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ABS
IMAGE MAPPING OF SHIPPING EMISSIONS

A research study, “Global assessment of shipping emissions in 2015 on a high spatial and temporal resolution” published in the Atmospheric Environment Journal, by Johansson, Jalkanen, & Kukkonen of the Finnish Meteorological Institute, presented a comprehensive global shipping emission inventory for 2015. The emissions were evaluated using the Ship Traffic Emission Assessment Model (STEAM3). The bottom image represents the geographical distribution of SO₂ emissions from shipping in 2015. Emissions were analyzed in selected sea areas, by ship categories, ship sizes and flag states. The dispersion modelling can be used to assess the impacts of various emission abatement scenarios.

In 2013, NASA Earth Observatory created this NO₂ image map (image on right) of the earth using Ozone Monitoring Instrument OMI data from instruments aboard its Aura satellite, in which heavily used shipping lanes show up as dark colors. Just how much shipping contributes to overall NOx emissions remains an open question, however research suggests that shipping accounts for 15 to 30 percent of global NOx emissions.
The Port of Barcelona has been a hub of international trade since it was founded as the Roman colony of Barcino some 2,000 years ago, when its chief business was export of building stones and highly-prized Spanish wines. Today, Barcelona is equally famed as an intermodal center and host of international trade shows such as Gastech 2018, a premier conference focusing on the gas industry and maritime companies involved in gas transport, where over 30,000 professionals meet to share insight on the latest innovations in the fast-moving world of natural gas and LNG.

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There seems no end to the rippling effects of the unconventional oil and gas revolution, which, over the past decade, has boosted oil and gas production in the U.S. by nearly 60 percent. This hydrocarbon ocean reversed the declining energy fortunes of the United States, thwarted the geopolitical aims of some powerful leading gas producers, and reshaped the status quo in the energy sector. Over the past eight years, it has also changed the world of petrochemicals, and now has manufacturers around the globe scrambling to take advantage of what appears to be a virtually endless supply of low cost U.S. ethane.

The most important industrial use of ethane is in the production of ethylene, the basic ingredient of the world's most commonly created organic compound, polyethylene. This happens in a process called cracking (because the ethane molecules are broken, or 'cracked', to make the smaller ethylene molecules). Just 15 years ago, the price of U.S. ethane was so high that even domestic chemical giants were abandoning their American cracking plants and building all their new facilities elsewhere, to be closer to their ethane suppliers in, for example, the Middle East. The outlook was bleak as more than a dozen plants on the U.S. Gulf Coast were shut down in 2008 and 2009.

Today, a superabundance of U.S. ethane has become the cornerstone of rebirth in the American chemical processing industry. A total of about USD$185 billion is being invested in more than 300 new U.S. petrochemical projects under construction or in planning, according to the American Chemistry Council. In 2016, in fact, expenditures on chemical plants alone accounted for half of all capital investment in U.S. manufacturing, up from less than 20 percent in 2009, according to the U.S. Energy Information Administration (EIA).

Ethane is chiefly found alongside methane in natural gas and in a byproduct of crude oil refining, associated natural gas, as part of a hydrocarbon mixture called natural gas liquids (NGL). Fractionating plants separate NGL into its components, mostly ethane, propane and butanes, which are basic raw materials, or feedstocks, used in industrial processes that produce everything from shopping bags to semiconductors.

Led by shale gas, NGL production in the U.S. has nearly doubled since 2010, outpacing the rate of natural gas production growth and setting an annual production record of 37 million barrels per day (b/d) in 2017, according to the U.S. Energy Information Administration.
Administration. Expecting this production to continue apace, and buoyed by belief in the long-term low price of the resulting feedstocks, the world’s chemicals manufacturers are committing massive sums to build a chemical empire chiefly along the U.S. Gulf Coast.

