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)) Open Ocean Robotics Makes Foresight 50 List. Open Ocean Robotics has been named among the Foresight 50, a list of Canada's most investable clean tech ventures by Foresight Canada, marking the second year in a row for the company. This year's Foresight 50 honorees were chosen based on the criteria of investability, potential environmental impact, job creation and probability of success. Open Ocean Robotics is at the leading edge of robotics as a service for the blue economy, with applications for defense, commercial and scientific markets. Zero-emission, quiet and capable of anywhere, anytime operations, the company's solar-powered USVs provide safe, affordable and sustainable ocean monitoring solutions. Open Ocean Robotics aims to scale robotic solutions to digitize "Planet Ocean" and sustainably grow the \$2.5 trillion blue economy.

)) Hundested Propeller Marks a Century in Business. Hundested Propeller A/S is celebrating more than 100 years in the maritime market. It started off in 1921 by repairing local fishing vessels in Denmark and has evolved to developing, producing and delivering propulsion systems, propellers, axles, and maritime equipment to the global maritime industry. With 40 employees, Hundested maintains flexibility and fast delivery by housing development and production under one roof. In 2019, Danish ship manufacturer BSI A/S bought the company and integrated it into BSI Group under its original name and with headquarters placed close to Hundested harbor in Denmark. Product development is now focused on commercial ships, superyachts with sails and hybrid propulsion technology as the world shifts toward CO₂ reduction and lower climate footprints from industry.

)) NOAA Partners with Microsoft on R&D. NOAA and Microsoft have signed a cooperative research and development agreement (CRADA) to perform collaborative research and development to advance five major goals: to help NOAA's Earth Prediction Innovation Center (EPIC) implement pilot projects to effectively enable Earth system modeling and research using Microsoft Azure, a public cloud-computing platform; to harness the power of machine learning to improve NOAA's climate models and forecast models for air quality, wildfire smoke and particulate pollution; to integrate Microsoft computing tools to accelerate data collection, processing, storage and dissemination of NOAA Fisheries' survey and observation data to advance sustainable fisheries management; to create a new searchable catalog of ocean observations, which includes case studies of how they are used to support public policy, safety, economic growth, environmental protection and increase climate resilience in developed and developing nations; and envision and design a resilient and accessible weather modeling and forecasting system that will enable data collection, access and processing across the NOAA enterprise, as well as incorporate data from external sources.

)) Norwegian Collaboration for Green Shipping Challenge. The Green Shipping Challenge, formulated jointly by the governments of Norway and the U.S., aims to catalyze the global transition to green shipping. In response to this challenge, Norwegian maritime cluster organizations, shipping industry associations, shipowners, business organizations, classification societies and finance actors have committed to achieve zero emissions for the maritime sector. The Norwegian collaboration was formally announced during COP27 in Egypt and will strive to reduce emissions from shipping by 50 percent by 2030, in line with Norway's national climate goals. This comes in addition to the current target of the International Maritime Organization (IMO) to reduce CO₂ emissions from global shipping by at least 40 percent by 2030 and 70 percent by 2050. Alongside efforts to improve the energy efficiency of existing vessels, the partners undertake to develop, design and build the zero-emission vessels of the future. Achieving 2030 national climate goals will require 700 low-emission and 400 zero-emission ships in Norway alone. Norwegian financial partners with maritime patronage will utilize capital instruments to support green measures and projects through the provision of risk capital and financial advisory services in line with regulatory requirements and expectations. Norwegian government support for green initiatives and infrastructure development for fossil-free energy sources will also play a key role.

)) Two Projects Chosen for American Lobster Fishery Funding. Sea Grant has awarded \$1.2 million in support of its American Lobster Research Program to continue addressing emergent needs and priorities associated with this important fishery. The two projects chosen, which require at least a 50 percent match in nonfederal funds, focus on operational needs related to gear technology implementation, research and adoption. The American lobster (*Homarus americanus*) fishery, one of the largest and most valuable single-species fisheries along the Atlantic coast, faces economic uncertainties due to recent regulatory changes affecting where and how the lobster industry operates. The projects selected for funding will enhance research on the development and implementation of gear technologies in the American lobster fishery to better understand and address the opportunities and barriers associated with bringing gear technology to commercial scale. Kevin Staples from the Maine Department of Marine Resources will lead the testing and evaluation of various gear modification technologies aboard commercial vessels, thereby producing information on gear system viability, compliance with federal regulations and feasibility of use by fishermen. Erin Pelletier from the Gulf of Maine Lobster Foundation will lead the testing of data imaging tools and various ship-to-shore communication modes for providing lobstermen with real-time information that they can use to inform their fishing activities. **ST**

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Meeting Marine Sector Challenges: 2023 and Beyond

Skills, the environment and technology are the key challenges the marine sector faces over the short, medium and long term, according to the findings of a survey the Institute of Marine Engineering, Science & Technology (IMarEST) ran in 2022 and published in our report "The Challenges in the Marine Industry: 2023 and beyond."

Over 700 IMarEST professional members completed the survey. The findings demonstrate that anticipating future skills is vital if the marine sector is going to be able to apply current and future technologies and achieve environmentally acceptable and commercially sustainable outcomes.

Chief among the skills challenge is being able to attract new talent and retain existing expertise. Members specified difficulties such as a "lack of interest from young people to enter the engineering and technical fields"; a "lack of experienced engineers, especially ones with hands-on and practical experience to support their new recruits' technical education and knowledge"; and a "general lack of engineers also means that there are fewer engineers to whom to pass the lifelong experiences of other engineers."

As a sector, we're not alone in facing a skills gap: Competition for talented engineers, technologists and scientists is high. To successfully compete, the marine sector must work hard to remain attractive to new talent from a diverse range of backgrounds; recognize, develop and retain existing expertise; and retrain people where the opportunity exists. We also need to widen our talent pool and welcome those who may have STEM backgrounds and seek to return to the workplace following a career break, or transfer into the sector from other areas. This requires a collective effort from academia, employers, individuals and bodies such as IMarEST.

It is no surprise that challenges associated with protecting the environment, such as decarbonization, reaching net zero, climate change and mitigation, and meeting regulations also emerged among the primary concerns for the future. The issue of sustainability has become mainstream and particularly so in the marine sector. From being a fringe topic, it has now taken center stage and there is increasing interest, participation and, importantly, expectation. In time, sustainability will become ingrained. As an institute, the breadth and depth of expertise of our members who are working in engineering, science and technology is unparalleled, and gives us great insight and understanding of the issues, challenges and potential solutions. The responsibility of a sustainable marine sector lies in all of our hands.

Technology is the third theme raised by our members as both a challenge and opportunity. Over the coming decade, our members are anticipating increases in autonomous shipping, digitization and further introduction of artificial intelligence systems. While the sector is already embracing innovation, we know there is much more to come across all areas of maritime, not just shipping. It is an exciting time and one of much opportunity for the industry. Inevitably, it will bring disruption and challenges but also potential.

In embracing the technological possibilities, first and foremost, we must keep the human front and center. We need to ensure that those whose roles will change or be affected by technology are given opportunities to upskill and retrain where necessary.

If there is one thing we've learned from the COVID-19 pandemic, it is that we can adapt and do many things that were previously thought impossible. It has given us a foundation for change, and we should be emboldened by this and use the experience as a basis from which to learn as we move into 2023 and beyond. **ST**

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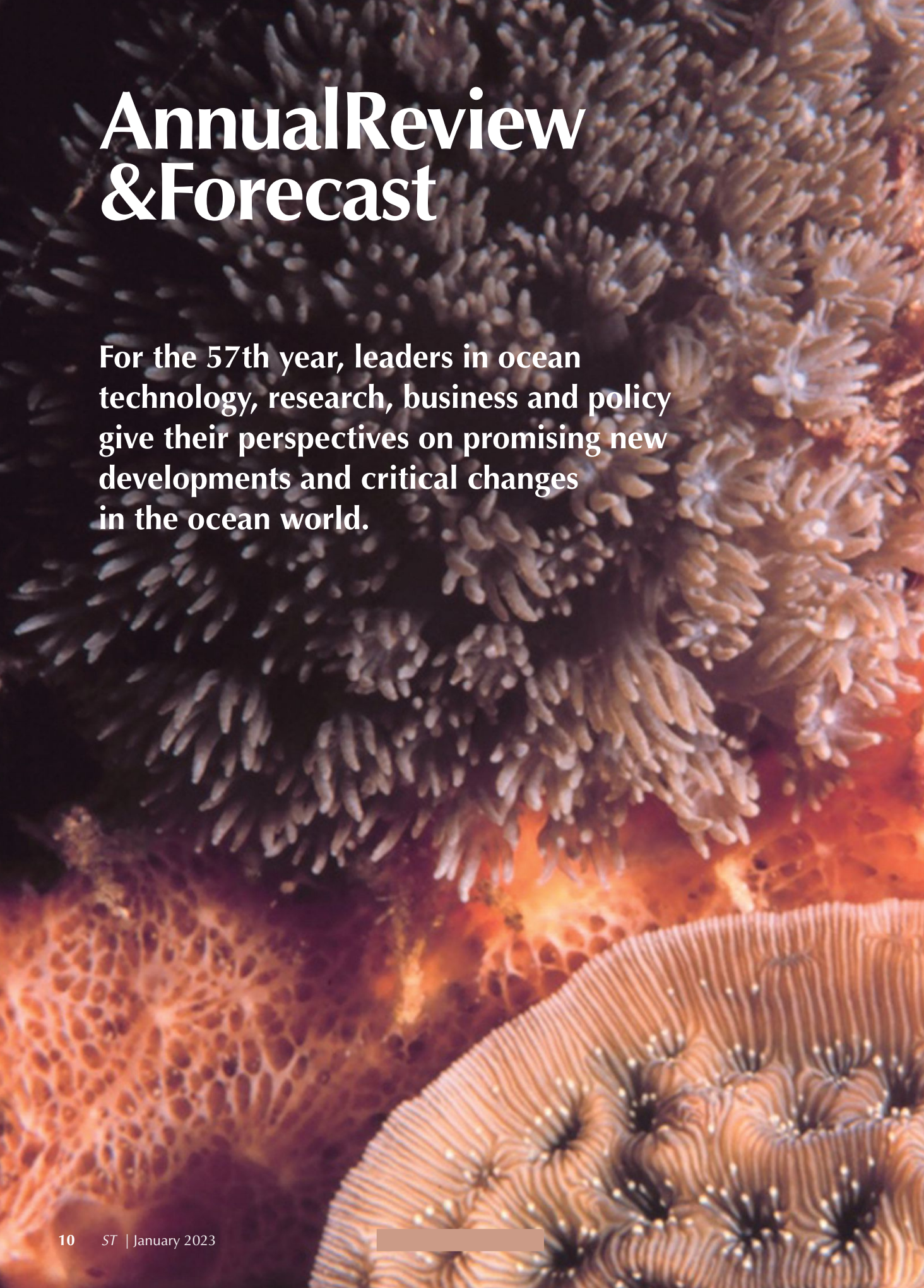
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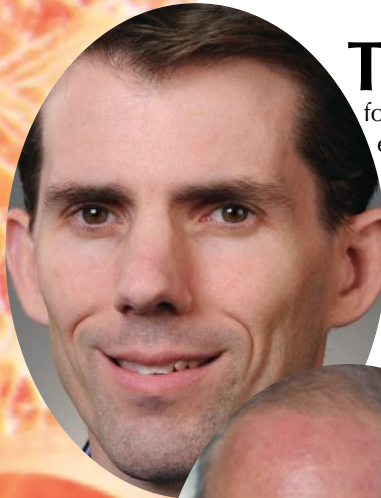
Review&Forecast

Defense Procurement Is *Not* Broken—And That's a Huge Problem

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The Department of Defense's (DoD) procurement and innovation system is under constant attack for being broken. These attacks cite numerous Government Accountability Office (GAO) studies on frequent cost over-runs and schedule slips. They also include assaults on favorite targets such as the Littoral Combat Ship, Future Combat Systems and the Joint Strike Fighter.

This view of a “broken” DoD innovation and procurement system entices every new cadre of congressional, administration and DoD leadership to implement various repair techniques, including new programs, task forces, commissions, etc.—very few of which ever produce meaningful or enduring impact (<https://aida.mitre.org/demystifying-dod/innovation-ecosystem>).

There is a very simple yet perhaps not-so-obvious reason for this supposedly consistent lack of improvement: The DoD procurement and innovation system is absolutely not broken. It works exactly as designed.

The Problem

The problem is that this system is designed for a world that no longer exists (<https://steveblank.com/category/technology-innovation-and-modern-war-2>). Specifically, the assumptions underlying its design were born of the Cold War era. These design assumptions are the causal factors that produce the observed, repeated stumbles that are actually a mismatch between the DoD's procurement and innovation system and the realities of today's world.

Outdated Design Assumptions

There are (at least) three foundational design assumptions that are no longer valid. They are: *The rate at which technology emerges* is now faster than any other time in recent history; *the*

threats to national security are emerging faster and are more varied than any other time in recent history (e.g., a nonbipolar geopolitical world, nonstate actors, etc.); and technological innovation is available globally, no longer dominated by national security—instead, innovation is now primarily nondefense-centric.

While the mission of the DoD has not changed since the Cold War, the validity of these design assumptions has. Previously, the evolution of major threats was predictable and relatively slow. U.S. military technology was the pacing threat for the rest of the world, and militarily significant innovation was mostly controlled by the defense sector. If the DoD were designed from scratch today, these assumptions would drive very different design results.

One clear difference is that threats to national security aren't just emerging faster—they're emerging faster than the DoD's traditional development cycles can field capability to counter them. While this is obviously bad, if this were the only difference, one could conceptually modify the existing system to simply "go faster." Unfortunately, this difference is coupled with the other two foundational disconnects stemming from accelerating technological change and innovation exogenous to DoD.

Historically, disruptive innovation in warfare was enabled by changes in platforms (e.g., longbows to crossbows, sailboats to steamships, etc.) and followed a traditional *design-build-test* approach. This is a foundational tenet of the DoD procurement and innovation system. However, in today's commercial sector, disruptive innovation is enabled by changes in components of platforms (e.g., software, computing power, etc.). This not only harnesses the acceleration from Moore's Law and rapid software update cycles, but it also inverts the traditional design approach into a modern *build-test-design* approach, whereby software-centric capabilities are rapidly and affordably redesigned after fielding. This allows the designers to gain a genuine and firsthand understanding of end-user needs—which is absolutely essential in a world of rapidly emerging threats.

This is fundamentally different from the development cycles of Cold War-era bombers and ships, and it is not something that "design tweaks" or "repairs" to the DoD's procurement and innovation system can achieve.

To further illustrate this key point, imagine you purchase an advanced all-terrain vehicle (ATV) and spend months successfully exploring previously undiscovered wilderness. Eventually you reach the coast, see a large number of offshore islands, and begin tweaking your ATV to be a boat. After significant time and money, you now have an inferior ATV that is also not suitable for open-ocean use. Why? Because any engineered system (hardware, software or process) has a limit on how much it can be modified to account for new intended uses or different operational conditions while still meeting its original purpose and design assumptions.

This principle is exactly what is violated by many attempts to "fix" the DoD. The DoD procurement and innovation system is a well-tuned, highly optimized ATV, but the U.S. now needs a boat—yet the DoD keeps trying to modify the ATV.

The Current Paradigm

To clearly see the critical difference between fixing and redesigning, the correct mental model is needed. Envision the DoD procurement and innovation system as a pipeline. Entering the pipeline on the left are raw ideas and concepts, and exiting the pipeline on the right is capability in the field, at scale. (For DoD, the term "scale" includes both input efficiencies gained via classical notions of economies of scale, as well as the output of appropriate capacity to outpace one's adversaries.) At some point in the middle of the pipeline is where the initial, potentially useful prototype is first demonstrated (note that prototypes can include hardware, software, process, procedures, etc.).

This simple, two-part model—concept to initial prototype on the left, and initial prototype to capability in the field, at scale on the right—helps illustrate how continual efforts to "fix" DoD either have no effect or actually make things worse. It provides the perspective to finally illuminate the proverbial elephant in the room: Every DoD "repair" action taken—every new program, new funding source, every innovation effort—ultimately only impacts the left-hand side. No "fixes" ever impact the right-hand side—and, frankly, very few are ever even aimed at it.

