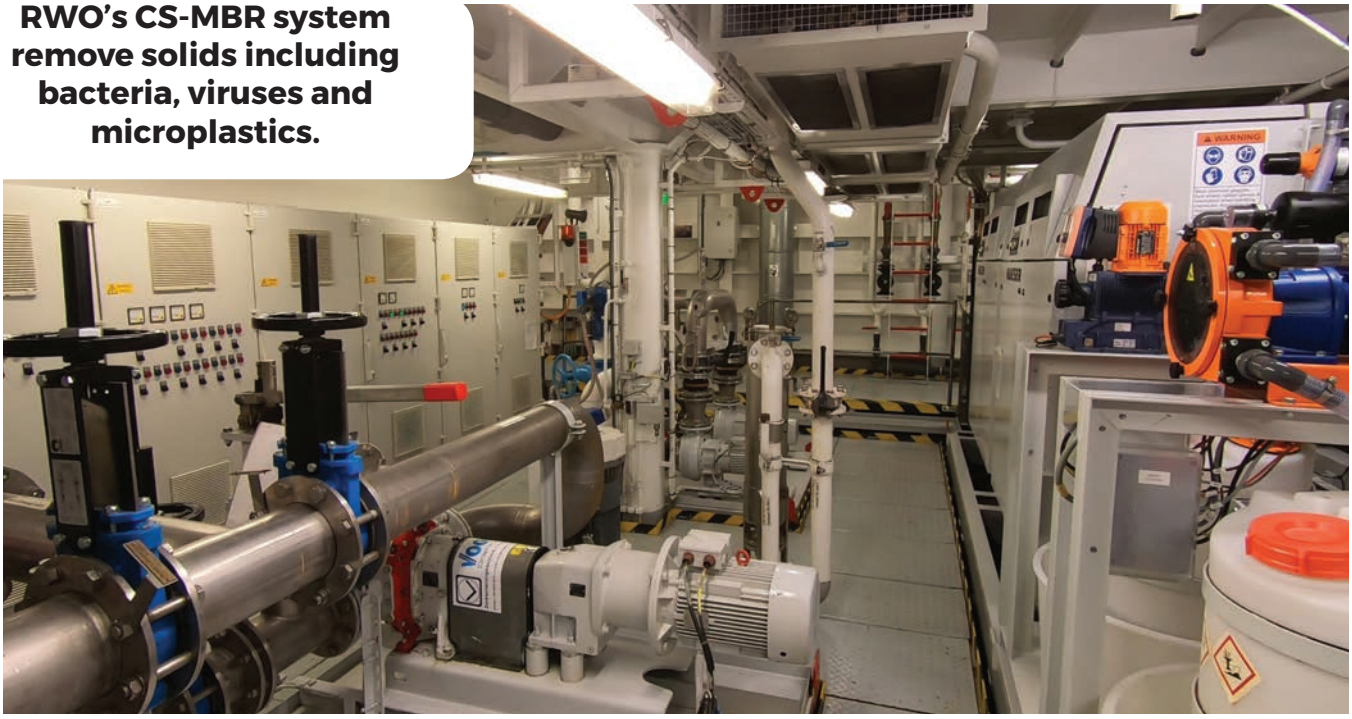


Image courtesy RWO

Image courtesy Power Knot

Fish don't eat steak pie and chips.

– Iain Milnes,
President, Power Knot

Cunard's Queen Anne will have 26 Power Knot systems installed.

Image courtesy Power Knot

Kirsch, Area Manager for Advanced Wastewater Treatment at RWO, says that the CleanSewage Membrane Reactor (CS-MBR) system's submerged ultrafiltration membranes remove solids including bacteria, viruses and microplastics. Additionally, the system does not involve the use of flocculants or chemicals for disinfection.

"This is a feature that is unique to the CS-MBR and contributes to its sustainability profile as not only does it ensure the highest effluent standards, but the treated water is clean enough to be re-used in technical water applications," says Kirsch. This includes the water used in the CS-MBR itself. The system has been installed on five Celebrity Solstice-class vessels, and has now been chosen by KiwiRail for two ropax ferries.