In 2017, for example, Dow completed a USD$6 billion expansion in Freeport, Texas, that included new ethylene and plastics plants, and announced a further USD$4 billion investment in new plants in Michigan, Texas and Europe. Not long after, Exxon announced selection of a site near Corpus Christi, Texas, for a USD$93 billion petrochemical complex to be built jointly with Saudi Basic Industries Corporation. Planned for completion in 2021, the proposed facility would be the largest of its kind in the world, producing 18 million tonnes of ethylene per year. This is just one part of a 10-year, USD$20-billion investment that the energy giant plans for the U.S. Gulf in chemical, refining, lubricant and liquefied natural gas facilities, which, the company says, will create 12,000 permanent jobs.

Over the next two years, according to the EIA Short-Term Energy Outlook, growth in U.S. consumption of ethane by the petrochemical industry will exceed increases in consumption of all other petroleum and liquid products combined – including gasoline, distillate and jet fuel. EIA also projects that ethane exports will continue increasing, both by pipeline to Canada and by tanker to Europe, India and Asia.

This immense investment will make the U.S. a major plastics exporter and, according to the American Chemistry Council, will also add some USD$294 billion to the country’s economic output and generate 462,000 direct and indirect jobs by 2025. As a result, analysts say, net U.S. petrochemical exports, which include polyethylene as well as ethylene and products such as fertilizer, adhesives and solvents, will grow to USD$110 billion a year by 2027, up from USD$17 billion last year.

Overseas, several new European chemicals plants are being built to make use of cheap U.S. ethane as well. For example, in July, global petrochemical giant Ineos announced plans to invest more than USD$3 billion to build a world scale ethane cracker and propane dehydrogenation unit in northwest Europe to take advantage of U.S. natural gas availability. At the time, Ineos said the facility would be Europe’s first new cracker in two decades, and that both units would “benefit from U.S. shale gas economics.”

The upshot of all this activity is a robust ethane and ethylene export business for the United States. The EIA projects continued growth in average annual U.S. ethane exports, increasing from 180,000 b/d in 2017 to 290,000 b/d in 2018 and 310,000 b/d in 2019 – another remarkable occurrence, because ethane exports from the U.S. were nonexistent before 2014.

Such activity has even caused a new type of cargo ship to be developed, the Very Large Ethane carrier (VLEC). The first company to bring such vessels into existence is Indian manufacturer Reliance Industries, which took delivery of six VLECs, built to ABS class, in 2016 and 2017. These groundbreaking vessels have capacities of 87,000 m³ – more than twice that of the next-biggest ethane tankers – and will be joined in future by even larger ABS-classed VLECs having capacities of approximately 97,000 m³.

Meanwhile, numerous crackers and plastics plants have been proposed in China to capture the promise of U.S. ethane, leading to projections that a further 50 ethane carriers could be ordered over the next few years. However the speculations play out, it’s clearly no guess that the U.S. ethane revolution is only just beginning.
Unobtrusively and efficiently, shipping reaches into the furthest corners of the globe to supply the world’s populations with an uninterrupted daily flow of goods. Through the smooth operation of this vital industry, food, raw materials, products, energy and consumer goods reach them reliably, effectively and at relatively low cost. By providing improved access to basic materials, goods and products, by facilitating commerce and helping create prosperity among nations and people, shipping is helping lift millions of persons out of poverty.

The maritime industry today is central to the functioning of civilization as we know it, through the vessels of international trade, their connection through ports, inter-modal links and hinterland networks, and the projects that bring energy in from offshore. Thus, we can truly say that there is no part of our lives that has not been touched, in one way or another, by ships and shipping.

In this essential industry, the International Maritime Organization (IMO), as a specialized agency of the United Nations, has the role of being the global standard-setting authority for its safety, security and environmental performance. IMO Member States create a global regulatory framework for the shipping industry that is fair and effective, universally adopted and implemented.