The left-hand side of this pipeline already has a strong "flow" of ideas to initial prototypes. It is supported by a vibrant community. Efforts to further improve it by the DoD are prolific and include visits to Silicon Valley, benchmarking innovative companies, attempting to leverage private capital, creating rapid prototyping and innovation programs, and an unrelenting deluge of new "innovation efforts." Engaging in these activities stirs the participants' passion, attracts out-of-the-box thinkers with high initiative, and can be rewarding both personally and professionally. In the end, many of these activities do succeed in further increasing the quality and magnitude of flow on the left-hand side of the pipeline.

While continuous improvements on the left are needed, this is only one half of a single, contiguous pipeline, and warfighting impact is not achieved until the flow exits the entire pipeline.

The right-hand side has a very limited and extremely slow flow from initial prototype to capability in the field at scale—its flow is a trickle of thick syrup in comparison to the left. Where flow does occur, it is mostly for incremental upgrades to existing, funded, long-standing programs of record. For the remainder—the majority of the potentially high-impact prototypes rapidly emerging from the left-hand side—there is no path to the right-hand side (i.e., there is no mechanism to consistently and repeatedly go from initial prototype to capability in the field at scale for any innovation not already part of a program of record).

Efforts to improve the right-hand side include: battling for agility in a budgeting environment expressly designed for stability; trying to manage risk in a bureaucratic organization expressly designed to minimize it; and seeking to divest less-relevant, decades-old, costly programs with lobbying support expressly designed to prioritize politi-

cal goals over warfighting impact. These are some of the structural design factors explicitly preventing rapid flow from initial prototype to capability in the field, at scale. The patriotic and committed men and women engaging in these activities put their careers at risk, generate opposition from multiple directions, and, despite noble effort, are relentlessly frustrated by systemic barriers.

It is no surprise, then, that most new “innovation effort” focuses on the left-hand side of the pipeline. More importantly, this view places a spotlight on the elephant in the room—that none of the tweaks or fixes can affect meaningful “repair” on the right-hand side. This is due to the pipeline’s inherent design. It is designed for high budgetary stability, risk minimization and political influence to reinforce the status quo. It is a high-performing, optimized ATV, and it will never be a boat.

The Fix

As with solving any problem, the first step is to understand the actual problem. In this case, it is not a “DoD problem”; it is a “large organization problem” of how to innovate disruptively.

This problem is precisely stated as: How does a successful, large organization continue to maximize the resources it devotes to what makes it an industry leader today, while appropriately diverting resources to discover what new business models could make it an industry leader in the future?

This is not a new problem. The crux of it is: Today is

certain, while tomorrow is uncertain; therefore, how to best posture the organization for the future is also uncertain. This is the nature of disruptive innovation, and there are doctrinal principles underlying its successful pursuit. The challenge is in learning how to instantiate these principles and produce the correct design changes in the complexity of the DoD procurement and innovation system.

Before detailing these principles and design changes, there are two critical notes concerning redesign of large, currently successful organizations based on an uncertain future. First, do not attempt to redesign the entire system all at once. For example, the way the DoD procures nuclear-powered submarines, aircraft carriers and similar capabilities is not the place to begin one’s experiment with design change. Second, this sort of change requires a separate entity, purpose-designed and purpose-built. It must be “far away enough” from the existing organization so as to be effective, yet “close enough” so as to have its fruits fielded, adopted and scaled. This is critical for innovations intended to result in capability in the field at scale.

Despite criticism, the DoD is well-postured to begin implementing these design changes. To do so, four principles of disruptive innovation must be followed.

First, this separate entity for disruptive innovation must be protected and incentivized. The U.S. Navy did this extremely well in the 1920s and 1930s, when it began to create a viable alternative to battleship-centric forma-

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tions by experimenting with aircraft carriers and building task forces around them (<https://tinyurl.com/2uhkbafd>).

Second, the separate entity's design must be optimized for discovery and speed, not for efficiency or scale. This is natural for startups because they prioritize learning and recognize they are still searching for an effective business model. However, this principle is anathema to large successful organizations that prioritize cost and schedule.

Third, it must focus on solving operational problems, not meeting requirements. Starting with requirements literally means the designer can see the future and envision an effective solution before prototyping or experimenting with the end-user. In today's world of rapidly evolving threat and technology, this is nonsensical and ensures a product is procured that no one wants or needs. This is because the path to a disruptive solution requires just as much discovery of the true nature of the problem and evolution of the concept of operations as it does developing innovative solution options.

Fourth, problems must be attacked by a process of discovery utilizing incremental, hypothesis-based exploration. The NASA lunar landing program is an excellent example: The Mercury and Gemini programs learned solutions to "known unknowns" and discovered the "unknown unknowns" prior to initiating the Apollo program. This reduced known risks, uncovered previously unknown risks, and eventually discovered what would constitute the Apollo 11 mission.

Systemic Design Changes

These four principles must be followed by any large organization seeking disruptive innovation during times of rapid and uncertain change. For the DoD to instantiate these principles, it must begin with three systematic design changes—all of which concentrate on the right-hand side of the pipeline.

First, the DoD needs a separate, agile budgeting mechanism for disruptive capabilities that emerge inside the DoD's current 2.5-year budgeting window. Today, the DoD's budgeting process is so complex that it takes on average 2.5 years to complete. Locking one's fiscal agility for the next 2.5 years would be inconceivable in a non-defense, software development company that successfully innovates at speed and scale. The DoD and Congress must implement fiscal agility for the upcoming 2.5 years for a relatively small portion of the budget focused on disruptive innovation.

Second, the DoD needs the ability to do limited production and limited fielding inside the current 2.5-year budgeting window. To capitalize on rapidly emerging technologies and respond to rapidly changing threats, the DoD needs to be able to develop, produce and initially field capability within the existing window over which the DoD budget is currently locked. This is a fact of how quickly the current world is changing.

Third, the DoD needs a robust mechanism to connect these agile, emerging changes to its long-term programs and budgeting. This includes developing the ability to divest programs currently in development where alterna-

tive (disruptive) capabilities have already demonstrated sufficient warfighting impact and ability to scale.

None of these design changes are conceptually complex; however, their implementation entails the challenge of maneuvering inside a nearly \$1 trillion annual budget. This generates resistance of epic proportion from competing interests.

But the reality remains: The DoD procurement and innovation system is not broken; it is precisely what helped win the Cold War. The Global War on Terror began to reveal a lack of fit to the changing world, but the DoD's enormous overmatch concealed the severity. Today, that enormous overmatch is gone. We are already late in re-designing. **ST**

Review&Forecast

How Navy Science and Technology Support the Future Fight

*By Christian Schumacher
Chief Development Officer, Undersea Warfare
U.S. NAVSEA Warfare Centers*

The U.S. Navy's warfare centers play a critical role supporting the U.S. Navy fleet as in-service engineering agents, or ISEAs. They find effective, innovative ways to sustain and maintain the current surface ships, submarines and their systems. An equally important role of the warfare centers is working with industry, academia, federally funded research and development centers (FFRDCs), and university-affiliated research centers (UARCs) to collaborate, guide and develop future technical capabilities for the fleet.

First and foremost, the Navy's science and technology (S&T) community is guided by Navy mission needs and makes every effort to accelerate research, development, test and evaluation for the fleet. With a broad spectrum of technologies spanning multiple stages of development, the warfare centers maintain the Navy's current systems while they simultaneously develop future systems.

To that end, the warfare centers' S&T community takes its direction from the highest level of guidance from the Navy, which is the Chief of Naval Operations (CNO) Admiral Michael Gilday's Navigation Plan (NAVPLAN), originally released in January 2021 and updated in July 2022 (<https://tinyurl.com/mr26fp5e>).

The NAVPLAN outlines the Navy's strategic direction with particular attention to four key focus areas: readiness, capabilities, capacity and sailors.

The Navy subsequently built a framework to support the NAVPLAN: the Navigation Plan Implementation Framework (NIF), which includes 18 objectives. The framework prioritizes four capability objectives with four enabling objectives, known as the "NIF 4+4." The capability objectives are: long-range fires (how we shoot); counter-C5ISR (how we maneuver); terminal defense

“The enabling objectives are: live, virtual and constructive training; naval operational architecture; artificial intelligence; and unmanned systems. By aligning S&T to these objectives, Navy labs can focus on current and future capabilities.”

(how we defend); and contested logistics (how we resupply). The enabling objectives are: live, virtual and constructive training; naval operational architecture; artificial intelligence; and unmanned systems.

By aligning S&T to these objectives, Navy labs can focus on current and future capabilities. Examples of this work include:

Contested Logistics. This is “the ability of ships, submarines and unmanned vehicles to stay in the fight by rapidly rearming and resupplying them and, when necessary, assessing and restoring damaged systems to provide operational capabilities needed by the combatant commander.”

The Navy needs remote capability for shore-based experts to provide real-time guidance to deployed maintainers to solve maintenance issues while minimizing the need to travel to the ship. Through a funded acquisition program known as Surface Training Virtualized Environment (STAVE), a warfare centers team demonstrated an ability in an extremely low-bandwidth environment to develop specialized repair procedures. These procedures allowed shipboard personnel to correct problems in near real time. Once STAVE is fielded on a surface ship, this technology fundamentally will change the way remote technical assists are accomplished across the Navy with greatly reduced response times.

Unmanned Systems. These must be incorporated into various aspects in the fleet, from maintenance to operations. Eagle Scout, an unmanned drone detection system for explosive hazards (EH) integrates a proven laboratory prototype that uses machine learning to detect specific classes of EH onto a robotic platform. The combination of this EH sensor and robotic platform can seek these hazards during route clearance, amphibious landings and dismounted operations while maintaining a true standoff distance from the warfighter and the EH.

Performance characteristics were analyzed at prototype demonstrations. The project refined the original detection algorithm, fully developed the software architecture and conducted controlled testing to characterize sensor performance. Based on the results, Eagle Scout is one of the fastest, cheapest and lightest detection systems for this class of EH. The next step is determining performance against other EH classes.

Artificial Intelligence and Machine Learning. (AI/ML) enable the autonomy of unmanned systems. The warfare centers focus on AI/ML systems engineering, safety and

workforce development. Their investments are moving the needle by examining critical warfighter gaps and needs that can be solved with AI/ML approaches.

Validation and verification efforts ensure these systems behave predictably and are robust to outliers or adversarial attack. Funding is being invested in modern cloud-based software tools and computer environments, replacing antiquated stand-alone desktop workstations and data silos. Training programs are being developed to teach the workforce the latest programming languages and hardware systems needed for advanced AI/ML development.

Live-Virtual-Constructive. LVC is the virtual training that allows warfighters to cost-effectively develop and iterate mission sets. The Virtual Undersea Battlespace (VUB) project is one of two key efforts promoting LVC capabilities across multiple domains and applications. LVC VUB is an undersea warfare (USW) focused, collaborative modeling and simulation environment supported by several geographically separated warfare centers divisions. Principal stakeholders are both the fleet and acquisition community who will leverage warfare centers’ capabilities to provide access to a virtual undersea environment in support of wargaming and experimentation. In fiscal year (FY) 2022, the VUB team supported 11 LVC events—more than twice the number of events in FY 2021.

Another effort to increase LVC accessibility is the “LVC in a Cloud” mega-project. Cloud-based LVC activities have centered on mini-projects addressing the issues of cloud application enablement, cloud application deployment and cloud application operations. Application enablement is the process of staging or even modifying existing applications and algorithms to allow their deployment to a cloud-based container or virtual machine runtime environment. Deployment is running these applications on either a commercial cloud platform as virtual machines (i.e., infrastructure-as-a-service) or as containers (i.e., platform-as-a-service). Operations investigations are defining the necessary interfaces and processes to make these applications available as services.

The CNO’s focus areas provide the foundation for the S&T workforce. Creative freedom to experiment while operating under the CNO’s guidance benefits the warfighter and advances the Navy’s capabilities. It is how warfare centers S&T evolves Navy technology in preparation for the future fight. **ST**



Review&Forecast

Building a Climate-Ready Nation

By Dr. Rick Spinrad
Under Secretary of Commerce, Oceans and Atmosphere
Administrator
NOAA

At NOAA, we experienced a year of advances in tackling our key priorities: building a climate-ready nation; invigorating a sustainable new blue economy; and centering equity in our work and within our workforce. In answering President Biden's call to lead by example with clean, zero-emission government vehicles, we are harnessing exciting innovations to transform our fleet. NOAA-operated vessels and small boats will achieve net-zero emissions by 2050. Vessel emission controls and high-efficiency diesel engines will be built into *Discoverer*, NOAA's newest research ship that, along with its new sister ship, *Oceanographer*, will have the potential to cut an estimated 5,700 tons of carbon dioxide annually.

With science driving climate-smart decisions and services, and game-changing technologies stretching scientific boundaries, I remain a climate optimist, supporting a whole-of-government approach to building a healthy, safe and prosperous climate-ready nation.

While the challenges of addressing the climate crisis are steep, there is an upside. The Intergovernmental Panel on Climate Change (IPCC) reported progress in adaptation planning and implementation across all sectors and regions, generating multiple benefits that include widely applicable paths to resilience.

Supporting Community Resilience

NOAA helps our nation and the world lay the scientific foundation to identify such paths. As a first, for example, NOAA successfully deployed an Altius drone during Hurricane Ian, sampling over 200-mph winds inside the eyewall near the ocean surface, an area too hazardous for human flight. This is a huge milestone and vital to producing more accurate hurricane forecasts. Battling waves higher than 50 ft., NOAA and the intrepid Saildrone USV chased Hurricane Fiona, providing a vital new view from within the eye of a hurricane and data expected to bolster the resilience of coastal communities.

In another breakthrough, NOAA conducted live testing of future neighborhood-scale storm surge watches and warnings during Hurricane Ian. This has never occurred before during an active hurricane. And it's a lifesaver: Storm surge accounts for about 50 percent of coastal hurricane fatalities.

At NOAA, science is transformed into services that inform weather forecasts, climate models, flood maps, water resources and much more. NOAA services help

coastal communities adapt to sea level rise and homeowners to determine whether to rebuild or relocate after a flood. Insurers seek data about climate risks. Municipalities check that new construction will be climate ready. A new partnership with the American Society of Civil Engineers and the University of Maryland will help bring climate information into our nation's standard-setting process, increasing the pace of adaptation and reducing the costs of climate-related natural disasters.

Our aim is to optimize NOAA climate science, services and stewardship so that communities can take charge of their climate futures by anticipating risks, reducing uncertainty and equitably safeguarding lives and livelihoods. Historic new funding is a once-in-a-generation opportunity to advance this goal. The highly valued \$3 billion funding to NOAA from the Bipartisan Infrastructure Law is vital in coordinating ocean and coastal management with our partners, including underserved and tribal communities. And \$3.3 billion over five years from the Inflation Reduction Act to NOAA provides a tremendous opportunity to prepare, adapt and build resilience to weather and climate events. A National Institute of Building Sciences study found that each \$1 invested in disaster mitigation saves society \$6.

Identifying Regional Challenges

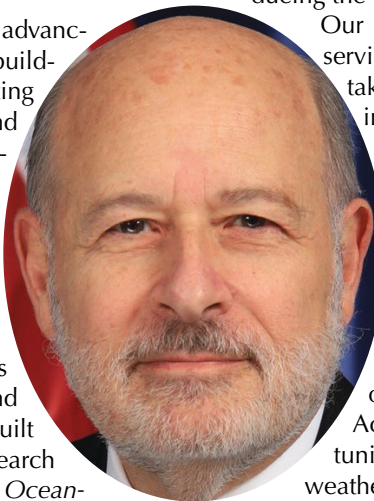
With boots on the ground and broad engagement, NOAA helps communities identify distinct challenges and vulnerabilities. As hubs of regional expertise, NOAA Regional Climate Centers draw on targeted data and services to equitably tailor support to particular needs. NOAA's Climate Adaptation Partnerships (formerly Regional Integrated Sciences and Assessments, RISAs) connect science with local knowledge, helping communities incorporate climate and social science expertise into a growing range of planning needs.