The issue of discharging plastic into the ocean is not new. Plastic cups and straws can end up in food waste that is allowed to be discharged untreated out to sea at most locations. Power Knot food waste systems can trap that plastic and prevent its discharge. President Iain Milnes started working with Carnival Corporation 10 years ago on the management of its food waste stream. Most recently, that relationship has meant that Cunard's Queen Anne will have 26 Power Knot systems installed when launched in 2024.

The company's LFC biodigesters weigh the amount of waste that is ingested and report that on the cloud by the hour, day, week, month and year. Larger models can categorize waste by type or by source. For example, they can detail how much fruit, meat, or vegetables were ingested and which galley produced the waste.

"Fish don't eat steak pie and chips as part of their natural diet, and what's not eaten will decompose anaerobically creating methane and polluting the sea," says Milnes. He hopes the IMO will move quickly on preventing the discharge of untreated food waste overboard and that MARPOL will be changed accordingly, sooner rather than later.

ALMACO: Enhanced Sustain

When it comes to sustainability in the maritime industry, there are many avenues beyond power and propulsion that vessel owned can explore to improve the environmental footprint of their ships. Enhancements to interior spaces such as accommodation, catering and laundry areas, though sometimes overlooked, can make a big difference, says Finnish based ALMACO Group.

ALMACO builds, refurbishes and services interiors and hotel areas of marine vessels and offshore units including galleys, provision stores, refrigeration machinery, laundries, public spaces, as well as guest cabins and crew living quarters. A major player in the cruise and passenger vessels markets, ALMACO is also active in other segments, including, naval and offshore. In each, the company is laser-focused on sustainability. "Our vision is to create a sustainable maritime industry. That is what we strive for," said Tapani Wendelin, Vice President, Business Process Development, ALMACO. "Our mission revolves around innovative solutions, resource efficiency and of course conservation of natural resources."

As a company, ALMACO closely monitors energy consumption at its facilities, and it also goes through great lengths to streamline its logistics, working to avoid air freight as much as possible.

For its clients, ALMACO goes to great lengths to study the materials in the items it delivers, looking closely at factors such as manufacturing footprint and recyclability. Even weight is considered as heavier materials in items such as beds and carpeting will mean more weight on board, negatively impacting vessel efficiency.

Product lifespan is also very important, Wendelin said, noting the use of high-quality materials typically means longer lifespans, and thus less waste. On a merchant or offshore vessel, cabins, for example, are usually built to last 25 to 30 years, while cabins in the cruise market are typically refreshed in shorter five- or 10-year intervals, depending on the owner.

Wendelin said ALMACO also strives to maximize utilization of advanced digitalization tools for sustainable lifecycle improvements. "This is where we can make the biggest impact, in my opinion, when it comes to the big picture, because we can make the lifespan of the vessel longer with modernizations," he explained.

Johanna Tenovuo, ALMACO's Vice President, New Sales Catering Division, said that when the company is supplying a galley delivery, whether for newbuild or modernization, it works with the shipowner and shipyard to produce the design. Always high on the agenda is energy consumption and the various ways to implement digital tools and automation to maximize efficiency.

ALMACO's Galley Energy Management system (GEM) — installed on vessels such as Viking Line's cruise ferry Viking Grace — allow shipowners to monitor and control energy us-

When considering your ship's cumulative sustainability, don't forget accomodations, galley and laundry facilities.

nability via Interior Spaces

Extending product lifespan is key.
Tapani Wendelin, VP, Business Process Development

Helping cruise clients to cut food and energy waste.
Johanna Tenovuo, VP, New Sales Catering Division

age in the galley area. According to ALMACO, owners can slash electrical power consumption from the cooking equipment by 25%, or even more when combined with the ventilation system. GEM can also be used to monitor equipment running hours to optimize preventative maintenance and service plans. According to Tenovuo, an internal study revealed that advanced monitoring and preventative maintenance on onboard catering equipment could extend the lifespan of a ship's galley by two years.

ALMACO also works with its partners to find ways to limit single-use plastics and reduce food waste, whether through equipment engineering, logistics improvements or both.

Tenovuo said ALMACO recently helped a cruise line that was having problems with fruits and vegetables being wasted because they were freezing inside provision store rooms. It turned out that crews were overloading the rooms by stacking the food too high and too close to the air coolers. "We actually changed our provision storage air cooler so that they're operating on the ceiling height, recycling the air from the very top ceiling level, but also, instructing, of course, the shipowners about this," Tenovuo said, noting that some cruise operators now want to mark the walls of their store rooms with a line to indicate maximum loading height.