A BANNER YEAR FOR ALL
This is a special year for IMO, as we celebrate two major anniversaries: 70 years since the IMO Convention was adopted and 60 years since it entered into force. Thus, our theme for 2018 – “Our Heritage: Better Shipping for a Better Future” – reflects on the past and looks to the years that lie ahead.

In 1948, only three years after the creation of the United Nations, a new spirit of global unity was in the air and the first glimpses of a new world order were on the horizon. It was gradually becoming generally accepted that a situation in which each shipping nation had its own maritime laws was counterproductive to ensuring the seamless flow of traffic and promoting safety in shipping operations worldwide. Not only were standards different around the world, but some were far higher than others. There was, therefore, an inescapable logic in favor of a framework of international standards to regulate
shipping - standards which could be adopted and accepted by all.

IMO’s mandate was originally limited to safety-related issues, but subsequently that remit expanded to embrace environmental considerations, legal matters, technical cooperation, maritime security and other issues that affect the overall efficiency of shipping. Today, 174 Member Governments drive IMO’s activities. They send their representatives, usually a mixture of policymakers and technical experts, to IMO’s highly specialized committees and sub-committees, each of which has its own well-defined agenda. They work together on issues of importance to international shipping. Other non-governmental bodies assist in this, offering their expertise. Industry as well as environmental groups and many others are thus able to participate in the process.

This is reflected in the IMO mission: “to promote safe, secure, environmentally sound, efficient and sustainable shipping through cooperation”. My vision as IMO Secretary-General is to bring all maritime stakeholders together effectively, to further enhance the efficiency and sustainability of shipping and lead the industry into the future.

I believe that this can be achieved through three main avenues: first, through collaboration among all stakeholders; second, through enhanced and improved capacity building in developing countries; and third, through education as well as appropriate and constant training of all stakeholders in the maritime community. I am convinced that by working together we can shape the future of shipping and its role in the global economy.

It is in everyone’s interest that industry actively participate in this process. Regulations adopted by IMO usually become mandatory in the form of international conventions or treaties to which Governments, both flag States and port States, become parties. As such, IMO’s work often has significant impact on the business of shipping, affecting both day-to-day operations and long-term policy decisions for the industry - particularly when regulatory developments signal the shape and profile of shipping in the future and, thereby, signal investors and technology developers about the way forward. For example, there is often more than one way to satisfy new regulations, giving vessel owners a choice between retrofitting new on-board systems or equipment, radically changing operational procedures, or, in some cases, ending a ship’s economic lifetime early to invest in a brand-new vessel.

That’s one reason why it’s so important that all sectors of the maritime world should be aware of what goes on at IMO and have input to the decision-making process - through active participation in the technical committees that make regulations both practicable and viable in the service of the safety culture.

TECHNOLOGY REINFORCES A CULTURE OF SAFETY

I have lived and worked in the maritime sector for the better part of four decades, first as a seafarer, and then in the Korean Government’s Maritime Safety Bureau. I represented the Republic of Korea at IMO and was President of the Busan Port Authority in Korea before having the honour to be elected as Secretary-General of IMO. I know personally that seafaring is one of the world’s most dangerous occupations, and safety in shipping has always been extremely important for me. Yet the unpredictability of the weather and the vast power of the sea itself are so great that, for centuries, it seemed little could be done to truly make shipping safer - that is, until the maritime industry began awakening to the concept of the safety culture in recent decades.

Given the present comprehensive regulatory framework - IMO has developed more than 50 international treaties and related standards - I believe the future will see more and more emphasis placed on technical cooperation and capacity building to enhance harmonized implementation of these instruments. Therefore, we must also work together to ensure that the regulatory framework incorporates the improvement opportunities presented by the digital revolution.

Today, technology seems poised to have a transforming impact on all our lives, and on our industry as well.
Indeed, I believe that the opportunities afforded by the radical new trends and developments of this so-called fourth industrial revolution, generally driven by innovative digital technology, are putting shipping on the brink of a new era.