NOAA tools are customized to meet these needs. With 210 stations working 24/7, the National Water Level Observation Network is the backbone of decision making for coastal planning, safe navigation, building bridges, and even knowing when to go boating and the best time to fish.

NOAA's Sea Level Rise Viewer visualizes how flooding affects communities. Enter an address and, with just a click, see regional sea level rise projections and data about flood frequency, depth, socioeconomic vulnerability and much more. Our Coastal Inundation Dashboard brings water-level data right to desktops, showing real-time flood levels and levels a few days later. More than 800 mi. above Earth, our satellites measure regional and global sea level. By measuring how long it takes for a radar pulse to make a roundtrip from the satellite to the sea surface, scientists can calculate sea level height around the globe to within less than half an inch.

Powering a New Blue Economy

On the horizon is a dynamic new blue economy, an



entrepreneurial engine projected to grow to over \$100 billion by 2030, complementing the broader blue economy of \$3 trillion. As America's ocean agency and part of the Department of Commerce, we look to this emerging oceanic frontier for both capability and capacity, not to extract material goods but to obtain the known and yet-to-be-discovered data it holds to address societal challenges and inspire and implement solutions. With data as a commodity, return on investments is measured by value-added services instead of products on shelves.

How much, for example, are improved temperature and acidification forecasts worth? Can they boost the value of shellfish and coral reef services? What is a petabyte of sea surface temperature data worth? Consider how port-by-port fog forecasts could substantially cut shipping costs, and the difference better seasonal sea ice predictions could make to Arctic navigation. How about the value of more precisely anticipating a hurricane's track and intensity? What is the value of evacuating vulnerable communities and preparing detailed plans for stressed infrastructure and failed water and power?

Specificity of data and robust public-private partnerships are needed to answer such questions.

Above all, it will take a shared commitment to honor the sea. A bountiful new blue economy requires a healthy ocean. If we are to sustainably reap the benefits now beckoning from the sea, everyone has a stake in keeping it healthy. NOAA's packed toolbox is open, and we have reams of data to share. Join us on an extraordinary journey. **ST**

Review&Forecast

Advancing Ocean Solutions Through Research, Partnerships and Innovation

*By Dr. Lauren Howe-Kerr
Ocean Policy Fellow*

*Dr. Jim McManus
Division Director
Division of Ocean Sciences
U.S. National Science Foundation*

The ocean is becoming increasingly critical to our planet's health, economy and security. The U.S. National Science Foundation (NSF) Division of Ocean Sciences (OCE) supports research to advance our understanding of the ocean and our ability to leverage this understanding for a more sustainable future for our planet.

"For over seven decades, NSF has supported both foundational, curiosity-driven, discovery-oriented research

and use-inspired, solutions-oriented work," NSF Director Dr. Sethuraman Panchanathan said.

In addition to the core programs and infrastructure that OCE supports, OCE also facilitates innovative, interdisciplinary partnerships and research models to advance ocean-based solutions.

Technology, Innovation and Partnerships Directorate

This year, NSF announced its first new directorate in 30 years: TIP, or Technology, Innovation and Partnerships, which focuses explicitly on "use-inspired" research and technology development. Together, OCE and TIP are collaborating in the ocean innovation space to address ocean-related challenges.

The Convergence Accelerator, a TIP program, brings multidisciplinary teams together in a cohort with use-inspired research tracks to stimulate innovation and to address societal and economic challenges that require convergence: the merging of ideas, approaches and technologies from a wide and diverse range of expertise and sectors.

Within the program's portfolio is Track E: Networked Blue Economy, which focuses on interconnecting the blue economy and accelerating convergence across ocean sectors—creating a smart, integrated, connected and open ecosystem for ocean innovation, exploration and sustainable use. In phase one, 16 multidisciplinary teams were selected; these teams identified team members and partners, participated in the program's innovation curriculum, and developed their initial idea into a proof of concept. At the end of phase one, teams participated in a formal phase two proposal and pitch.

In September 2022, NSF invested \$30 million toward six phase two teams. Over the course of two years, the phase two teams will participate in an innovation and entrepreneurial curriculum that includes training on product development, intellectual property, financial resources, sustainability planning, and communications and outreach to develop and implement their ocean solutions. At the end of the team's three-year participation, solutions are expected to be sustainable beyond NSF support.

Innovation and Scale In Ocean Mapping and Technology

Ocean mapping and characterization provide the fundamental knowledge needed for sustainable economic development and conservation. NSF participates in the interagency National Ocean Mapping, Exploration and Characterization (NOMECE) Council, which aims to map the U.S. Exclusive Economic Zone (EEZ); specific targets include all U.S. waters deeper than 40 m by 2030 and coastal waters shallower than 40 m by 2040.



Related to OCE's interest in innovative technologies for the marine environment, OCE, in collaboration with other NSF programs in the Geosciences, Biological Sciences, Engineering, and Computer and Information Science and Engineering directorates announced an upcoming Ideas Lab solicitation, called Engineering Technologies to Advance Underwater Sciences (ETAUS). ETAUS will bring together experts from diverse scientific and engineering backgrounds to develop technologies and solutions for localization, navigation and mapping of ocean environments. Approximately \$8.2 million over three years will fund five to eight selected awards from the Ideas Lab.

Convergent Research for Critical Coastlines

NSF's Coastlines and People Program, or CoPe, announced \$51 million in fiscal year 2022 to fund new multi-institution Coastal Research Hubs. This year's Hub projects focus on coastal hazards, including extreme heat and urban heat islands in Southern California; erosion and flooding in tropical coastal areas; wetland hazards that drive declines in important species in the Great Lakes; storms and stormwater hazards in the Gulf of Mexico; and stormwater impacts in the Northeast.

These hubs all employ a convergent science approach that merges coastal sustainability, human dimensions and coastal processes to advance our understanding of interactions among natural, human-built and social systems in populated coastal environments. Stakeholder groups are involved early on in the design and question formulation stages.

CoPe was discussed at the first NSF-NOAA Leadership Roundtable in September 2022. Sustaining regional partnerships past the duration of NSF CoPe funding is a discussion priority over the next year.

A Diverse and Inclusive Blue Workforce

NSF prioritizes the creation of a diverse blue workforce, inclusive science and technology structures, and recruitment and long-term retention of diverse people and teams to help build innovative, comprehensive information to better understand and predict environmental change. The Geosciences, Engineering and Education directorates released a "dear colleague letter" this year to encourage proposals to develop the workforce required to support current and future ocean technologies. Strong emphasis is placed on inclusion of researchers, engineers and students from groups that are underrepresented in the marine science and mariner communities.

Looking Ahead

OCE looks forward to further leveraging the United Nations Ocean Decade to advance its partnership, innovation and sustainability goals during the upcoming year. As co-chair of the White House Ocean Policy Committee working group focused on writing the first U.S. government Ocean Climate Action Plan, OCE will support the completion of this plan and work to advance the identified priority areas in the ocean-climate nexus in 2023.

On a similar note, OCE's previous decadal survey,

entitled "Sea Change 2015 – 2025 Decadal Survey of Ocean Sciences," was an effort to inform the development of OCE priorities over that time period, and the document has proven to be a valuable resource.

OCE looks forward to receiving additional community-based input for assisting with the vision and priorities of NSF-funded research for the coming decade. **ST**

Review&Forecast

Propelling Marine Energy From the Lab to the Ocean

*By Sarah Loftus
Technical Advisor
Water Power Technologies Office
U.S. Department of Energy*

Fully reaching the United States' ambitious climate goals of a carbon-free electricity sector by 2035 and net-zero-emissions economy by 2050 will rely on emerging technologies to complement currently available ones such as wind and solar energy. One such emerging technology is marine energy, which generates power from the unstoppable motion of waves, tides and river and ocean currents, as well as from temperature differences between deep and shallow ocean waters.

Marine energy technologies are still developing. In the short term, they could power off-the-grid activities in the ocean such as environmental monitoring, fish farming and desalination for making drinking water. They could also power remote coastal communities that otherwise depend on expensive fossil fuel shipments. Within decades, these technologies could also contribute to the U.S. clean power grid.

The Marine Energy Program in the U.S. Department of Energy's (DOE) Water Power Technologies Office (WPTO) conducts research, development, demonstration and commercial activities that advance development of reliable, cost-competitive marine energy technologies and reduce barriers to technology deployment.

Investing in Foundational Research and Demonstration

In the past year, several advancements emerged from WPTO's efforts to fund inspiring research that will potentially accelerate wave energy technologies, giving people access to electricity in proximity to their regions. For example, Pacific Northwest National Laboratory (PNNL) researchers designed and built an advanced triboelectric nanogenerator (TENG) prototype. TENGs generate electricity from relatively small and slow-moving ocean waves, enabling them to increase wave energy technologies' range of operating conditions. The prototype includes a 20-cm-wide disc made of materials capable of generating electrical energy. The disc sits atop a floating gear box with a small pendulum that swings back and forth as ocean waves roll by, relaying this mo-

tion through the gears to the disc to convert waves to electricity. The TENG prototype successfully powered ocean sensors and an acoustic transmitter when the team tested it in simulated waves. The research team was subsequently awarded funds to optimize, build and test a larger-scale prototype.

Meanwhile, WPTO-funded research conducted by engineers at the National Renewable Energy Laboratory (NREL) led to a patent in 2022 for distributed embedded energy converter technologies, a novel method of harnessing ocean energy from structures embedded with tiny energy transducers. These structures could bend, contract or stretch with wave motion, converting energy along the entire structure and taking advantage of a wider range of wave motion.

Designing Marine Energy for People and the Planet

Marine energy can help solve user-defined energy needs in the ocean and on the coast. WPTO invests in assessing marine energy's role for specific activities, including sustainable fish and seaweed farming, desalination, marine carbon dioxide removal, oceanographic research, underwater vehicle charging, and marine energy-powered microgrids for coastal communities.

A team led by PNNL researchers published a report on offshore aquaculture and marine energy that summarizes available data on various ocean farms' energy usage, which helps fill a major knowledge gap (<https://tinyurl.com/yxa4bxyh>). The report also describes opportunities and challenges for siting and integrating marine energy with ocean farms, which complements other WPTO-funded research projects (*Sea Technology*, August 2021).

NREL researchers are currently working to determine the feasibility of integrating wave energy technologies with coastal structures such as breakwaters and sea walls that protect shorelines. Such energy technologies could provide power to coastal communities and take advantage of planned coastal protection structures.

To expand this type of research, WPTO selected nearly \$4 million in additional DOE national laboratory-led proj-



ects in 2022 through its Powering the Blue Economy funding opportunity (<https://tinyurl.com/ymwvx8m>). For example, one PNNL-led project, conducted with Sandia National Laboratories and the University of Guam, will assess the technological, environmental and economic feasibility of using waves and ocean thermal energy around the island to power aquaculture.

In addition to providing electricity, marine energy devices could provide freshwater to communities after a disaster by pumping seawater through desalination systems. In spring 2023, WPTO expects to announce selected projects as part of a \$10 million funding opportunity to accelerate the development and testing of marine energy technologies with a focus on waves and ocean currents. Among other things, this funding opportunity aims to build marine energy-powered desalination technologies with the goal of testing them in the ocean for weeks to months. This effort builds on previous WPTO-supported work, including NREL's hydraulic and electric reverse osmosis wave energy converter and the Waves to Water Prize (<https://tinyurl.com/mrf5w5j3>), which asked innovators to design and build wave-powered desalination technologies and allowed finalists to test their devices off the North Carolina coast last April. Lessons from these projects—such as how to optimize energy harvesting from small coastal waves and how to quickly deploy an inflatable wave energy device—can transfer to other marine energy devices.

Testing Technologies in the Ocean

Several marine energy companies deployed their devices in the ocean during the last year with WPTO support. One major success was CalWave's 10-month demonstration of its pilot wave energy device off the San Diego coast. The device is a box-like structure about 15 ft. wide and as tall as a person. The device successfully weathered major storms because of its position below the ocean surface and ability to submerge deeper autonomously. The company also partnered with environmental scientists to monitor potential effects on wildlife using hydrophones and a camera.



Looking ahead, Oscilla Power and C-Power will be testing small versions of their wave energy devices at the U.S. Navy's Wave Energy Test Site in Hawaii. WPTO selected CalWave and C-Power to test their wave energy devices for the new PacWave test facility off the Oregon coast, expected to be operational with grid-connected testing starting in 2025. Oscilla Power was also selected to design their device for PacWave.

In 2023 and beyond, WPTO will continue propelling marine energy technologies from the lab to the ocean, with technology designs based on the specific needs and interests of the people and places that will use them. These technologies have potential to help achieve national and local energy goals for a sustainable future. **ST**

Review&Forecast

As Sanctuaries Turn 50, A Vision Toward the Future

*By Shannon Colbert
Vice President of External Affairs
National Marine Sanctuary Foundation*

Milestones are opportunities to celebrate past accomplishments, reflect on present circumstances and prepare for the future.

This past October, the U.S. National Marine Sanctuary System celebrated its 50th anniversary. National marine sanctuaries, like national parks on land, represent the most special places in our ocean and Great Lakes. They protect extraordinary seascapes, wildlife and the places they call home, and maritime and cultural resources that tell the history of our past.

In 1972, when the legislation creating the system was enacted, the country was facing a crisis in its waters. Environmental disasters such as the 1969 Santa Barbara oil spill and the Cuyahoga River burning drew attention to the need for environmental protection. The public outcry spurred Congress to action, resulting in the National Marine Sanctuaries Act.

In the 50 years since, the system has grown to include 15 national marine sanctuaries and two marine national monuments across the ocean and Great Lakes, from Hawaii to the North Atlantic and from the Great Lakes down to the Gulf of Mexico. They not only protect natural and cultural treasures, such as endangered species, fragile coastlines, sacred cultural sites and historic shipwrecks, they also exist to connect people to their local waters and provide access to recreational and educational opportunities.

During this milestone year, the National Marine Sanctuary Foundation and our partners at NOAA's Office of

National Marine Sanctuaries launched the Save Spectacular campaign (<https://savespectacular.org>) to invite partners, supporters and the public to discover the wonders of our national marine sanctuaries and work together as stewards to conserve our ocean and Great Lakes. As part of this effort, NOAA and the U.S. Postal Service collaborated on a series of sanctuary-themed Forever stamps to build awareness across the country. The foundation partnered with corporations from clothing companies to retail centers to hotels to engage consumers and the general public in the value of our protected waters. On Capitol Hill, the foundation helped launch the Congressional Sanctuaries Caucus to work with ocean champions to increase government support through federal funding and policy making.

While we celebrate the past 50 years, it's important we also point to the future and emphasize the importance of supporting the sanctuaries for another five decades and beyond. It is a chance to refocus on strengthening and expanding our national system of protected waters with permanent protections for biodiversity, increasing resilience and mitigating the impacts of climate change, and ensuring equitable access to nature for all.

To meet U.S. climate goals, which include conserving 30 percent of lands and waters by 2030, creating protected areas that address gaps in our national system will be critical to conserving the diversity of life in our ocean in the face of climate change and its impacts. Capitol Hill Ocean Week, the nation's premier ocean policy conference, will focus the national policy discussion on this nexus of ocean and climate in June 2023.

Sanctuaries and marine protection have widespread support among Americans. A nationally representative public opinion survey conducted by NORC, an independent research institution at the University of Chicago, for the National Marine Sanctuary Foundation revealed

insights into Americans' opinions on ocean conservation and climate change. The poll shows that Americans, regardless of demographics, political party or geographic location, care deeply about the ocean and its health. They want the government and businesses to do more to protect the ocean and ensure human activities do not harm ocean life.

A full 82 percent of survey respondents favor protecting marine areas that have environmental, educational or cultural significance. Furthermore, 70 percent of Americans favor establishing marine protected areas that do not allow oil and gas drilling, 77 percent want more government action on businesses' effects on marine life and ocean health, and 66 percent want more federal funding to protect the ocean.