"It's about the learning," Tenovuo said. "How to teach, learn and try to develop the equipment toward finding better solutions."

– Eric Haun

In the Shipyard

Latest Deliveries, Contracts and Designs

Vard Inks $450M to Build Cable Layers

VARD won a $252m contract for the design and construction of a third cable laying vessel for Italy's Prysmian Group: Monna Lisa is still under construction; Leonardo da Vinci was delivered in 2021.

The new ship is the VARD 9 18 design, measuring 185 x 34m and equipped with advanced cable installation solutions, featuring three cable carousels for a total capacity of 19,000 tons. A bollard pull in excess of 180 tons will allow the vessel to perform complex installation operations of simultaneous cable lay and burial (up to 4 cables) with a variety of ploughs. The vessel will be equipped with a DP3 positioning and seakeeping systems and will be operational by beginning of 2027.

The vessel is designed by Vard Design in Ålesund, Norway. The hull will be built at Vard Shipyards Romania in Tulcea, while the final outfitting, commissioning and delivery will be carried out by one of VARD's shipyards in Norway. The third cable layer is scheduled for delivery in Q4 2026.

The second cable layer contract signed by VARD is for $200m to design and build a customized hybrid cable-laying vessel for Japan's Toyo Construction.

The hybrid cable vessel will have a design specifically developed for custom needs to meet the growing Japanese offshore wind farm market and will also be able to operate worldwide. It will have an optimal hull design to suit natural and construction conditions in Japan, allowing it to be used in both shallow and deep water for power generation in floating offshore wind farms and for direct current power transmission projects. It will also be able to carry out construction work at a high operational rate in a wide range of ocean areas.

Image courtesy VARD

The ship will measure 150 x 28m, with a cable transport capacity of 9000 tons. It will be equipped with a high-performance crane and a large deck, making it suitable for a wide range of activities, including mooring work related to floating offshore wind farms and marine resources projects. The vessel will also have a 4-point mooring system and a helipad. The vessel will be built in Vard shipyards and will be delivered in Q2 2026.

Austal USA Wins USN EMS Contract

Image courtesy Austal USA

Austal USA received an $867.6m contract award (UCA) for final design and construction of three Expeditionary Medical Ships (EMS) from the U.S. Navy. The EMS will be manufactured in Austal USA's aluminum manufacturing line following completion of the last Expeditionary Fast Transport (EPF 16). The Expeditionary Medical Ship (EMS), an Expeditionary Fast Transport (EPF) variant, is a dedicated medical ship optimized to provide patient holding, stabilization, evacuation and transport in support of Distributed Maritime Operations (DMO). The EMS design features a shallow draft which enables greater reach and allows for direct access to austere ports. The flight deck will accommodate military aircraft, including the V-22 and H-53K.

CO2 Tanker Ordered

Bernhard Schulte ordered its first CO2 tanker, a newbuild to be built in China at Dalian Shipbuilding Offshore (DSOC). Planned for delivery in 2026, the ship will have a capacity of 7,500 cu. m. liquid CO2 in a pair of cylindrical cargo tanks at a maximum 19 bar(g) pressure and minimum -35°C temperature, and is committed to a long-term time charter agreement with Northern Lights. The newbuilding ordered now is the first ship of this type for the Bernhard Schulte fleet and the fourth CO2 carrier for Northern Lights. The joint venture, owned by Shell, TotalEnergies and Equinor, has already ordered three vessels, two already under construction at DSOC and another ordered in September 2023. Northern Lights is developing a ship-based CO2 transport solution and has implemented innovative technologies in the ship design to reduce the CO2 emissions from shipping. The primary fuel for the ships will be LNG.