It is highly likely that big data, robotics and automation will usher fundamental changes, including the possibility of fully autonomous ports and unmanned semi-autonomous ships. In response, IMO is looking into the use of Maritime Autonomous Surface Ships and the regulatory aspects of autonomous vessels, from safety, security, liability and compensation aspects. Because technological advances present challenges as well as opportunities, we need to balance the benefits with safety and security concerns – particularly cyber security – and their impacts on people and the environment.

The technologies emerging around fuel and energy use, automation and vessel management, materials and construction, and so many other areas, will lead to new generations of ships that bring step change improvements in all the areas that IMO regulates. And, in the future, we can expect the “soft” technologies of digitization and big data to be as important in the evolution of shipping as the traditional “hard” technologies have been.

THE HUMAN ELEMENT
All of this raises the bar when it comes to the human element side of shipping, both onboard the ship and for shipping operators.

The Standards of Training, Certification and Watchkeeping (STCW) Convention enshrines standards for seafarer training, certification and watchkeeping, recognizing that seafarers are ultimately responsible for implementing many of IMO’s measures. The challenge is to ensure these standards remain relevant. The modern ship’s officer, in a highly technical workplace, needs to be far more than a navigator or an engineer, and may need management and communication skills, IT knowledge, and the ability to handle budgets. This places special demands on maritime education and training, which must be of high and consistent quality, throughout the world. Maritime education and training needs to be skills-based, competence-based and to utilize the latest technology, such as simulators reflecting modern ships and up-to-date bridge layouts.

Alongside this, concern for seafarers’ welfare, both as employees and as individuals, is going to persist as evidenced in IMO’s ongoing work on issues such as fatigue, fair treatment and liability and compensation for seafarers.

The human element of shipping also includes ship operators. The mandatory International Safety Management (ISM) Code was adopted back in 1994, requiring a safety management system to be established and policies adopted, including the relevant shore-side support. But the evolving nature of shipping makes it ever more important that safety management remains a fundamental function of the ship company, taking into account new issues – such as ensuring that cyber risks are appropriately addressed in existing safety management systems.

LINKS WITH CLASSIFICATION SOCIETIES
As shipping evolves, the link between IMO and the classification societies is as important as it ever has been. Many different non-governmental organizations have consultative status at IMO, ensuring all interests are represented. But the relationship IMO shares with the International Association of Classification Societies (IACS) is unique, underscored as it is by the Code for
Recognized Organizations which sets the standards for organizations to carry out statutory certification and other services on behalf of IMO member States.

Most importantly, IACS has supported the development of goal-based construction standards for bulk carriers and oil tankers (which entered into force in 2012). IMO’s Maritime Safety Committee has reviewed goal-based standards verification audit reports on the 12 IACS members and confirmed that their construction rules were in conformity with the goals and functional requirements set out in the International Goal-Based Ship Construction Standards for Bulk Carriers and Oil Tankers. This marked a significant step in the IMO rule-making process, bringing a much closer alignment between the classification societies’ rules and the IMO regulatory process.

It is highly important that we work actively to maintain and reinforce the links with the classification societies, with IACS providing ongoing technical expertise, including on technology and sustainability.

A GLOBAL GOAL

I firmly believe that technology holds the key to a safer and more sustainable future for shipping. I do not expect that one single breakthrough will solve all our problems at once, but, instead, that we will see real progress through the collective effect of small gains in many different areas.

One area of focus involves the role of data in our work and in our decision-making processes. For example, we need to have more detailed and deeper analysis of statistics and data so that we can truly understand underlying trends and causal factors behind shipping casualties, and we must make sure additions and amendments to the regulatory framework are also based, wherever possible, on relevant statistics, studies and analysis.

That said, technology is but one part of a much larger whole, one often wrapped in the term “sustainability.”