Now is the time for action. As we head into 2023, the foundation will continue to bolster and engage leaders across the country to strengthen and expand our network of interconnected protected waters. To assist communities exploring new sanctuaries, the foundation launched an in-depth online toolkit that provides a step-by-step



“While we celebrate the past 50 years, it’s important we also point to the future and emphasize the importance of supporting the sanctuaries for another five decades and beyond.”

roadmap, including resources, information and tools, to create a national marine sanctuary. The toolkit also features several current designation and nomination initiatives: <https://marinesanctuary.org/sanctuarytoolkit>.

Today, communities in New York, California, Alaska and beyond are gathering support for the protection of their most treasured places in our ocean and Great Lakes as new national marine sanctuaries. These include indigenous-led and -designed nominations, designations that address co-management and support engagement of underrepresented and underserved communities, and enhanced conservation through collaborative and inclusive approaches.

In California, the Northern Chumash Tribal Council is leading the effort to designate a portion of the Central California coastline that is an essential part of the heritage of the Chumash, one of the ocean-going bands among the First People of the Pacific Coast; this designation would protect some of the most biologically diverse and ecologically productive regions in the world. Off the coast of New York City, local groups hope to designate Hudson Canyon, which rivals the Grand Canyon in scale and

is home to an abundance of marine wildlife that ranges from endangered, protected and sensitive species such as the sperm whale to deep-sea coral and sea turtles. In upstate New York, the state and local communities are in the process of designating a sanctuary that would encompass a portion of Lake Ontario that is replete with maritime heritage resources beneath the waves, including some of the oldest intact shipwrecks discovered in the Great Lakes. And in the Pribilof Islands of Alaska, the indigenous Unangan community of St. Paul Island Tribal Government nominated their surrounding waters, which are vital breeding and feeding habitat for more than half of the world’s population of northern fur seals and make up an ecosystem that is facing climate change impacts at unprecedented rates.

To secure the future of our ocean and Great Lakes, the wildlife, communities and economies that rely on them, and, ultimately, the future of the planet, marine protected areas such as national marine sanctuaries are an essential tool. As we reflect on all the good created through our spectacular sanctuaries since 1972, we can’t help but be optimistic about their potential in the next 50 years. **ST**

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Review&Forecast

Science-Based Solutions to Protect Ocean Health

By Rep. Eddie Bernice Johnson (D-Texas)
Chairwoman
U.S. House Committee on Science, Space, and Technology

When I was named chairwoman of the Science, Space, and Technology Committee at the start of the 116th Congress, I laid out three main priorities: ensure the U.S. remains a global leader in innovation; address the climate crisis; and restore the credibility of the Science Committee as a place where science is respected and recognized as critical to good policymaking. We also aimed to strengthen Earth and ocean observation infrastructure, advance ocean science and technology, and build a diverse STEM workforce ready to address our greatest challenges.

I am proud to say that we delivered great progress on every one of these priorities during my tenure. Working together in a bipartisan manner as much as possible, we made tremendous strides in strengthening America's research, science, technology and innovation enterprise in ways that have helped us to address climate change. This work has gone hand in hand with protecting and preserving our oceans and supporting coastal communities and the blue economy.

Advancing ocean science is more critical than ever. Climate change, ocean acidification, pollution and other human activities are worsening ocean health. Protecting the oceans is not just a priority for our coastal communities—ocean preservation is important to inland communities as well. The oceans play a major role in mitigating the impacts of climate change by absorbing heat and carbon dioxide from the atmosphere. They also play a significant role in regulating our climate and weather system.

The Biden Administration has demonstrated its commitment to ocean science and research by working to develop our country's first-ever Ocean Climate Action Plan. This plan will guide federal actions related to ocean-based climate mitigation and adaptation solutions. Furthermore, the White House Office of Science and Technology Policy has committed to advancing environmental justice across federal ocean science and technology activities and investments. NOAA is seeking to make America's deepest canyon in the Atlantic Ocean a national marine sanctuary for its protection, another example of the Biden Administration making good on its commitment to protect the ocean, combat the climate crisis and build resilient coastal communities.

The Science, Space, and Technology Committee is leading on these efforts as well. Last year, the committee held hearings to understand how science can help us attain our climate goals and prepare us for the future, including how the ocean plays a major role in capturing emissions.

In the 117th Congress, I was especially proud to lead the passage of the CHIPS and Science Act—the most significant investment in American science, technology and innovation in over a decade. This bill will spur innovation and economic growth and increase America's competitiveness. The CHIPS and Science Act also makes a substantial investment in STEM education. Investing in our children's education will help develop the next generation of science, technology, engineering and innovation professionals. This important investment includes increased opportunities for communities across the nation, including those in underserved and low-resource communities. This effort will help promote diversity and inclusion efforts for the STEM workforce. The CHIPS and Science Act will also create more high-skilled and high-paying jobs across every sector in the American economy, including the ocean economic industry.

A highlight for the oceans community in this transformative legislation was the expansion of federal ocean and coastal acidification research and monitoring and support for the development of adaptation strategies. This legislation expanded ocean and coastal acidification activities at NOAA, the National Science Foundation and NASA. It also established an advisory board to facilitate stakeholder engagement, as well as an ocean acidification prize competition to stimulate innovation.

"I am proud of what we were able to accomplish in my final year in Congress: a pivotal, science-focused year."

Additional groundbreaking legislation passed last year included the Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA). The IRA makes a historic investment in combating climate change, including \$3 billion to help coastal communities become more climate resilient and weather ready. NOAA's aircraft fleet received an additional \$100 million to replace aging aircraft that not only "hunt" hurricanes but also conduct ocean and coastal research. Additionally, \$150 million was provided to advance research, forecasting, observations, assessments and dissemination of climate



information to the public. Finally, NOAA received \$190 million for weather, oceans, and climate research and high-performance computing capacity. This law also makes other large investments in U.S. climate priorities while at the same time reducing America's deficit. The IRA and the IIJA work hand in hand. Not only does the IRA aim to address environmental impacts, but the IIJA aims to create the infrastructure needed to do so. IIJA invests millions for debris reduction in the ocean, a grant program to restore natural features, including coral reefs, and for NOAA to enhance ocean and coastal observations in support of weather and climate forecasting. The investments in protecting communities and nature do not end there. The IIJA makes historical investments in traditional and climate infrastructure while also creating good-paying jobs.

I am proud of what we were able to accomplish in my final year in Congress: a pivotal, science-focused year. Although I am stepping away, I am hopeful that the Science Committee will continue to advance good, science-based policy in a bipartisan manner. There is still much more that needs to be done to drive innovation, address the climate crisis and advance ocean science. **ST**

Review&Forecast

EurOcean: 20 Years Brokering Ocean Science and Technology

By Sérgio Bryton
Executive Director
EurOcean

For the last 20 years, EurOcean has been one of Europe's leading champions of the ocean, promoting a better understanding of ocean science, nurturing partnerships and collaborations, and raising awareness among the broader public of the importance and relevance of the ocean in daily life.

EurOcean is an international, scientific, independent, nonprofit organization based in Lisbon, Portugal. It was founded in 2002 by the Portuguese Foundation for Science and Technology and the French Research Institute for Exploitation of the Sea in response to a growing need for marine science and technology actors to work together more closely and for information from the sector to be better organized and more readily available. At that time, there was little precedent for complex international collaboration, and marine science knowledge was often proprietary and not easily found or accessed.

The organizational structure of EurOcean is that of a pan-European network of ocean science and technology stakeholders committed to various activities such as research, innovation, funding, capacity building and lit-

eracy. EurOcean members are present in many European countries and, together with other partners, notably from industry and media, simultaneously support and benefit from its activities.

Guided by its principles of trustworthiness, coherence, independence, integrity and excellence, EurOcean continues promoting collaboration, fostering innovation and disseminating information among the members of its network, the ocean community and broader society, thus contributing to a better future for humankind.

One of the first challenges for EurOcean was to develop and make freely available to the ocean community unique and important repositories of information, such as the Research Infrastructures Database (rid.eurocean.org) and the Knowledge Gate (kg.eurocean.org) that continue to support policymaking and research activities. Additional missions were to spread science-based knowledge and to promote a future vision where the ocean was front and center in terms of science, technology, economy and societal importance.

With the emergence of the blue economy as a new paradigm, EurOcean continues to be a prominent and evermore relevant advocate for the ocean as a broker for knowledge and information flow between traditional and evolving maritime sectors. Now, EurOcean works with many stakeholders in areas such as sustainable development, climate change preparedness and action, and "ocean literacy" (which has become the standard term describing a mainstream understanding of the mutual influences of the ocean and society).

By spreading science-based knowledge, EurOcean contributes to developing solutions to global crises through its participation in European-funded ocean science and technology projects. Among these activities are: the All Atlantic Cooperation for Ocean Research and Innovation, Ocean Literacy for All, the Alliance of European Marine Research Infrastructures (EuroFleets), the Catalogue of Research Infrastructure Services, Responsible Research and Innovation in the Marine Sector, Sea for Society, the Integrated Arctic Observatory System, and the proof-of-concept for the implementation of a European Copernicus Coastal Flood Awareness System.

Recently, and in light of the United Nations Decade of Ocean Science for Sustainable Development (2021 to 2030) and the 2030 Agenda, EurOcean was acknowledged by the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) as an Ocean Decade implementing partner. Using its broad network, EurOcean is developing events, communication campaigns and ocean literacy activities to support the Ocean Decade objectives and to contribute to the United Nations' Ocean Decade with ambitious actions to make the "science we need for the ocean we want."

One example is the flagship initiative entitled Mário Ruivo Memorial Lecture. The lecture will be biennial, starting in 2022 and developed jointly with IOC-UNE-



SCO and the government of Portugal. The initiative pays homage to the late, distinguished Portuguese visionary professor Mário Ruivo, his lifelong commitment to ocean science and sustainability, and his significant contributions to the work of IOC-UNESCO. The lecture, focused on present and future ocean challenges, will give early-career ocean professionals the opportunity to present their projects at the assembly of the governing bodies of the IOC-UNESCO in 2023 and beyond.

EurOcean's role has never been so needed, challenging and exciting. There are many more ocean science and technology actors than before, and the effort required to foster their cooperation and collaboration is much greater. Information about ocean science and technology is increasingly available in the digital era, but this leads to increased challenges concerning its organization and how to find it, aggravated by the phenomena of misinformation and greenwashing. The public needs reliable sources of correct and accurate information.

The success of EurOcean depends heavily on its network. The larger the network, the greater the ability to understand the needs and opportunities of the ocean community. As such, expanding the network is a top priority. EurOcean seeks to be even more active and have more impact, particularly in key areas such as knowledge management and transfer, science communication, and ocean literacy.

To learn more, visit: www.eurocean.org. **ST**

Review&Forecast

Ending Plastic Pellet Pollution

By Tanya Cox

Senior Technical Specialist, Marine Plastics
Fauna & Flora International

In May 2021, the single largest instance of plastic pellet pollution in the world happened when the Singapore-registered MV *X-Press Pearl* caught fire and, after burning for about 12 days, sank into the Indian Ocean just a few kilometers off Sri Lanka's western coast, along with the thousands of containers it was carrying.

Of these containers, 400 were holding plastic pellets, otherwise known as nurdles, lentil-size pieces of plastic that are melted together to create almost all plastic items used day to day. Approximately 84 billion pellets were spilled from the ship, which quickly started washing up in droves on the beaches of Sri Lanka.

It is the worst maritime disaster in Sri Lanka's history. Cleanup efforts are still ongoing.

The harm this plastic pellet spill caused to the beaches and oceans surrounding Sri Lanka's western coast

was not just cosmetic. The pollution has caused serious economic, social and environmental impacts. In the months following the spill, 20,000 fishers were unable to fish in the area, and marine wildlife and their carefully balanced coastal ecosystems were heavily affected.

Due to their small and round appearance, nurdles are often mistaken for food by marine life and are regularly eaten or ingested, filling the stomachs of fish and animals and leading to starvation. In some areas where nurdle pollution is particularly acute, they can also smother seagrass meadows, marine plants that have an immense carbon sequestration capacity. The influx of nurdles reduces the ability of the plants to photosynthesize while also threatening the many species that use the meadows as a breeding, nursery or feeding ground.

Making their impact even worse, plastic pellets are inherently hazardous due to the toxic additives they contain, and, once they are spilled into the ocean, they also act like a sponge, adsorbing and accumulating bacteria and persistent environmental pollutants that are present in seawater. When pellets come into contact with (or are eaten by) marine animals, the toxins, chemicals and bacteria can potentially be transferred to the animal, effectively acting as a poisoned pill for marine life.

Unfortunately, the MV *X-Press Pearl* shipping disaster is not the only mass plastic pellet spillage in recent years. Since 2011, there have been eight known major incidents of pellet loss at sea, occurring all over the world, from South Africa to Hong Kong to Norway. Together, the incidents have resulted in a total of approximately 1 trillion nurdles being lost in the ocean.

In addition to these large-scale maritime disasters, smaller but more chronic pellet spillages from ships are occurring daily. Nurdle losses can occur when the primary packaging that houses pellets becomes damaged and the nurdles leak out into the containers. If those containers are damaged or improperly sealed, or if they are opened for inspection or cleaning, loose or poorly packaged pellets can escape into the environment.

So, what is being done to address these issues? Over the last 30 years, efforts to tackle plastic pellet pollution have largely focused on voluntary measures to stop losses occurring at production and manufacturing sites, in other words, "land-based sources" of pellet pollution. Far less attention, however, has been paid to pellets that are being lost during transport—especially at sea. In Fauna & Flora International's (FFI) new report, "Stemming the Tide: Putting an end to plastic pellet pollution," we highlight the disastrous impact plastic pellet pollution is having on marine wildlife, and, crucially, we call for a more robust regulatory approach from industry, governments and the International Maritime Organization (IMO) to put an end to all sources of plastic pellet pollution, both on land and at sea.

When cargo is on a vessel, it travels under international maritime laws, which are governed by the IMO. While the IMO has introduced various pieces of general legislation on pollution prevention, none of the existing



legislation adequately addresses the conditions in which plastic pellets are shipped. For example, unless the cargo housed in containers is subject to International Maritime Dangerous Goods Code restrictions—which pellets are not—there is currently no requirement for the container contents to be disclosed to the ship operator. This means that, among other consequences, the operator can stow containers holding pellets anywhere on the ship, including above deck in positions where they are more vulnerable to being lost overboard.

Given that the IMO's role includes preventing pollution from ships, there is a clear need for the different stakeholders represented at the IMO to act to prevent further pellet pollution incidents, both chronic and acute. As outlined in further detail in our report, FFI calls for the IMO to take a series of measures to ensure pellet loss at sea is minimized.

“FFI calls for the IMO to take a series of measures to ensure pellet loss at sea is minimized.”

FFI recommends the IMO to legally classify pellets as marine pollutants in recognition of their persistent, polluting nature and the harm they cause to marine life and ecosystems. This would immediately trigger significant improvements in the way that pellets are packaged, labeled, stowed and transported around the world. FFI believes that national administrations, under the auspices of the IMO, must work together to develop standardized disaster response protocols to aid containment and cleanup of future offshore, nearshore or coastal shipping disasters. Clear protocols or guidance related to liability and compensation claims in the event of accidental loss must be established, according to FFI. These changes in practice would help reduce the likelihood of chronic loss of pellets at sea, as well as mitigate the likelihood and impact of catastrophic pellet spills during shipping disasters.

“The harm being caused by plastic and microplastic pollution is as perverse as it is inexcusable,” said UN Special Envoy for the Ocean Ambassador Peter Thomson, who wrote the foreword for the FFI report. “It’s clear that the damaging impact of plastic pellet pollution needs to be raised to much higher ground on the global agenda. It is an assault on nature, and, with the right attitude to living harmoniously on this planet, it is entirely preventable.”

Governments around the world must not delay in stepping up, both in terms of bringing about changes in national or regional legislation and in international rules being negotiated at the IMO. Preventing pellet pollution is achievable, and it’s essential for the future of our oceans. **ST**

Review&Forecast

Climate Change as Threat Multiplier: The Mediterranean Sea in Dire Straits

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The semi-enclosed Mediterranean Sea region is a hotspot for climate change. A combined series of threats is generating pressure on the marine ecosystem and tensions of economic and geopolitical nature.