Image courtesy Bernard Schulte

In the Shipyard

Latest Deliveries, Contracts and Designs

Gulf Craft, Incat Crowther Team on Virgin Island Ferry

© Incat Crowther

Incat Crowther will partner with Gulf Craft LLC in Franklin, La., to design and deliver a new USCG Subchapter-K approved, 104-ft. (32-m) passenger ferry for the government of the U.S Virgin Islands. Construction of the new ferry began in November 2023. The new ferry will service the tourist and commuter route between Red Hook on the island of St. Thomas, and Cruz Bay on the island of St. John. Currently, two other Incat Crowther-designed 28-m vessels service this route. The ferry will transport up to 300 passengers at speeds of up to 28 knots, fitted with the latest diesel engine emission control technologies in compliance with EPA Tier 4.

ClassNK AiP for MOL Ammonia FSRU

Image courtesy of MOL

ClassNK issued an Approval in Principle (AiP) for an Ammonia FSRU (Ammonia Floating Storage and Regasification Unit) jointly developed by Mitsui O.S.K. Lines, Ltd. (MOL) and Mitsubishi Shipbuilding Co., Ltd. Ammonia, which does not emit CO2 during combustion, is projected to be widely used as a source of clean energy for decarbonization, while the development of onshore facilities for storage and regasification is a challenge. ClassNK carried out a review of a conceptual design of the Ammonia FSRU based on its Part N of Rules for the Survey and Construction of Steel Ships for ships carrying liquefied gases in bulk, "Guidelines for Floating Offshore Facilities for LNG/LPG Production, Storage, Offloading and Regasification" and the other relevant rules, and examined risk assessment taking into account the results of gas dispersion study.

Van Oord Upgrades Heavy-lift

Image courtesy Van Oord

Van Oord's heavy-lift installation vessel Svanen will receive a major upgrade: the gantry crane will be extended by 25m, making the vessel ready to handle the next generation of monopile foundations for offshore wind projects. The extension, weighing 1200 tons, will be built by Holland Shipyards. Besides the gantry extension, the upgrade program includes an upgrade of the lifting hooks, which will increase the lifting capacity of the vessel from 3,000 tons to 4,500 tons, an upgrade of the gripper to handle increased loads, and an upgrade of the structure of the vessel to accommodate the latest hammer size.