As the most cost-effective and fuel-efficient way to carry goods, shipping forms the backbone of world trade and is, therefore, an essential component of all future sustainable economic growth. This means that shipping itself must be sustainable – a goal that, in turn, calls for shipping’s activities to be balanced with the oceans’ capacity to remain healthy and diverse in the long term.

Sustainability is, by nature, a forward-looking concept. The broad challenge we all face is how to ensure that future growth can be achieved sustainably - and that globalization becomes a positive force for all the world’s people.

As part of the United Nations family, IMO is actively working towards the 2030 Agenda for Sustainable Development and the 17 Sustainable Development Goals, or SDGs, which were agreed and adopted by the nations of the world in 2015. They are, without doubt, some of the most far-sighted and important set of goals that mankind has ever conceived, setting out clear targets to end poverty and discrimination, protect the planet and ensure prosperity for all.

Most elements of that Agenda will only be realized with a sustainable transport sector supporting world trade and the global economy. Maritime activity can both drive and support a healthy economy, which
is why investment, growth and improvement in the shipping and port sectors are so important - all together, they facilitate global commerce and the creation of wealth and prosperity among nations and peoples, generating a wide variety of jobs onboard and ashore and other beneficial impacts, both direct and indirect, on the livelihoods of others.

It bears repeating that the maritime industry’s critical role in the working of the world means that shipping needs to secure its own sustainability, both financially and environmentally. Very significant progress is being made towards this goal, as demonstrated in April this year, when IMO adopted an Initial Strategy for reducing greenhouse gas (GHG) emissions from international shipping.

I cannot stress strongly enough how significant this is. For the first time, there is a clear policy commitment to a complete phase-out of GHG emissions from ships, a specific linkage to the Paris Agreement and a series of clear levels of ambition – including at least a 50 percent cut in emissions from the sector by 2050.

The strategy includes a series of candidate measures that might be applied to achieve these targets in the short, medium and long terms. Now begins the detailed work of agreeing which of these, or perhaps others, will actually be adopted. To have this overall framework within which the technical discussions can now take place is a truly historic breakthrough.

Another key IMO measure helping shipping to secure its environmental sustainability is the forthcoming reduction in the global upper limit of permissible sulfur content in ships’ fuel oil, from the 3.5 percent limit currently in place to 0.50 percent. This is a landmark decision for both the environment and for human health, often referred to in the industry and the media as “IMO 2020” in recognition of its implementation date of 1 January 2020.

That date will not be changed. The deadline is approaching, and the important thing now is to ensure consistent implementation of the requirement. IMO is currently developing implementation guidelines which will look at a range of issues including the impact on fuel and machinery systems resulting from new fuel blends or fuel types – including the safety aspects – and issues surrounding mechanisms for verification and control.

BUILDING THE FUTURE, TOGETHER

In practically every aspect of life today we encounter radical new models for the way we live, usually driven by innovative digital technologies or artificial intelligence. Our challenge is to ensure that the benefits offered by these emerging technologies can be fully realized without compromising safety, security or environmental protection. If shipping needs to be more nimble and more adaptive in the future, then so, too, must IMO. In this way, we can continue to help shipping make its contribution towards global sustainable development.

For that goal to be reached, the world’s people ultimately need a viable shipping industry. Their own prosperity and well-being depend on it. So, when IMO regulates on issues such as how ships are designed and built, emissions reduction, cleaner fuel use, ballast water management, container safety and so on, the overarching objective is to ensure that the people of the world can continue to enjoy the benefits of this important industry on which they rely – and to do so in a manner that meets modern expectations about safety and environmental protection.

I get a strong sense that shipowners, by and large, understand all this and are supportive. What is most important is that the trend, over time, is for IMO, its Member States and the industry to walk together and work together on the journey towards our shared goals of safety and sustainability. That is my hope, and I do believe that’s exactly what we are doing today.
NEW CONNECTIONS FOR FSRUS

Viewed with great skepticism by the energy establishment when it was first revealed to the public some 15 years ago, the floating storage and regasification unit (FSRU) is now a darling concept recognized by many as the latest big promise in the ever-expanding world of natural gas.