The 2022 summer can be considered as a real “*annus horribilis*,” having set unprecedented records in atmospheric and oceanic temperatures. For example, in September 2022, anomalies in sea surface temperature (SST) reached up to 3.7° C in mean and 6.8° C in maximum values over the western Mediterranean Basin. An anomaly is determined by the difference between the mean temperature of the month and the mean temperature of the same month during the period from 1987 to 2020.

Rather than cheering for the new possibility of swimming until late October, we should worry that a warmer Mediterranean Sea is an extreme condition that calls for immediate action. Let’s quickly review some of the problems brought along by abrupt increases of water temperature.

A More Vulnerable Mediterranean

For starters, the thermal expansion of the water is accelerating sea level rise, exposing thousands of kilometers of coasts and plains to increased flooding and faster erosion. Associated risks affect not only beaches and tourist and coastal cities but also critical infrastructure such as roads, railways, oil plants and civilian and military airports.

When compared with the global average ocean-warming rate, the Mediterranean Sea is showing a rate of triple increase at about +0.3° C every decade. Among the main physical phenomena affected by rising sea temperature is the rate of dense-water formations, which, because of high density, sink to the bottom of the sea and act as the basis of the Mediterranean’s water circulation. This phenomenon is happening in the Gulf of Lyon, the northern Adriatic Sea and the Aegean Sea. All in all, generalized warmer waters are slowing down these “cold engines,” or sea circulation, in a similar way to what is happening in the Atlantic region. Although precise consequences are difficult to project, there is already evidence of diminished injection of nutrients and oxygen into the deep-

er regions of the Mediterranean and of changes in circulation, ventilation at depth and heat fluxes through the atmosphere, with consequent climate effects, including severe changes in precipitation rates.

A warmer Mediterranean Sea is also more prone to fueling extreme events that extract their vital energy from the air-sea temperature difference. In the last decades, the number of depressions that became particularly intense has been increasing. An infamous example is represented by the Vaia cyclone in October 2018 that was forced to develop over the Mediterranean as it was blocked between high-pressure fields that enabled it to deepen extremely fast, generating a powerful flux of latent heat. This led to the occurrence of severe precipitation and super-intense winds that produced destructive waves capable of wiping out coastal dikes on the Ligurian coasts. The storm proceeded for several kilometers into the mainland and mountains, striking out some 40 million trees in the Alps.

SST anomalies highly influence tropical-like cyclones (a.k.a., medicanes), both in the phases of triggering and development. Medicanes occur about 1.5 times per year, can reach the intensity of Category One hurricanes, and

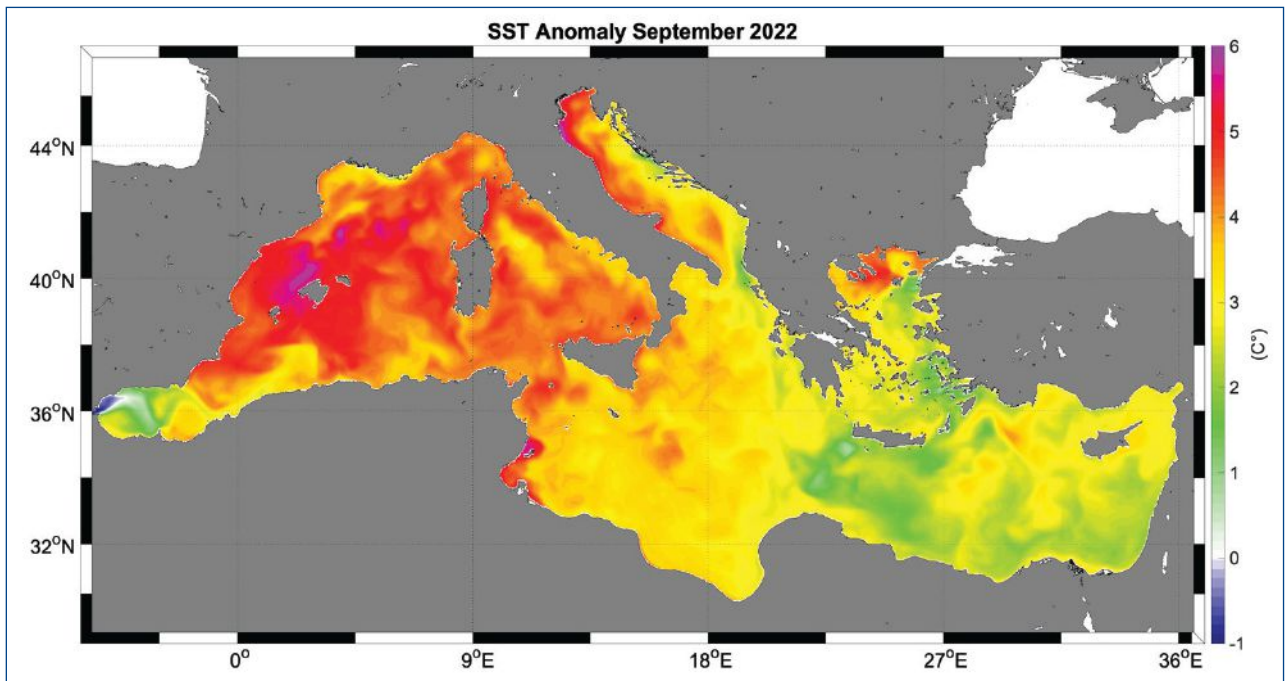
are greatly influenced by ocean heat content, especially with regard to storm intensity (wind, waves, precipitation), with significant socioeconomic impact, as in the case of Cyclones Zorbas in 2018 and Ianos in 2020.

In addition, there are also several biogeochemical implications of the increased marine and atmospheric temperatures, such as a decrease in most of the fish populations, increasing invasions of tropical vegetal and animal species, and the proliferation of jellyfish populations.

All in all, the Mediterranean region is becoming extremely vulnerable under the effects of global warming, and climate change is acting as a threat multiplier that affects human security aspects, which calls for an urgent change of policies. This is even more valid in consideration of the key role played by the Mediterranean Sea as a natural link between its two culturally and economically different southern and northern shores.

Technological Support

There are great expectations that emerging technologies can help in the direction of better understanding and forecasting these processes. Among them are the increased sensing capabilities that are concurrent with



Mediterranean Sea surface temperature anomaly in September 2022, with respect to the 1987 to 2020 average. Maximum anomaly of about 6.8° C was reached in the northwest Balearic Basin. Data source: Copernicus Marine Service, <https://data.marine.copernicus.eu/products>.

improved autonomy and robotics; improved scenarios based on AI approaches; knowledge discovery via advanced big data analytics; improvements in terms of positioning, sensing and computing from quantum technology; and the evolution of an “ocean digital twin” concept.

Meanwhile, the adoption of state-of-the-art, fully coupled ocean-atmospheric-wave numerical models can already help provide more accurate forecasts for adaptation and mitigation scenarios by faithfully describing the energy transfer at the air-sea interface. They have been successfully demonstrating more accurate flash-flood timing and intensity predictions, more accurate medicanes landpoints, better reconstruction of water masses, and wind and wave dynamics.

These complex numerical frameworks require intensive computing resources to simulate processes at high resolution for the whole Mediterranean region. The advent of numerical technologies such as parallel computing on graphics processing units (GPUs), the growth of storage resources and the increasing availability of high-performance central processing units (CPUs) are advancing toward a point where we can run them routinely.

Instead of reacting *a posteriori*, while acting on the mitigation side by reducing the atmospheric emission and concentration of greenhouse gases, the best way to plan for adaptation is to engage with this series of problems using a holistic approach. This approach should: recognize and understand the changes that are already happening by investing more in integrated ocean observing systems and coupled modeling tools; plan for the near future using strategies that integrate updated scenarios; and include collaboration among different disciplines and nations of the Mediterranean. **ST**

Review&Forecast

2023 Can Keep Offshore Energy Flowing

By Erik Milito
President

National Ocean Industries Association (NOIA)

Major economic, energy, and geopolitical upheaval and uncertainty made 2022 the year of the unexpected. However, the U.S. offshore energy sector was able to capture a substantial legislative victory, giving it far more momentum heading into 2023 than one year prior.

To begin with, a Democrat-controlled Congress granted American offshore oil and gas production an unexpected reprieve from canceled lease sales and permitting delays. In August 2022, Congress passed the sweeping Inflation Reduction Act (IRA). The result of a deal between Senate Energy and Natural Resources Chairman Joe Manchin (D-WV) and Senate Majority Leader Chuck Schumer (D-NY), the IRA,

surprisingly, included a levy of provisions supporting a diversity of offshore energy segments, including oil and gas, wind, and carbon sequestration.

The IRA reinstated the previously vacated Gulf of Mexico oil and gas Lease Sale 257. The legislation also requires the Department of the Interior to hold the previously canceled offshore Lease Sales 258, 259 and 261 and established a clear timeline of when these lease sales must be held. The bill also creates a 10-year tie-in for the issuance of offshore wind leases, under which oil and gas leasing acreage of 60 million acres (roughly an area-wide Gulf sale) must be offered in lease sales within a year of issuing an offshore wind leaser.

Under the terms of the IRA, Lease Sale 258, for the Cook Inlet, Alaska, must be held by the end of 2022. Gulf of Mexico Lease Sales 259 and 261 must be held by the end of March 2023 and September 2023, respectively. The Bureau of Ocean Energy Management (BOEM) has thus far released the relevant environmental assessments and notice of sales in a timely manner, suggesting that these leases will be conducted on schedule.

The IRA also provides a boost for offshore wind. After being included in several bills that never made it to the finish line, language lifting a 10-year offshore wind leasing moratorium in the Southeastern U.S. and Eastern Gulf of Mexico was included in the final package. Florida, Georgia, and, perhaps most importantly, North Carolina and South Carolina now have a clearer line of sight for new offshore wind opportunities. BOEM is already looking at the next round of Central Atlantic offshore wind lease sales, which may include lease sales offshore North Carolina.

The IRA will also increase staffing for BOEM and NOAA. The federal government should not have to choose between working on offshore wind lease sales, permitting of offshore wind projects, or regulatory action for offshore oil and gas or carbon sequestration. In addition, the legislation granted an extension of production tax credits (PTC) for offshore wind, new tax credits for offshore wind vessels, and amended the Outer Continental Shelf Lands Act (OCSLA) to finally allow for wind lease sales offshore U.S. territories.

Finally, the IRA will help jump-start the U.S. offshore carbon sequestration sector. While the Department of the Interior is still promulgating the first offshore carbon sequestration regulations, many companies are moving ahead with their plans to break into this important space. The Inflation Reduction Act increases the federal 45Q tax credit for carbon sequestration and offers “direct pay” for offshore carbon sequestration projects via tax refund.

During 2022, the U.S. offshore oil and gas outlook went from canceled and vacated lease sales to every Democrat in Congress voting to restore and resume near-term offshore oil and gas lease sales. As the IRA shows, even the most plugged-in prognosticator cannot always predict



what Congress is going to do. Predicting the Congressional outlook is even more difficult when heading into a new Congress after the midterm election in November.

Part of the IRA deal between Manchin and Schumer included an agreement on permitting reform. Ultimately, the permitting legislation stalled in the lead-up to the midterm election, but we expect permitting reform will continue to be a priority for both Manchin and Republican leadership.

Regardless of party, there is broad recognition that National Environmental Policy Act (NEPA) reform is essential for timely and thorough environmental reviews. Steps must be taken to make sure red tape does not unnecessarily or arbitrarily impede critical infrastructure projects, especially as the U.S. tries to modernize its infrastructure and scale and deploy additional solutions to address climate change, such as offshore wind and carbon sequestration.

“The lesson of 2022 is that energy should be nonpartisan.”

While offshore wind leasing and permitting are expected to continue at a steady pace in 2023, the year should also see the release of the overdue final federal offshore oil and gas leasing program. While the IRA does reinstate two region-wide Gulf of Mexico lease sales in 2023, additional legislative efforts to help shore up U.S. oil and gas production, both onshore and offshore, may be on the table to help address the global energy crisis and the high price of gasoline.

Maintaining lease sales is fundamental when it comes to keeping energy flowing. Continued American offshore oil and gas production means good-paying jobs, affordable energy supplies, important funding for local infrastructure needs, coastal restoration and resiliency, and parks and recreation programs, as well as providing Americans and our allies a stable source of lower carbon energy. These benefits cannot continue without a long-term leasing program. In the global energy marketplace, U.S. energy policy should serve to encourage and attract investment to the U.S. offshore region.

The lesson of 2022 is that energy should be nonpartisan. Sweeping offshore energy provisions, including oil and gas, were included in the historic Inflation Reduction Act because offshore energy benefits every American, regardless of party. Everyone wins through affordable energy, good-paying and accessible jobs, and domestic energy production that advances climate solutions and provides an alternative to energy from higher-emitting geopolitical adversaries such as Russia.

As the dust clears from the 2022 midterms, policymakers should work together to advance a balanced energy strategy based upon principles of affordability, energy security, national security, and continued environmental and emission reduction progress. **ST**

Review&Forecast

Ensuring Safe and Efficient Marine Contracting Operations

By Allen Leatt
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International Marine Contractors Association (IMCA)

IMCA is an international trade association representing the vast majority of offshore marine contractors and the associated supply chain in the world, with members from over 65 countries. We publish an extensive technical library of documents on operational good practice.

Safety runs like a golden thread through all we do. We create safety promotional materials, timely information notes, invaluable and highly acclaimed safety flashes, and safety statistics. Our technical and “core” committee structure (see www.imca-int.com) forms working groups for specific projects, ensuring that IMCA documentation is created by the industry for the industry.

During the last few years, the COVID-19 pandemic did not affect our ability to carry out our work programs; it only affected our ability to meet face to face, so, for the most part of 2022, we have been getting back on the road with a series of regional meetings, technical seminars and industry events as we transition out of the worst of the pandemic.

Our two important technical events in 2022 were the DP (Dynamic Positioning) Annual Conference and our 11th Lifting and Rigging Seminar; additionally, our secretariat members spoke at technical conferences from Houston to Singapore and Taiwan to Aberdeen. All these events proved the value of networking and the invaluable role IMCA plays in the industry. Dates are already in place for many of our 2023 meetings.

Looking Back to Look Forward

Our 2021 biennial membership survey and review helped to define our strategic approach, setting the scene for 2022 and 2023’s work programs. Key focus areas, in addition to continuing firm stewardship of our technical library of standards and guidance, included further expanding our reach into the offshore wind sector, broadening our scope in environmental sustainability and doing more on competency.

In all areas, we also took on board the value of closer collaboration with other key organizations, ranging from the U.S. Coast Guard to the Brazilian Navy, and from the U.S. Business Network for Offshore Wind to industry and government associations in Taiwan. After many years of active engagement in Jones Act work in the U.S. (the Jones Act requires that only U.S. vessels transit between U.S. ports), 2022 saw IMCA working with the American

Petroleum Institute and the American Clean Power Association in relation to the American Offshore Worker Fairness Act.

Offshore Wind

IMCA's members have been heavily engaged in building most of the major offshore wind farms installed in the Western world, and our Asian membership is expanding as offshore wind becomes a key component of national energy strategies in the East.

Our Marine Renewable Energy Committee (established in 2011) has produced an increasing number of guidance documents driving standardization and safety levels. We collaborate in this area with G+ (the Offshore Wind Health and Safety Organisation) and other key organizations in the U.K., U.S. and Taiwan.

Our secretariat has expanded to keep up with offshore wind development. New additions to the secretariat include Iain Grainger, who is our head of energy transition; Dustin Varnell, who looks after the growing U.S. offshore wind energy market; Jason Veerasingam, who focuses on Asia; and Rhys Jones, who is our global technical adviser for marine renewable energy.

IMCA has one major offshore wind concern on behalf of its members: market sustainability. At the moment, poor economics are created by uncovered contract risks and cost inflation. As a result, the supply chain is largely unprofitable today. Our Legal, Contracts, Insurance & Compliance Committee, having developed general contracting principles, followed by dedicated versions for marine construction, ROV services and survey work, has developed offshore wind contracting principles that are currently being rolled out in discussion with a wide range of key international stakeholders, a process that will continue throughout 2023.