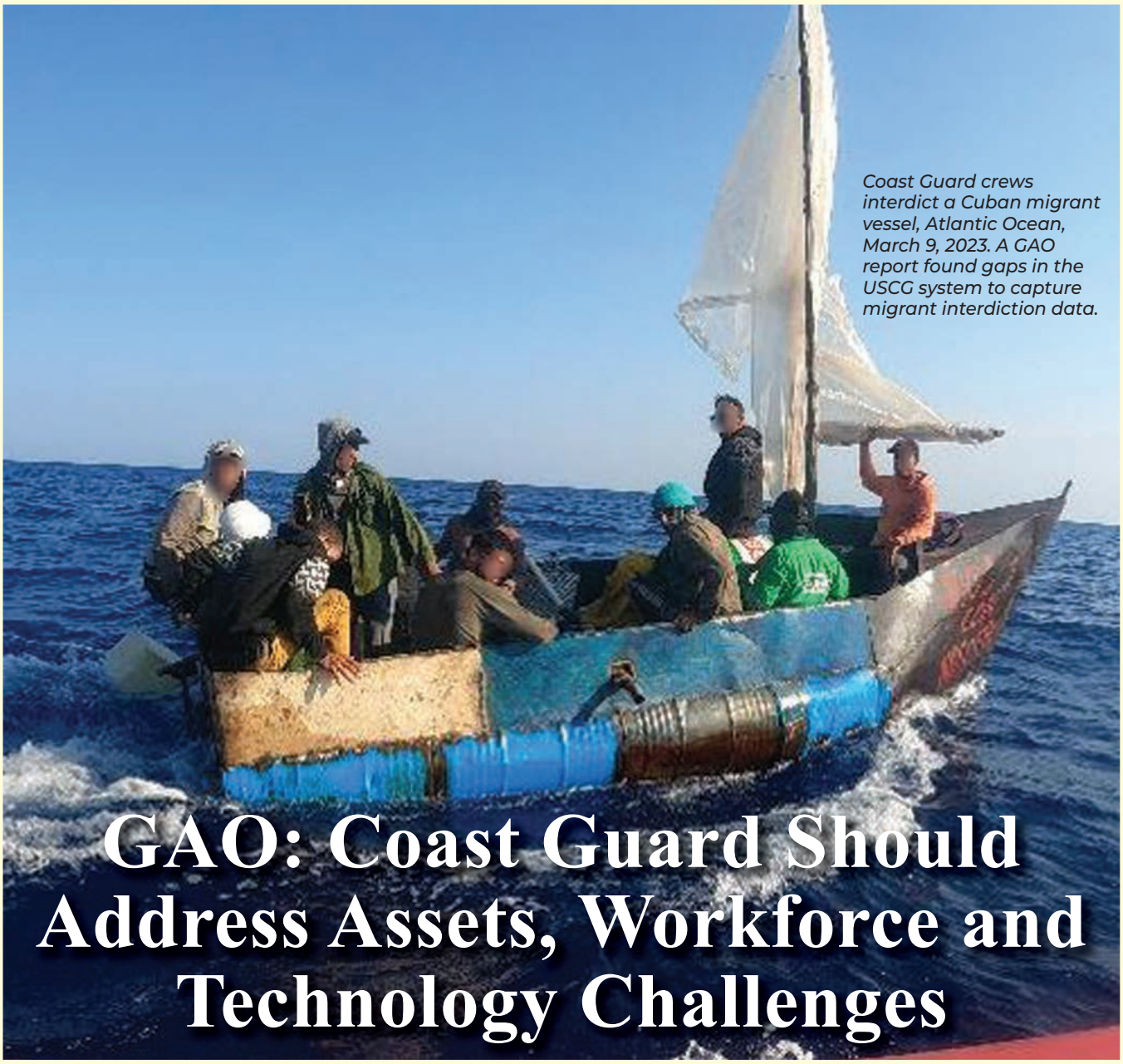
AiP: World's Largest Car Carrier

China Merchants Jinling Shipyard (Nanjing) Co., Ltd. received an Approval in Principle (AiP) certificate from DNV for its 11,000-CEU capacity pure car and truck carrier (PCTC) design: 234 x 40m wide with 14 decks allowing 11,000 car equivalent units (CEUs) to be stored simultaneously. The PCTC will use LNG as its primary fuel and will be equipped with a 4,200cbm LNG storage tank. Deltamarin helped to optimize the hull lines.

W&D Delivers Grace McAllister

Grace McAllister was delivered from Washburn & Doughty, a vessel with a Low Emission Vessel class notation from ABS and quipped with 3516E Tier IV Caterpillar engines powering twin Schottel SRP 490 Z-drive units. Packed into her 93' x 38' hull producing 6,770 horsepower, the GRACE achieved over 85 metric tons during her bollard pull certification. Combining her eco-friendly CAT engines with Markey winches on the bow and stern makes the American-made GRACE one of the most advanced and powerful ship-docking tractor tugs serving the Port of New York.

Image courtesy McAllister



Coast Guard crews interdict a Cuban migrant vessel, Atlantic Ocean, March 9, 2023. A GAO report found gaps in the USCG system to capture migrant interdiction data.

U.S. Coast Guard photo by Petty Officer 2nd Class Matthew Abban

GAO: Coast Guard Should Address Assets, Workforce and Technology Challenges

By Heather MacLeod, Director, GAO's Homeland Security and Justice team

The U.S. Government Accountability Office (GAO), the non-partisan, fact-based arm of the Congress, has an extensive body of work related to the Coast Guard's assets, workforce, and technology challenges. GAO has made 31 recommendations to address such issues. But, as of November 2023, 25 of these recommendations remain open and need to be addressed. Implementing these recommendations is critical to the Coast Guard's ability to meet its diverse array of mission requirements.

Assets

The Coast Guard is investing billions of dollars to modernize its ships but faces delays and rising costs. For example, in June and July of 2023, GAO reported that the Offshore Patrol Cutter and Polar Security Cutter acquisitions were billions of dollars over their initial cost estimates and more than 2 years behind schedule. In those two reports, GAO recommended that the Coast Guard should better align its acquisition policy with leading practices from the shipbuilding industry. The Coast Guard has taken some

steps to implement the recommendations, such as stating that it will begin to require shipbuilding programs to complete the functional design of major systems before starting lead ship construction.