The FSRU was originally conceived as part of a new gas supply infrastructure for the United States, in the days at the turn of the century when the world’s great minds ‘knew’ that the United States would become a leading LNG importer. Today, FSRUs are widely regarded as economically attractive alternatives to land-based LNG terminals, with shipowners, gas importers and energy companies viewing the vessels as a profitable means of accessing the gas revolution.

Proof of this newfound popularity is seen in the rapid expansion of the global FSRU fleet. The world’s first FSRU was delivered in 2005. Over the past 13 years, the number of FSRUs has grown from 1 to 29 in service, and there were at least another 13 on order as this issue went to press – remarkable growth, considering the commitment they require. It can take three years to build a new (and about 18 months to retrofit) an old LNG tanker to FSRU service. Once unsure of their future, industry analysts, now predict that around 50 FSRUs will be in operation around the world by 2025.

Among the compelling facts making the business case for FSRUs is that a new FSRU costs about half the price of an equivalent land-based terminal and can be fully operational in half the time. Being mobile, a unit can plug into a gas pipeline network or shoreside power plant for as long or short a time as needed.

In Kuwait, for example, an FSRU is employed only in summer to provide peak-shaving gas supplies, while in Turkey a unit to be built to ABS class for oil and gas pipeline operator BOTAŞ is expected to be plugged into the pipeline for on the order of 25 years.

FSRUs can be built with onboard power generation facilities, and deliver electricity directly to remote regions and areas left powerless after natural disasters. In 2017, ABS granted approval-in-principal to Japanese firm Chiyoda for this concept, by which an existing LNG carrier can be converted to an FSRU power plant. “Basing this concept on existing LNG carriers, we can reduce constructions costs and shorten delivery times,” a Chiyoda spokesman said at the time. “We look forward to developing this concept further and expanding the LNG value chain to new markets.”

Of course, FSRUs are not a “magic bullet” solution. However, in terms of capital expenditure, project timeline and flexibility, FSRUs offer a clear advantage, a fact recognized by the increasing number of vessel operators ordering them.

For Patrick Janssens, an FSRU pioneer in charge of building the world’s first newbuild FSRU for Exmar, this day could not have come soon enough. Today, Janssens is Vice President of Global Gas Solutions for ABS, and as much an advocate as ever of the revolutionary concept he helped realize.

“Today there’s an ongoing quest in the energy sector to see how quickly it can develop new markets for natural gas, and determine what business models work best with these emerging markets,” Janssens says. “The case is especially strong for FSRUs when you’re dealing with companies that don’t have the available capital that can back big projects. FSRUs have started filling that market gap – and people around the world are starting to realize that the model works. Back in 2005, energy majors were very skeptical about the concept, but now consider FSRUs the key to accessing new markets economically and quickly,” he adds.
technologies and practices regarding handling of LNG as cargo and its use as a marine fuel are as well-established as one could ask for: LNG tankers have been crossing the oceans in perfect safety for nearly 60 years and using LNG as a marine fuel for more than half a century. For reasons unknown, LNG carriers (LNGCs) get left out of much of the public discourse on the matter. But, precisely in that fleet, the engines and supporting systems that make LNG a viable marine fuel, have been developed and proven.

As this issue goes to press, there are 621 LNG-fuel ships in service. Of these, 485 are oceangoing LNGCs, 212 of which rely on dual-fuel diesel propulsion – 176 diesel-electrics and 36 two-stroke low-speed engines. Of the 116 carriers on order, 39 use diesel-electrics and 66 rely on low-speed two-strokes. The millions of service hours accumulated by these engines were steered away from traditional heavy fuel oils (HFO) into cleaner alternatives, by the coming global sulfur cap and the entire IMO 2020 mandate, the maritime industry is spurring the rapid growth and development of an LNG-powered fleet and the bunkering infrastructure to support it. As one might expect, the transition to LNG as a marine fuel is bringing some revolutionary challenges to the industry, but, unlike many other technological upheavals, this one is more a matter of mindset than machinery.