Environmental Sustainability

Our Code of Practice for Environmental Sustainability, setting expectations for the marine contracting industry in managing key environmental and climate topics, was published in 2021. Our Environmental Sustainability Committee has established working groups to prepare guidance on key elements, such as the circular economy, supply chain engagement, UN Sustainable Development Goal 14 and environmental performance factors, to enable members to progress their environmental sustainability performance.

This code provided a basis for developing a self-assessment questionnaire for IMCA members to establish how they are performing, and it was put to the test twice in 2022, enabling us to highlight the areas where additional focus is required. The exercise will be repeated regularly to understand the progress that has been made.

Competency and Training

The Competence and Training Committee (C&TC)

provides competence frameworks to support the industry by delivering a basis for assessing levels of competence of its personnel in safety-critical positions. Competence is not a static process since tasks, equipment and processes can change and develop, and with them the competence frameworks. We actively promoted awareness and benefits throughout 2022.

Continuing professional development (CPD) plays an ever-increasing role in both diving and DP, with app-based schemes and new modules regularly launched. The C&TC oversees these activities. For 2023, we are launching a new scheme for approval of ROV introductory training courses and standardizing training supplier membership to support only the best schemes across both diving and ROV personnel.

Diving and DP

Diving and DP are part of IMCA's DNA. New and updated guidance was issued by both of these divisions in IMCA throughout 2022, with the major task for the Diving Division Management Committee (DDMC) and its dedicated work group being the review and publication of revised editions of our Diving Equipment Systems Inspection Guidance Note (DESIGN) documents.

At the International Maritime Organization (IMO), where IMCA holds consultative status, work continues on the rewriting of the 1995 IMO Diving Code with IMCA involvement.

Cooperation with other international organizations also included the formation of the International Diving Industry Forum, which held its first seminar in Dubai in 2022.

Thanks are due to the Diving Medical Advisory Committee (DMAC), IMCA's DDMC and our secretariat for all the work they did in pooling their expertise to produce relevant information and guidance throughout the past three years.

DP station-keeping reports continue to be important, with the global request that more owners/operators of DP vessels make such reports so that lessons can be learned by their peers. Their annual publication, coupled with safety flashes, are key to increased safety levels. The DP Committee published more relevant guidance throughout 2022, the most recent being on network storms.

What's discussed in this article is only a short list of IMCA's ongoing work. Add to that a focus on eCMID, our database that provides standard formats for the inspection and auditing of offshore vessels to promote safety and efficiency, the establishment of a USV Committee along with its first guidance document, and more, and it's clear we're going from strength to strength. We look forward to an equally productive year in 2023. **ST**



international

Fleet Additions for Svitzer

Svitzer, a global towage provider and part of A.P. Moller-Maersk, will take delivery of two new ASD tugboats and one workboat, further modernizing and expanding its fleet in the Americas.

Based in Panama, Svitzer Americas is heavily engaged in the region, with harbor towage and terminal towage as the main market segments. With the three newbuilds, the fleet will reach 82 vessels operating in ports and terminals across 12 countries in the Americas.

ECA Group, iXblue to Operate Jointly

Following the acquisition of iXblue by Group Gorgé in September 2022, ECA Group and iXblue will operate under a new joint brand: Exail. It will specialize in cutting-edge robotics, maritime, navigation, aerospace and photonics technologies ranging from components and sensors to products and complex systems.

DyeTector Test in Caspian

OceanTools' D8 DyeTector has been deployed in the Caspian Sea for customer UBOC in Baku, Azerbaijan, for a 20-in. pipeline at a depth of 60 m. A successful leak test was undertaken at stable pressure and temperature. The dye solution was purged from the pipeline to confirm the correct functioning of the DyeTector. The excitation of the dye was clearly visible at the point where the purge water intersected with a ray of UV light.

The D8 DyeTector employs high-power LED light to create a concentrated beam tuned to a specific wavelength to cause maximum fluorescence of the dye. Detection electronics amplify even the smallest amounts of fluorescence from the agitated dye molecules. DyeTectors are typically around 100 times more sensitive than the human eye.

Guidance on Ship Recycling Regulations

The International Chamber of Shipping (ICS), the International Shippers & Services Association (ISSA), BIMCO and the International HazMat Association (IHMA) have collaborated on a new guide to help both shipowners and ship suppliers comply with both the current EU Ship Recycling Regulations (EUSRR) and the Hong Kong Convention on Ship Recycling (HKC), which is anticipated for ratification next year. The guide is available at: www.ics-shipping.org/publication/materials-declarations-for-inventories-of-hazardous-materials.

Under both sets of regulations, the shipowner must develop and maintain an inventory of hazardous materials for each vessel they own. In support of this, ship suppliers must provide material declarations and supplier's declarations of conformity for equipment delivered to the ship.

Equity Bridge Financing for Green Infrastructure

Ten years after structuring the first bridge financing for renewable energy assets, Eiffel is innovating again by

introducing equity bridge financing for green infrastructure, a first in Europe. Eiffel Transition Infrastructure provides equity or quasi-equity to finance the development phase of renewable energy infrastructure assets. The European Investment Fund is sponsoring the initiative with €75 million.

Project development generally takes several years and is capital intensive. This equity bridge solution is particularly relevant for renewable energy developers and independent power producers with large pipelines of new projects in development but without the capital to finance them all in parallel.

Equity bridge financing is also particularly relevant for merchant assets (i.e., renewable energy assets that plan to sell their electricity on the market rather than under regulated tariffs or long-term PPAs) and for assets with new business models, such as combined generation and storage.

Methanol-Fueled Newbuild

Proman Stena Bulk Ltd. has formally named its first state-of-the-art newbuild IMOIMeMAX methanol-fueled 49,900-dwt vessel, *Stena Pro Patria*, in a ceremony hosted in Trinidad and Tobago. The vessel is the first of three methanol-fueled vessels delivered in 2022 to the joint venture between tanker company Stena Bulk and methanol producer Proman, with a further three newbuilds due for delivery between now and 2024.

Review of Safe-Work Guidance on Ships

InterManager has welcomed a commitment by the International Maritime Organization (IMO) to review guidance governing safe work in enclosed spaces on board ships. heralding the move as a significant step forward in crew safety, the association says it will work with the IMO, flag states and other maritime partners to ensure that lessons are learned from the many fatalities that have occurred in enclosed spaces and that new legislation is workable and effective.

InterManager submitted a comment paper to the IMO's Maritime Safety Committee (MSC) 106 meeting, co-sponsored by a number of industry partners, in response to China's proposal to revise IMO Resolution A.1050(27). InterManager and its co-sponsors recommend that the resolution be considered by suitably competent subcommittees, which should also consider emergency drills for enclosed spaces, the carriage of gas detection equipment on board ships, and MSC.1/Circ.1401 dealing with vessels inerted with nitrogen, plus the associated risks and hazards. It advises re-examination of previous submissions to address issues already raised, such as cargo-hold gas monitoring, an appreciation of oxygen depleting cargoes, cargoes that are fumigated and cargoes that emit toxic gas.

Hydrogen Passenger Vessel Newbuild

DNV will be responsible for newbuild supervision and classification of Northern Explorer (NX)'s inaugural vessel, scheduled for delivery by 2026, as well as collaborating with Norwegian flag and technology providers

on the enhancement of rules and standards for safe operation of hydrogen-powered passenger ships.

Designed by naval architects Multi Maritime AS in Førde, Norway, the 250-passenger ship features ABB's fully electric propulsion system, including the battery and hydrogen fuel-cell technology that will enable it to sail emissions free in the Norwegian fjords and further afield as the green shift takes root.

Data Storage for Small UUV

Curtiss-Wright's Modular Open Systems Approach (MOSA)-based Data Transport System 1 (DTS1) Network Attached Storage (NAS) device has been selected by a leading U.S. system integrator for use on a small-class UUV deployment. Curtiss-Wright will supply the customer with its DTS1 data storage and removable memory cartridge technologies.

This is the company's first contract for a National Security Agency-approved data encryption solution on a small UUV.

Second Cohort of Tacoma Innovation Incubator

Washington Maritime Blue's Tacoma Maritime Innovation Incubator (TMII), a program dedicated to contributing innovation and economic growth in the South Sound, has chosen five companies and one community member into the Second Wave Cohort.

The Second Wave of TMII will obtain mentorship, networking and programming opportunities to help business

operations scale. In addition, the Second Wave will also obtain access to the Maritime Blue ecosystem, which includes advisors and mentors worldwide.

The Second Wave startups are: Air Mobility, Homeostasis, Innovat8social, Kara Technology and WhyGreene. The community member is Terrestrial.

Florida Utility Supports Everglades Research

Florida Power & Light Co. (FPL) has partnered with the 2022 Willoughby Expedition to support water quality research in the Florida Everglades (see Environmental Monitoring in this issue). Through FPL's charitable arm, the NextEra Energy Foundation, America's largest electric utility will help fund the sampling and analysis of water in remote portions of the Everglades that have not yet been researched because of lack of accessibility.

Maersk Partners with bp HOLC on Training Oilfield Workers in GOM

Maersk Training Houston has a new training partnership with bp Houma Operations Learning Center (HOLC) to develop the next generation of oilfield workers in the Gulf of Mexico (GOM). Training will take place in person, online and via simulators, and will be delivered according to industry and regulatory standards. Maersk will offer training on crew resource management (CRM) skills, which focus on how to effectively communicate information in high-risk industries. This CRM training will complement basic safety and other courses. **ST**

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New Director of BSEE Alaska Region

The U.S. Bureau of Safety and Environmental Enforcement (BSEE) has selected Justin Miller to serve as the new director of BSEE's Alaska Region.

"Justin brings experience, a wealth of knowledge in oil and gas operations at both the state and federal levels, and a proven track record to this vital leadership role," said BSEE Director Kevin Sligh. "His many years of experience in several bureaus across the department provide the leadership to guide the Alaska Region's daily efforts and operations to ensure safe and environmentally responsible offshore energy activities."

Miller will oversee more than 1 billion acres on the Outer Continental Shelf and more than 6,000 mi. of coastline; more coastline than in the rest of the U.S. combined. The region encompasses the Beaufort, Bering and Chukchi Seas, Cook Inlet, and the Gulf of Alaska. Miller will lead an experienced team of petroleum engineers, structural engineers, geologists, geophysicists, environmental scientists and administrative staff.

Miller began his federal career with the Department of the Interior at the Bureau of Land Management. He has more than 13 years of experience in regulatory oversight of the oil and gas industry, most of which has been in Alaska. Most recently, he served as the chief of the Re-

source and Economic Analysis Section for BOEM Alaska. He graduated from Penn State University with a B.S. in petroleum and natural gas engineering, following four years of active-duty service in the U.S. Marine Corps.

Funding for Marine Highways, Ports

The U.S. Department of Transportation's Maritime Administration (MARAD) has awarded nearly \$39 million in grants to 12 marine highway projects across the nation under America's Marine Highway Program (AMHP). The funding will help expand marine highway services on U.S. navigable waterways to reduce congestion, alleviate supply chain bottlenecks, and move goods more quickly from ships to shelves.

AMHP received an additional \$25 million in funding this year—the largest single investment in the program ever. This funding stems from the Bipartisan Infrastructure Law.

MARAD has also granted more than \$703 million to fund 41 projects in 22 states and one territory that will improve port facilities via MARAD's Port Infrastructure Development Program.

The MARAD funding, made possible by the Bipartisan Infrastructure Law and additional Congressional appropriations, will benefit coastal, Great Lakes and inland river ports, helping improve supply chain reliability through increased port capacity and resilience, more efficient operations, reduced port emissions and new workforce opportunities.

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North Atlantic Right Whale Protection

NOAA Fisheries and the U.S. Bureau of Ocean Energy Management (BOEM) has released a draft joint strategy to protect and promote the recovery of North Atlantic right whales while responsibly developing offshore wind energy. The draft strategy identifies the agencies' goals and objectives to better understand the effects of offshore wind development on the whales and their habitat.

The draft strategy identifies areas where the agencies will work together to improve upon the necessary science, information and Indigenous knowledge to support the U.S. goal of developing 30 GW of offshore wind by 2030 while protecting biodiversity and promoting ocean co-use. The draft strategy identifies three main goals: mitigation and decision-support tools; research and monitoring; and collaboration, communication and outreach.

It focuses on improving the body of science and integrating past, present and future efforts related to North Atlantic right whales and offshore wind development. The strategy also establishes the agencies' plans to engage stakeholders, partners and other ocean users on these issues. Following review of public comments, the strategy will be regularly evaluated and updated as new information becomes available.

Wind Energy Areas Designated in GOM

BOEM has finalized two wind energy areas (WEAs) in the Gulf of Mexico (GOM), with the potential to produce enough clean wind energy to power nearly 3 million homes.

The first WEA is located approximately 24 nautical mi. (nm) off the coast of Galveston, Texas. The area totals 508,265 acres and has the potential to power 2.1 million homes. The second WEA is located approximately 56 nm off the coast of Lake Charles, Louisiana. The area totals 174,275 acres and has the potential to power over 740,000 homes.

Fugro Chosen for Gulf Coast Mapping

NOAA has awarded Fugro two mapping projects on the U.S. Gulf Coast to monitor and quantify shoreline change in this flood-prone region. The projects, which are located in Texas and Louisiana, are underway and were awarded under an existing contract to support the agency's Coastal Mapping Program. Geo data deliverables are scheduled for the third quarter of 2023 and will be integrated into the national shoreline data set, aiding nautical chart updates, defining U.S. territorial limits and informing coastal resilience efforts.

For the Texas project, Fugro will generate high-resolution geo data depicting the land-sea interface using advanced airborne topobathymetric LiDAR and multi-spectral imaging technology. This work is being funded through the recently passed Infrastructure Investment and Jobs Act and will be used to define the coast and assess climate-related risks, such as inland flooding.

For the Louisiana project, Fugro will deliver coastal imagery to support restoration efforts following Hurricane Ida, a catastrophic storm that caused \$75 billion in damages to the area last year. **ST**

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Smart Marine Data Platform



The MDP accelerates the transformation of marine data acquired by diverse underwater sensors, including multibeam echosounders and related systems from any manufacturer, into actionable, easily shared information and insight via the cloud. It will meet immediate growth demands of the wind energy sector and prepare users for an expected boom in subsea data availability enabled by new autonomous marine survey vehicles. TrueOcean GmbH.

Compass

Unlike electronic navigation, the Helmsman Bracket Mount compass can provide a heading when stopped or moving slowly and can function if power fails. The CombiDial version adds dual red 45° lubber marks and a secondary front-facing yellow centerline. The compass is easy to read, even in the worst conditions. Ritchie Navigation.

Dark Ship Detection Solution

Near-real-time, global geolocation position validation can uncover suspicious activity and pinpoint a vessel without the need for an approximate location. The applications are critical to governments, intelligence and security agencies, and non-profit organizations' efforts to identify and locate vessels that are breaking international law. Spire Global Inc.

Watertight Integrity Tester

Coltraco Portascanner WATER-TIGHT PRO is an ultrasonic instrument to identify and quantify leak sites. It also calculates potential wa-

ter flow rates in watertight compartment cable transit areas, hatch covers, bulkheads and watertight doors on commercial ships, warships, and offshore oil and gas platforms. Saelig Company Inc.

Compact, Multifunction Gauge



VMH 35 is a black glass gauge that enables owners of single-engine boats with an NMEA 2000 backbone cable to have access to 30 types of vessel and navigation data. At less than 4-in. in diameter and waterproof to IPX7 standards, it's an ideal display solution for small consoles, dashboards and bulkheads. Veratron US Inc.

Fuel Consumption Estimator

Advanced Consumption & Emissions (ACE) API will enable charterers outside of the ZeroNorth Platform to query the ZeroNorth Fuel Model to forecast the estimated fuel consumption of an upcoming voyage and predict a vessel's profitability. Customers can input simple voyage parameters, such as origin port, destination port, IMO number and speed, for fuel consumption estimates. ZeroNorth A/S.