In addition, GAO has reported for decades that the operational capacity of the Coast Guard's legacy vessel fleet has been declining. In July 2012, GAO reported that Medium Endurance Cutters—a key asset for law enforcement missions that the Offshore Patrol Cutter is to replace—did not meet operational hours targets from fiscal years 2005 through 2011 and that declining operational capacity hindered mission performance. Further, since 2013, the Coast Guard has acknowledged that its two operational icebreakers—the Polar Star and Healy—are insufficient to meet its multifaceted mission needs in the polar regions, which include preventing illegal fishing.

Workforce

The Coast Guard's staffing shortfalls routinely affect the service's ability to meet daily mission needs and workforce analyses are urgently needed to address the problem. In several reports spanning 2010 to 2022, GAO found that the Coast Guard had not adequately determined its workforce needs. One study found that from 2003 through 2019, the Coast Guard had completed workforce requirements analyses—which are structured analyses that determine the number and types of personnel needed to effectively perform each mission to a specified standard—for only 28 percent of its workforce. As a result, GAO recommended that the Coast Guard update its plan for completing such analyses to include timeframes and milestones.

One example of a workforce challenge centered on the Coast Guard's Deployable Specialized Forces—multiple units with a range of capabilities needed to handle drug and migrant interdiction, terrorism, and other threats in the U.S. maritime environment. In November 2019, GAO reported that the Coast Guard could benefit from assessing Deployable Specialized Forces' workforce needs Conducting this analysis would better position the Coast Guard to identify capability gaps between mission requirements and mission performance caused by deficiencies in the numbers of personnel available.

Technology

The Coast Guard has experienced long-standing issues with managing its technology resources, such as a data system that does not capture key mission information. In July 2020, GAO reported on challenges with MISLE, a system that tracks data for most Coast Guard missions. The GAO report found gaps in MISLE's capabilities—for example, the system did not systematically capture migrant interdiction data that the Coast Guard was required to obtain and report. Careful monitoring of migrant interdiction data is all the more important given recent trends: in both fiscal years 2022 and 2023, the Coast Guard interdicted twice as many migrants as in fiscal year 2021. GAO recommended that the Coast Guard follow its system development processes in order to analyze and select an alternative data system. The Coast Guard agreed and is taking steps to replace MISLE.

In July 2022, GAO reported on various aspects of the Coast Guard's IT program and found that the service implemented two processes intended to ensure that its IT infrastructure resources meet the service's mission needs. However, the service did not have a comprehensive process for network capacity planning—a key process in IT infrastructure planning that involves assessing and determining the network resource needs required to effectively support an entity's mission. As a result, GAO recommended that the Coast Guard develop and implement network capacity planning policies based on leading practices in order to better plan for its mission needs. The Coast Guard agreed with GAO's recommendations is taking actions to address them.

The Coast Guard has acknowledged that operating in the dynamic security and maritime domains will become more complicated as it acquires upgraded information systems as well as technologically advanced aircraft and vessels. In addition, workforce growth and enhanced skills will be required to operate and maintain updated assets. Expeditiously addressing GAO's recommendations on managing its assets, workforce, and technology will help ensure that the service efficiently uses its available resources to carry out its missions.

The Author

MacLeod

Heather MacLeod is a Director in GAO's Homeland Security and Justice team. She oversees Coast Guard and maritime security issues, including Coast Guard workforce and strategic planning efforts, and maritime port and supply chain/cargo security.