Beyond the economics of it all, integrating LNG into the fleet will bring many shipowners a challenge in education and training – to educate themselves about this special fuel and train their crews in its proper use and handling onboard. The consolation in the challenge is that this is a well-traveled road and guidance for the journey is readily available. The GOING GLOBAL WITH THE FUEL OF THE FUTURE

One of BC Ferries’ ABS-classed LNG-fueled ferries.
should be enough to ease any concerns about the technology of the revolution.

At the same time, although LNG bunkering operations are new, as such, they are in no way a greenfield technology. For example, the 30 floating storage and regasification units (FSRUs) that have been in service for a decade provide an ample pool of experience that can be directly applied to onboard fuel handling and bunkering operations.

Altogether, the decades of knowledge, experience and safe practice accumulated on LNG tankers and floating gas plants, concentrated in the educational and training materials produced by SIGTTO (The Society of International Gas Terminal and Tanker Operators) and now by its independent spin-off the SGMF (Society for Gas as a Marine Fuel), attest to this lengthy past and provide ample guidance for its future use.

INROADS TO TOMORROW

Of course, in the new world of LNG-as-fuel, most owners will not be entering the LNGC market, but rather transforming their own sectors. This part of the revolution started slowly and with very small vessels, because, even if the technology does not need to be proven, logistics and viability of business models do. Further, experiments are easy to control when vessels in question are sailing short routes, and project subsidies often available when they are working for the public (such as ferries). Thus, 73 percent of the 136 vessels in the existing LNG-fueled, non-LNGC fleet are young, small, under 10,000 GT, and in local or regional service. Few are like the two 3,800-vehicle pure car and truck carriers (PCTCs) in short-sea service within the European ECA. Now the LNG-as-fuel revolution is beginning to change that profile, and of the 181 non-LNGCs presently on order some 57 percent are deep-sea cargo ships over 10,000 GT.

Signs of this accelerating change appeared in a survey conducted after the 2016 SMM exhibition, in which German trade fair organizer Hamburg Messe und Congress sought to “assess the mood of the maritime industry” via the opinions of some 2,500 show participants. The results reflected the usual cautious optimism, but also included welcome news for proponents of LNG as a marine fuel: 44 percent of respondents cited LNG-fueled propulsion systems as their first choice for newbuild orders – anecdotal, perhaps, but nonetheless in line with a firmly emerging reality.

Over the past year, several leading cruise operators announced construction plans for nearly 20 LNG-powered vessels, with scheduled delivery dates between 2019 and 2026. Most will be built in Europe, and the first is presently under construction at Germany’s Meyer Werft shipyard. In Asia, Toyota announced last September that the three shipowning companies operating its car carriers would, over the next “several years,” order close to 20 LNG-fueled PCTCs, each having capacity for 7,000 vehicles. The building project will replace a third of the fleet that services the automotive giant and will require an investment estimated to be roughly 200 billion yen (USD$1.83 billion). Two months after that announcement, container shipping leader CMA/CGM let it be known it would build nine LNG-fueled 22,000-teu containerships scheduled for delivery beginning in 2020, an order worth some USD$14 billion. All together, the projects mentioned in this paragraph have a value easily exceeding USD$12 billion.

Then, in April this year, Arista Shipping signed a letter of intent to build 20 vessels to its innovative Project Forward design, an 84,000-dwt LNG-powered dry bulk carrier. On the smaller end of the bulk carrier sector, Algoship, the longtime designer for GTR Campbell marine consultants, received approval-in-principle in 2014 for an LNG-fueled handysize bulk carrier. These designers hope their concepts, which can be applied to wet or dry trades, can revolutionize the bulk sector.