Wireless Marine Tank Sensor

Gobius Pro is ideal for refit or OEM use, and it is completely external. It measures from the outside of metal, plastic or fiberglass tanks. The sensor emits vibrations into the tank that its integrated accelerometer reads, then transmits data via Bluetooth to the companion mobile app. It works with all marine fluids, and the app is able to pair with up

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Oyster Aquaculture Could Improve Potomac River Estuary
Oyster aquaculture in the Potomac River estuary could result in significant improvements to water quality, according to a new NOAA and U.S. Geological Survey study published in *Aquatic Geochemistry*. All of the nitrogen currently polluting the Potomac River estuary could be removed if 40 percent of its riverbed were used for shellfish cultivation, according to the joint study. [2-3 SeaTech.com](#)

Navy's Laser Weapon Ready For Summer Deployment
Navy engineers are making final adjustments to a laser weapon prototype that will be the first of its kind to destroy a ship late this summer. The prototype, an improved version of the laser weapon system, will be installed on the USS Zumwalt (DDG 1000) in the Persian Gulf. Navy leaders have made direct-energy weapons a top priority to counter what they call asymmetric threats, including unmanned and light aircraft and small attack boats that could be used to deny U.S. forces access to certain areas. [2-3 SeaTech.com](#)

Ferry Sinks Off Coast of South Korea
With 482 passengers onboard, a ferry sailing from Incheon, South Korea, to the island Jindo sank near the southern tip of South Korea Wednesday, near the southern tip of South Korea. Most of the more than 400 people on the ship were high school students headed for a school trip to the tourist island. In the rescue effort, more than 90 vessels and at least 18 aircraft swooped in to pull passengers from the water to safety. [2-3 SeaTech.com](#)

Pay Increase for Sailors Soon to Come
Sailors serving for the U.S. Navy could see a pay raise in the coming weeks, reported the Virginia Pilot. On May 1, sailors serving aboard ships will receive a pay raise. The increase in pay comes as an effort by the Navy to incentivize thousands of unaffiliated sailors who work in jobs involving long deployments. Currently, the pay is between \$10 and \$700 a month. [2-3 SeaTech.com](#)

US Senate Reviews DOE Budget Request
For fiscal year 2015, the Department of Energy (DOE) requested \$27.8 billion. The U.S. Senate Appropriations Committee, Subcommittee on Energy and Water Development, held a hearing last week to review the funding request and discuss financial priorities. According to Lamar Alexander (R-Tenn.), research should be a focus of spending. [2-3 SeaTech.com](#)

US Technology Helps in Search for Flight 370
More than a month after Malaysia Airlines Flight 370 went missing, crews are hard at work trying to uncover what happened to the plane's black acoustic signals emitted from the flight, providing a lead to the location of the plane, and eight countries are participating in the effort to scan the waters off the coast of Northwest Australia. Crews aboard the U.S. Navy's Sea Systems Command ship Sea Technology have the U.S. Navy's help in the search. [2-3 SeaTech.com](#)

2014 Sea Technology Buyers Guide Now Available
Published annually by Compass Publications, the 2014 edition of the *Sea Technology Buyers Guide* is now available. The *Buyers Guide* features a market analysis and scores sub-directories, including industrial firms, services, federal government organizations, educational institutions, oceanographic research vessels and specialty survey vessels.

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to nine devices on board. Albin Group.

Managing Workforce Competency

An all-in-one digital evaluation solution, the Seafarer Evaluation App (SEA) enables organizations to gather all the information and evaluate the competencies of a seafarer in a single location. SEA comprises two tools: CompetenSEA to thoroughly evaluate the knowledge and competencies of seafarers and define their suitability for a particular position, and FluenSEA to evaluate the knowledge of seafarers in maritime English. OneLearn Global.

Foul-Release Coating Removal

Stripspeed removes foul-release coatings in 30 min. or less. There is no mixing required to create the thick consistency, which easily hangs on vertical and overhead surfaces. Stripspeed is nonflammable, noncaustic, DCM- and NMP-free, and doesn't create toxic dust or debris. Prospeed.

Low-Noise Hydrofoiler



P-8 Voyager can carry eight passengers. This electric hydrofoil vessel was made specifically for zero-impact tourism in sensitive waters, such as coral reefs. Flying on computer-guided underwater wings, the P-8 Voyager creates a barely discernible wake as it skims across the surface at 30 kt. It is 90 to 95% cheaper to run than combustion engine boats. Candela.

Cloud-Based Geospatial Data

Absolute Ocean (AO), a secure, easy-to-use, cloud-based geospatial solution, provides high-level visualization, analysis, collaboration and management of all marine data. This software as a service also features data from third-party vendors and is being used for projects ranging from environmental moni-

toring and construction engineering to offshore energy production and telecommunications infrastructure inspection. Terradepth Inc.

ADCP Wireless Connectivity

Wireless Integrated Suite (SWIS) - ADCP edition provides seamless wireless connectivity to a seabed-mounted ADCP integrated with the Subnero Wireless Network Communication (WNC) series of products. Users can interact with the remote ADCP through another WNC device deployed from top-side, such as from a boat, buoy or platform. Subnero Pte Ltd.

LED Light Bar

Sea Hawk-470 combines LED pencil-beam, long-distance visibility and the distinctive ambient glowing signature of Edge Light technology. New optics enhance the spotlight functionality for a powerful bright white light range of 330 m at 1 lux and a maximum luminous intensity of 113,000 candelas. Hella marine Inc.

Explosion-Proof 5G Smartphone

IS540.1 is an ATEX and IECEx Zone 1/21-approved smartphone with 5G frequency bands and Wi-Fi 6 connectivity. The chipset has powerful AI and compute capabilities that can process demanding applications without compromising power efficiency. i.safe MOBILE GmbH.

Ship Design Software

SeaTrust-HullScan V3 performs structural analysis for various types of vessels and marine structures by using finite element modeling. It enables large-capacity graphics and features various visualization functions and enhanced CAD interface. Korean Register.

Rudder Direct Trunk Support

DTS transfers the maneuvering forces from the rudder through the headbox and the steering gear deck directly into the hull structure for improved maneuvering, propulsion performance and weight savings that can save fuel and lower emissions. Kongsberg Maritime. **ST**

Innovation Endorsement for Vessel Cloud Service

ClassNK has granted its innovation endorsement for products and solutions to a cloud service called J-Marine Cloud developed by Japan Radio Co. Ltd. (JRC).

In order to promote the spread and development of innovative technologies, ClassNK has offered innovation endorsement as a swift certification service in cooperation with technological front-runners to establish appropriate evaluation criteria. Among the certification categories, products and solutions covers equipment and software technology on vessels.

J-Marine Cloud uses a common platform to collect various types of information, including meteorological, oceanographic and AIS data. Voyage data, route plans and navigational equipment status are also collected via JRC's VDR (voyage data recorder), J-Marine NeCST, and other shipboard equipment. These data can be combined to provide advanced vessel management and operational support solutions for onshore fleet managers. J-Marine Cloud's vessel services aid onboard decision-making capabilities.

New Member of Marine Battery Forum

Bureau Veritas (BV) has joined the Maritime Battery Forum (MBF), a global network aimed at supporting the development and deployment of batteries within the maritime industry.

Being part of the forum will enable BV to collaborate on the development of a standardized safety framework for onboard batteries, together with other companies and organizations from different parts of the battery value chain. Moreover, the membership will give BV the opportunity to join key partnerships, such as the Battery Safety Joint Industry Project to help accelerate the ramp up and adoption of onboard battery systems.

Batteries present unique opportunities for shipping, as the industry

explores a variety of options to support its decarbonization ambitions and ensure compliance with new emissions reduction regulations. This fast-evolving market can give shipowners a competitive advantage, enable shipyards to gain expertise, and open new markets for equipment manufacturers. However, challenges remain to be addressed on the key aspects of safety, cost, installation and battery life cycle.

BV considers batteries and hybrid electric propulsion as relevant decarbonization solutions for a number of cases in the shipping industry.

Hydrogen-Powered USV

SEA-KIT International has secured funding through round two of the Clean Maritime Demonstration Competition (CMDC) to design a hydrogen-powered, zero-emission USV.

SEA-KIT worked with clean tech disruptor Bramble Energy on a successful CMDC round one project to marinize a printed circuit board (PCB) hydrogen fuel cell.

This latest funding win will see the two companies continue their collaboration, implementing round one outputs into a proof-of-concept USV design that meets the performance, reliability and cost-saving challenges of a fast-growing, global marine autonomy market with zero carbon emissions.

The Zero Emission H-Class Ocean USV project, scheduled to start in January 2023, represents a significant step toward the commercialization of clean fuel vessel technology.

The SEA-KIT H-Class USV is a highly configurable design based on operational data and feedback from the company's established X-Class vessels. Design work will be carried out in accordance with the Lloyd's Register approval-in-principle process to ensure, as far as possible, that the resulting unmanned technology will satisfy regulatory requirements.

UK SHORE, a new division with-

in the Department for Transport, has been allocated £206 million to decarbonize the maritime sector. UK SHORE is delivering a suite of interventions throughout 2022 to 2025 aimed at accelerating the design, manufacture and operation of U.K.-made clean maritime technologies and unlocking an industry-led transition to Net Zero.

Sat Connectivity Collaboration

Viasat Inc. and Cobham Satcom are collaborating on a new, advanced satellite connectivity solution for the maritime and energy industries in preparation for the launch of Viasat's next-generation satellite constellation, ViaSat-3.

The connectivity system, which will include a portfolio of ground-breaking antenna systems from Cobham Satcom, is being meticulously designed to deliver advanced, high-speed connectivity that will leverage the immense satellite capacity expected from the ViaSat-3 constellation.

Each of the three ViaSat-3 satellites is anticipated to deliver at least 1 terabit of data per second—equal to 1,000 gigabits per second, which will provide the flexibility to offer even faster internet speeds and manage increasingly data-hungry applications.

In addition, the collaboration will include the introduction of the industry-first upgrade kit, which will enable conversion of existing Ku- and other Ka-band services to Viasat services.

Viasat and Cobham Satcom will work with Cobham Satcom's broad global distribution network to provide customers with pre-sales and after-sales support.

The companies are expanding upon a successful relationship that dates back to 2015. They have been working together since then to make rapid inroads to provide high-speed connectivity to the maritime industry.

The companies have deployed fast, reliable satellite broadband internet on hundreds of vessels with Viasat's existing Ka-band network and Cobham Satcom's advanced Ka-band SAILOR user terminal. **ST**

Delivery Support for British, French MCM

Barum & Dewar has supported the delivery of an unmanned mine countermeasures system to the British Royal Navy and French Marine Nationale with long-term client Thales.

This project saw the French and British governments, in conjunction with OCCAR (Organisation Conjointe de Coopération en Matière d'Armement) sign a joint contract for Thales to launch the production of the Maritime Mine Counter Measures (MMCM) program.

Thales approached Barum & Dewar to deliver a number of sets of antenna, cable reel and ancillary protective cases to ensure safe transport of equipment for the MMCM program.

More Damen OPVs for Pakistan

Construction of a second batch of two offshore patrol vessels (OPVs) for the Pakistan Navy has begun. Together with the keel laying of the first vessel planned for completion, the first plates of steel were cut for the construction of the second of two Damen OPV 2600 multimission patrol vessels. These will provide the Pakistan Navy with a highly effective search and rescue capability and enable it to play an important role in safeguarding international trade routes from piracy and other threats.

These ships will act as force multipliers in enhancing the Pakistan Navy's capability of safeguarding maritime frontiers and will offer more flexibility for the Regional Maritime Security Patrols in the Indian Ocean.

MST, BMT Roll Out First UK Police Patrol Craft

Marine Specialised Technology (MST) Group, alongside design partner BMT, has announced that the first Police Patrol Craft being built for the U.K. Ministry of Defence Police (MDP) and the Gibraltar Ministry of Defence Police (GDP) have been launched on to the River Mersey for trials. In the early part of the first craft's life, it will primarily be used as an educational platform for MST to provide training to the MDP Training Team. MDP trainers will then be able to provide high-level guidance and support to officers who will crew and operate each craft that enters service. The second craft is anticipated to be delivered in early 2023.

Awarded in March 2021, the police patrol craft contract is a six-year program that will see delivery of 18 state-of-the-art patrol craft to various police units around the U.K. and Gibraltar. The craft will be used to ensure protection of major Royal Navy assets, including capital ships and submarines, as well as installations in and around U.K. dockyard ports, Gibraltar Naval Base and wherever else necessary.

Preliminary Consortium Agreement for European Modular and Multirole Patrol Corvette

In July 2022, the European Commission selected the proposal submitted by the consortium led by Naviris, together with Fincantieri, Naval Group and Navantia, for

the Modular and Multirole Patrol Corvette (MMPC) call. As the next step, the consortium has agreed to build the EPC ship: a smart, innovative, affordable, sustainable, interoperable and flexible vessel designed to meet a wide range of future missions in a continuously evolving global context.

The consortium has agreed that the project will include the participation of four countries under the banner of the Permanent Structured Cooperation project (Italy, France, Spain and Greece); six countries involved in the co-funding (Italy, France, Spain, Greece, Denmark and Norway); three main European shipbuilding companies (Fincantieri, Naval Group and Navantia); and 40 companies for maritime systems and equipment from 12 EU countries.

KR Joins Naval Safety Association

Korean Register (KR) is now a member of the International Naval Safety Association (INSA). INSA members comprise 13 navies and nine classification societies. INSA has developed three naval ship codes for surface vessels, submarines and naval boats. The codes are ratified by NATO as Allied Naval Engineering Publication (ANEP). The three types of ship codes, NSC (Naval Ship Code, ANEP-77), NSubC (Naval Submarine Code, ANEP-102) and NBoatC (Naval Boat Code), are goal-based standards, applicable to surface ships, submarines and small ships (less than 24 m). Such standards allow for the swift adoption of new technologies. **ST**

Li-Ion Ocean Power



The advertisement features several images of battery products: a large yellow battery pack labeled 'Energy Storage System' with an 'API17F certified' seal; a smaller yellow battery pack labeled 'All-Electric'; a cylindrical battery labeled 'Li-Ion Batteries'; and a black battery pack labeled 'Vehicle Charger & Batteries' with a 'MILITARY STANDARD' seal. The background is a blue gradient with a large white circle containing the product images.

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offshore oil & ocean engineering

CCUS Consortium in Singapore

Air Liquide, Chevron, Keppel Infrastructure and PetroChina1 have signed a memorandum of understanding to form a consortium that will aim to evaluate and advance the development of large-scale carbon capture, utilization and sequestration (CCUS) solutions and integrated infrastructure in Singapore.

The consortium intends to research, test, and develop technological, logistical and operational solutions for CCUS in Singapore. In doing so, the consortium will look to provide industry-wide CCUS integrated infrastructure, primarily to support the energy and chemicals sector, by capturing and aggregating carbon dioxide from large industrial emitters at a centralized collection facility.

The CO₂ could then be utilized to make products such as plastics, fuels and cement, and/or transported through pipelines or ships to suitable reservoirs in the Asia Pacific region for sequestration via a process of injecting CO₂ into deep underground geologic formations for permanent and secure storage.

Fleet Cybersecurity

Uniwise Offshore, a Thailand offshore support vessel (OSV) company, is enhancing cybersecurity standards across its OSV fleet by adopting technology from Inmarsat. With reliable connectivity delivered by Inmarsat's Fleet Xpress, Fleet Secure Unified Threat Management (UTM) provides Uniwise with end-to-end functionality to protect its network from cyber attacks and intrusion via infected devices.

In the busy Gulf of Thailand, where a majority of Uniwise's OSVs operate, connectivity is a key requirement. During prolonged downtimes and when usage is high, vessels become susceptible to cyber attacks, which could impact vessel operations and result in significant business losses for both owners and charterers.

Inmarsat's end-to-end connectivity and security package for Uniwise

also includes Fleet Hotspot, which provides crew access to high-speed connectivity and is independent of the vessel's bandwidth. This ensures uninterrupted connection to high-speed, always-on, business-critical bandwidth.

Hybrid Power for DP Vessel

Subsea7 has announced that the heavy construction/flex-lay vessel *Seven Arctic* is to be equipped with a new energy-saving system that will hybridize the vessel, which currently has a total installed power of 27 MW and DP3 classification and is suitable for worldwide operations in water depths up to 3,000 m.

The contract for supplying and fitting the energy storage system has been awarded to Bakker Sliedrecht, an electrical integrator specialist in dynamic positioning (DP) vessels.