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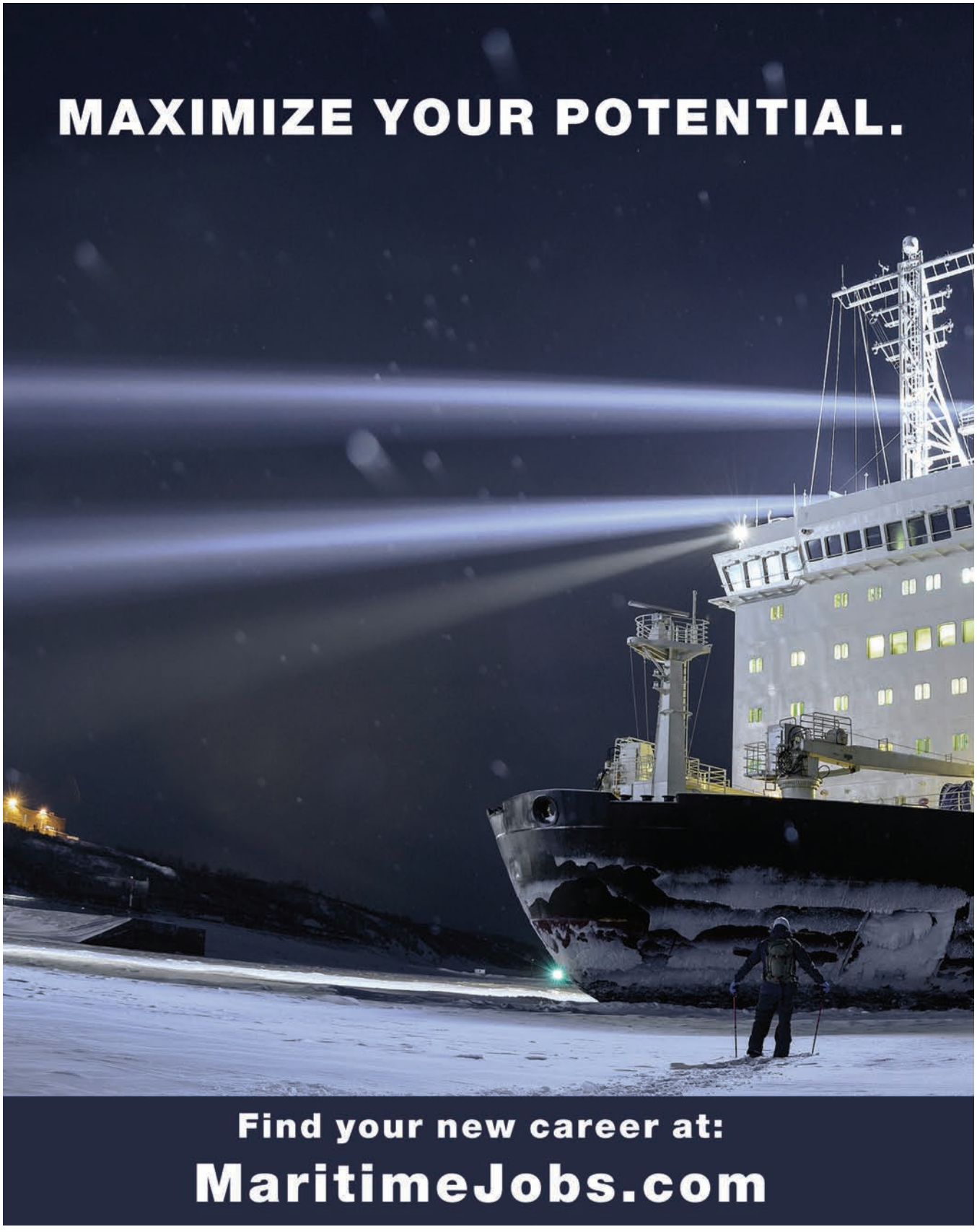

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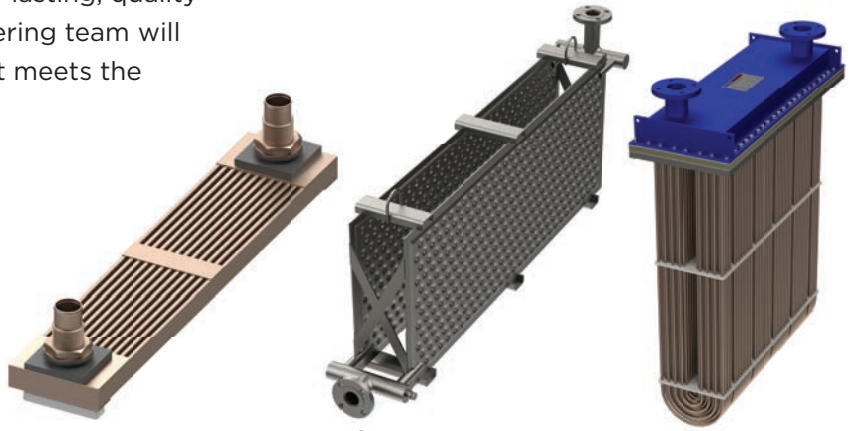

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