At the heart of the new energy storage system is a containerized battery room with a maximum power of 3,750 kW and 1,250 kWh of energy. The system also includes a connection for shore power.

Based on the vessel's operating profile, it's estimated that a reduction of 5,000 tons of CO₂ emissions is expected.

Fit 4 Offshore Renewables Designation in UK

Houlder has been granted Fit 4 Offshore Renewables (F4OR) status by the ORE Catapult review panel, following an extensive evaluation period.

The F4OR program is designed to support the development of an increasingly competent, capable and competitive U.K. offshore renewable energy supply chain domestically and globally.

With this new accreditation, combined with years of experience supporting the marine sector, Houlder can demonstrate that it operates the key management systems and has the core skill sets required for success in the offshore renewable energy sector.

The U.K. has increasingly ambitious renewable energy goals as it

transitions away from fossil fuels, with a target of 50 GW of operating offshore wind capacity by 2030, of which 5 GW will be floating wind.

Supporting the energy transition requires a comprehensive understanding of what drivers are influencing developers' decision making and identifying the optimal solutions for a site. This complex challenge requires fresh thinking in engineering, design and project delivery.

Winner of NOIA ESG Award

Vallourec has won the inaugural NOIA Environmental, Social & Governance (ESG) Excellence Award, which highlights those who, by their actions, design or influence, are contributing to the advancement of the ideals embodied by the NOIA ESG Principles and the NOIA Climate Change Principle.

Vallourec's ESG roadmap is a proactive approach that prioritizes measurable, third-party validated impacts and targets; communication with employees and stakeholders; building trust with communities; and teamwork and innovation.

Geotechnical Support for DenAr in Black Sea

TDI-Brooks has successfully completed a third geotechnical support project for DenAr Ocean Engineering S.A. for phase two of the TPOTC Sakarya gas field pipeline route investigation and site survey project. TDI-Brooks deployed its geotechnical tools and geotechnical operators to the ongoing project off Turkey in the Black Sea, resulting in 78 gCPTs collected in 34 to 2,168 m of water and 60 T-Bar tests in box cores (BC) acquired by DenAr.

During the first program in April 2021, TDI-Brooks acquired approximately 30 gCPTs, with its memory standard 15 cm² CPT cones.

For the second program in July 2022, TDI-Brooks mobilized its research vessel *RV Proteus* to the Black Sea for "heavy" geotechnical coring/CPT acquisition comprising several dozen 20-m jumbo piston cores (JPCs), 40-m CPT-Stingers and up to 40-m SB Shelby-tube Stinger-Samplers. **ST**

environmental monitoring

UK Plankton Study

As part of a £6.6 million Natural Environment Research Council (NERC) funding package for U.K. environmental science equipment, Plymouth Marine Laboratory (PML) has been awarded £651,000 for its Automated, in-situ Plankton Imaging and Classification System (APICS). Designed for remote deployment in the Western Channel Observatory, the marine biodiversity reference site in the western English Channel, the new system uses two state-of-the-art submersible devices: an Imaging FlowCytobot and a Plankton Imager. They will gather images of plankton at varying sizes that can then be automatically classified using machine learning software. This technique will radically improve the frequency, duration and range of plankton monitoring, which is currently carried out manually in situ.

Via renewable energy to power the equipment and the reduced reliance on research vessels, the project supports the ambition of moving toward net-zero oceanography.

The APICS system will be operational in early 2023, adding to the set of existing equipment in the Western Channel Observatory to create a unique system for studying relationships between physical, chemical and biological variables. PML scientists can study trends in plankton abundance in fine detail to improve understanding of plankton community dynamics and the relationship between plankton and marine ecosystems.

Coastal Drone Observatory

The University of North Carolina Wilmington (UNCW) will soon be the first university in the U.S. Southeast to acquire an unoccupied aerial system (UAS) observatory for coastal mapping, supported by a National Science Foundation Major Research Instrumentation Grant for nearly \$851,000. The UNCW UAS Coastal Observatory will be housed at UNCW's Center for Marine Science in the MARBIONC labs. It will

consist of three commercial, off-the-shelf drone platforms equipped with four complementary remote sensors and other instrumentation that can study the coastal ecosystem in unprecedented ways from both the air and the ground. The sensors will collect valuable visual, infrared and thermal data.

The UNCW UAS Coastal Observatory will advance these focus areas: flooding impacts on the built environment, coastal infrastructure and indicators of coastal resilience; barrier island morphology and evolution; coastal water quality; coastal vegetation dynamics, including salt-water intrusion and the emergence of ghost forests; submerged aquatic vegetation dynamics and harmful algal blooms; wildlife habitat models; and archaeological and cultural resource identification.

The observatory should be fully operational by January 2023, with publicly available data.

Historic Canoe Trek

A team of four explorers made history after completing a daring, nearly 130-mi. canoe trek across the Florida Everglades to assess human impact on the world's largest subtropical wilderness. The 2022 Willoughby Expedition team retraced a canoe journey that was first completed by explorer and scientist Hugh de Laussat Willoughby 125 years ago in 1897. Willoughby's charts helped create the first accurate maps of the region, and his water sampling provided the baseline water chemistry for the Everglades.

The explorers started at the mouth of the Harney River in the Gulf of Mexico and ended in downtown Miami for the expedition that also commemorated the 75th anniversary of Everglades National Park, a UNESCO Wetland Area of Global Importance.

The 2022 Willoughby Expedition team tracked water pollutants that Willoughby couldn't have foreseen, including microplastics, perfluoroalkyl and polyfluoroalkyl substances (PFAS), pesticides, pharmaceuti-

cals, environmental DNA (eDNA), and antibiotic-resistant genes, all of which could adversely affect plant and animal species globally. The team also documented the abundance and location of apple snails, the primary food source of the endangered Snail Kite, a bird of prey. The water samples collected by the explorers will be researched at the University of Florida.

The Source of Seismic Noise

Scientists have harnessed internet-transmitting fiber-optic cables to identify where seismic noise (microseisms, tiny vibrations of Earth) in the ocean originates. The research, published in *Geophysical Research Letters*, sent laser pulses through a commercially operated fiber-optic cable linking Valencia, Spain, to Palma on the Mediterranean island of Mallorca. The researchers then measured the small amount of light that bounced back through the cable, a technique called distributed acoustic sensing (DAS). When seismic vibrations disturbed the cable, they changed how the light returned to the source and let the researchers identify the origins of microseisms.

The researchers found that the microvibrations emanated from source regions between a few kilometers and about 10 km across, but this source region migrated within a band between 7 and 27 km from the coast, where the ocean was between 25 and 100 m deep. Where the vibrations were strongest was not always near the source of the microseisms, however. Sometimes they were strongest in areas closer to or farther from shore.

The researchers hypothesize that wave-wave interactions at the sea surface cause microseisms, and the variable nature of local winds means that wave action also shifts.

Properties of the underwater environment, e.g., depth, seafloor slope and the seismic velocity of the subsurface structure, might also influence microseisms, perhaps explaining why they were not always strongest near the source and suggesting that excitation of microseisms likely differs depending on bathymetry. **ST**

contracts

Strategic Marine, Singapore, has signed an order to build three Brevity-class crew transfer vessels (CTVs). The 27-m catamaran design forms part of Chartwell's new offshore wind support vessel range. Chartwell Marine.

Hexagon AB, Stockholm, Sweden, has announced that R-evolution, its sustainable innovation and green-tech investment subsidiary, has been awarded a contract to supply multidimensional intelligent mapping services of the Bahamas' seabed. The services are part of a larger initiative to enable the island nation to protect, restore and activate its blue carbon ecosystems to invest in climate resilience and biodiversity initiatives. Bahamas government.

Vallianz Holdings, Singapore, is accelerating the digitalization of its fleet of offshore support vessels with Fleet Xpress, a comprehensive package of connectivity services. Inmarsat.

Echandia, Stockholm, Sweden, has been chosen to supply energy storage solutions for two new electric ferries that will operate the Alslinjen and Samsølinjen routes starting in 2024. The battery systems will have a total capacity of around 7 MWh. The two new ferries are designed by OSK-ShipTech and will be built by Cemre Shipyard for delivery in 2024. Molslinjen.

Trelleborg Marine and Infrastructure, Dubai, United Arab Emirates, will provide four sets of its Super Cone Fenders (SCN), docking and mooring equipment, and ship-shore links for Thi Vai LNG Terminal in Vietnam. PetroVietnam Gas.

Safetytech Accelerator, London, U.K., will collaborate on pilot technology solutions for robotic hull cleaning and ship digitalization. Cargill.

TDI-Brooks, College Station, Texas, has been awarded a surface geo-

chemical exploration program in deepwater blocks off Colombia. The program will include acquisition and analyses of 105 piston cores in COL-1, 2, 6 and 7 in 3,700 to 4,100 m of water depth. Fieldwork is expected in the second quarter of 2023. Undisclosed. **ST**

meetings

Note: The coronavirus (COVID-19) pandemic could affect event dates. Check event websites for the latest updates.

FEBRUARY

February 1-2—Combat Systems Symposium, Arlington, Virginia. 703-836-6727, ASNEHQ@navalengineers.org or www.navalengineers.org/Symposia/TSSCSS23.

February 13-15—Geo Week, Denver, Colorado. www.geo-week.com.

February 14-16—Oceanology International Americas, San Diego, California. www.oceanologyinternationalamericas.com.

February 27-March 1—World Ocean Summit, Lisbon, Portugal. <https://events.economist.com/world-ocean-summit>.

February 28-March 2—Subsea Tieback, Galveston, Texas. www.subseatiebackforum.com/2023.

MARCH

March 12-16—US Hydro, Mobile, Alabama. www.thsoa.org/us-hydro.

March 26-28—Canadian Underwater Conference & Exhibition (CUCE), Halifax, Canada. www.cuce.ca.

March 28-30—MCE Deepwater Development, London, U.K. 713-447-8559, Sara.Wilkins@GulfEnergyInfo.com or <https://tinyurl.com/456e9yjb>.

APRIL

April 18-20—Ocean Business,

Southampton, U.K. www.oceanbusiness.com.

April 26-28—NOIA Annual Meeting, Washington, D.C. www.noia.org/event/noia-2023-annual-meeting.

MAY

May 1-4—Offshore Technology Conference, Houston, Texas. <https://2023.otcnet.org>.

May 8-10—World Utilities Congress, Abu Dhabi, United Arab Emirates. www.worldutilitiescongress.com.

May 8-11—XPONENTIAL, Denver, Colorado. meetings@auvsi.org or www.auvsi.org/events/xponential/xponential-2023.

May 9-11—UDT, Rostock, Germany. team@udt-global.com or www.udt-global.com.

May 17-19—OceanTech Expo, Zhoushan, China. www.oceantech-ap.com.

May 17-19—Subsea Technology Eastern Mediterranean, Limassol, Cyprus. www.subseatechnologyconference.com.

May 23-24—Blue Food Innovation Summit, London, U.K. www.bluefoodinnovation.com.

JUNE

June 5-8—OCEANS 2023, Limerick, Ireland. <https://limerick23.oceansconference.org>.

June 6-8—Capitol Hill Ocean Week, Washington, D.C. <https://marinesanctuary.org/chow-2023>.

June 20-22—INMARTECH, Barcelona, Spain. <https://sites.google.com/view/inmartech-2023>.

SEPTEMBER

September 11-15—London International Shipping Week, London, U.K. <https://londoninternationalshippingweek.com>. **ST**

For more industry meetings, visit sea-technology.com/meetings.

Simon Ring heads Pole Star's global regulatory technologies and PurpleTRAC systems, working with trade financing banks, commodity trading companies, maritime insurers, flag administrations and governments with sanctions and sustainability regulatory exposures in maritime trade and its supply chains. PurpleTRAC has developed to cover the full spectrum of risk intelligence in global maritime trade.



As the world of trade finance adjusts to international sanctions against Russia and intermittent lockdowns in China's ports, carbon reduction is a hot topic. Having concentrated on unplugging Russia from the global trading system following the invasion of Ukraine, international regulators will intensify focus on carbon emissions in maritime transport as part of the wider environmental and social agenda.

The European Union (EU), for example, has already embarked on the next phase of its Emissions Trading System (ETS), which was set up in 2005 and aims to include the maritime industry in the EU's primary target of 55 percent net reduction in greenhouse gas emissions by 2030. This will involve full disclosure of routes, fuels and speeds.

The EU's ETS is the world's first major carbon market, and it holds another distinction of being the biggest one. The EU ETS works on the "cap and trade" principle. A limit is set on the total amount of certain greenhouse gases that can be emitted by installations in the system. The cap lowers over time to result in a total decrease of emissions.

Emissions allowances can be bought and traded. These allowances have value because there is a limit on their total number.

After each year, an installation must surrender enough allowances to cover its emissions fully. If it

doesn't, then heavy fines are imposed. If an installation comes in under its cap, it can keep the spare allowances to cover its future needs or sell them to another installation that is short of allowances.

Trading brings flexibility that ensures emissions are cut where it costs the least to do so. A robust carbon price also promotes investment in innovative, low-carbon technologies.

Although the costs of compliance may be debated between owners and charterers, we can be certain major trade banks and commodities companies will want to distance themselves from use of shipping with inefficient engines or dirty fuel. Incentivized green trade finance is likely to become much more prevalent.

To make quick progress in line with the deadlines imposed by the EU, International Maritime Organization and COP26 as they aim for net zero, trade finance banks will need to screen every transaction for carbon emissions. In time, they will have to include environmental degradation, deforestation and child labor when evaluating each deal or application for finance or insurance.

This task is immense for banks, requiring an end-to-end view of the financial and physical supply chains in thousands of transactions. Since carbon emissions are viewed as the most urgent and the most immediately fixable item on the sustainability agenda, that is where banks are certain to concentrate. Banks will want to see that vessels are as fuel efficient and green as is reasonable and that they follow the optimum route and travel at the most efficient speed. In the near future, banks are likely to need evidence that vessels use sustainably produced methanol, hydrogen or other cleaner fuels.

To perform these checks, banks must implement solutions that in-

tegrate with the screening systems they already use, folding them into their portfolio of know-your-customer and trade-based-money-laundering detection platforms.

There are clear signs countries such as Iran, Syria and North Korea will actively seek ways around the draconian sanctions they face while the sanctions against Russia continue. It therefore makes sense for sanctions and sustainability monitoring to go together, using the same data, such as screening against public information and peer group and Paris Climate Accord rankings, along with wider risk and adverse sentiment monitoring.

Banks are also heavily scrutinized by regulators and must provide reporting data, which will ultimately make disclosure a necessity for all parties in global trade. Unfortunately, research by Pole Star found a technology gap in two of the main trade and shipping hubs in Europe: Switzerland and the U.K. This is likely the case in other areas around the world.

The shortfall in screening capabilities not only inflicts costs but also increases risk of regulatory penalties. Banks lack sufficient screening and monitoring capabilities to have full end-to-end transparency on which to base benchmarks and incentives for green trade practices. As a result, they cannot yet take full advantage of the green business opportunity. Meanwhile, shipping companies, carriers, forwarders and charterers lack technology to demonstrate compliance, so they miss out on preferential terms and a significant amount of business.

More advanced and automated screening technology should be a business and compliance priority. The high initial costs will eventually be offset by the ability to demonstrate sustainability compliance in near real time to stimulate investment. With these capabilities, carbon reduction is good business. **ST**

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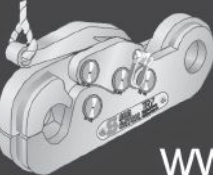
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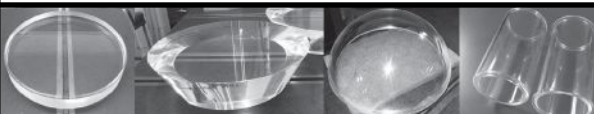
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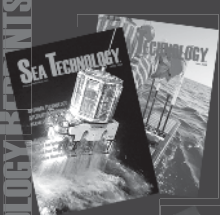
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COVER IMAGE

A ship's gun in a crevasse at the Gledstanes shipwreck site in Hawaii's Papahānaumokuākea Marine National Monument. The vessel was a British whaler that was shipwrecked in 1837. (Credit: Tane Casserley, NOAA)

NEXT MONTH

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