Whether any of the ships of the future mentioned above will revolutionize their individual sectors remains to be seen, but as a collective force they do appear to be pushing LNG as a marine fuel to its long-awaited place on the world stage.

“We’ve seen profound changes in infrastructure and availability of LNG as fuel in the last few years.
“Previously, LNG was used as fuel in specific regions, usually tied very closely to the European SECA or the North American ECA, generally on short routes routinely within those small corridors; now it is definitely entering the global arena,” Hatley says. “It’s a watershed event for the industry and a profound step forward for the world. We have long seen LNG as an available, affordable, clean and safe marine fuel, and now the infrastructure to use it has evolved.”

As that infrastructure expands, so does interest in the green fuel spread throughout the maritime sector. Other announced projects intending to use LNG as fuel include ore carriers, aframax tankers, DP-2 shuttle tankers and a semisubmersible crane vessel.

The cumulative capital being committed to this alternative fuel is extremely encouraging for proponents like Hatley, who also is a founding member of SEA/LNG, an LNG-as-fuel advocacy group, and a Board member of Puget LNG, a small-scale liquefaction plant including a waterside pier for LNG bunkering that is under construction in Tacoma, Washington.

“The recent orders - all of which have happened in a very short time frame – probably total more than USD$12 billion in commitments to LNG fuel,” he says. “That reflects that the entire shore-based infrastructure is moving forward as well, from...
trucking, which is a great first step, to bunkering vessels, which is the next, greater-volume step.”

Right now, most ships fuel up on LNG dockside at terminals or at jetties from tank trucks. As LNG-fueled vessels increase in number, demand is rising for ship-to-ship LNG bunkering services. This new activity is growing so rapidly that its vessels already have their own unwieldy acronym – LNGBV (for LNG bunkering vessel). There was one LNGBV in service at the start of 2017, by May this year the number of bunkering vessels grew to six, and nine more were on order. Altogether, it is an encouraging situation for the early adopters ushering LNG fuel into the cargo-carrying sectors.

“Based on increasingly stricter regulations regarding emissions control in shipping and, therefore, the resulting technical investigations, developments and innovations, it becomes an obligation to establish new technologies that will replace HFO in the shipping industry,” says Fritz Daniel, a longtime proponent of green technologies and LNG as a marine fuel who currently is Project Manager for Hamburg, Germany-based Green Tanker International GmbH. The company is presently planning to build four LNG-fueled chemical tankers to ABS class. “For many years already, projects using LNG as fuel (power stations, ferries, LNG carriers and others) show very clearly its advantages for reducing harmful emissions components, as well as bringing positive effects to the environment and benefits for ship owners and charterers,” he says.

“LNG propulsion and power generation onboard requires special training of the crew, but, as this training is offered by many parties, from manufacturers to classification societies, I expect that crews on ‘non-heavy-fuel’ vessels will soon be able to handle LNG technology without problem. Another benefit for crew and owner is that LNG operation will reduce expenditures on maintenance – periods between overhauls can be extended, there will be fewer off-hire situations and, consequently, less costs for service and spare parts,” Daniel explains. “And, of course, nobody will miss the daily challenge of HFO handling – heating, treatment, operations, waste handling and so on,” he adds.

BUILDING FUEL SECURITY

At this stage, fuel security is still a critical piece of any newbuilding plans for LNG-fueled ships. That’s why all the groundbreaking shipbuilding programs mentioned above are attached to long-term fuel supply agreements with major energy companies. For example, Total signed a contract to deliver bunkers to the CGA/CMA vessels for ten years beginning in 2020, while Shell has signed on for long-term bunkering of the Project Forward ships. To ease the pressure for such agreements elsewhere in the industry, several governments have made significant moves to back the evolution of an LNG-fueled fleet and position themselves as future suppliers.

TOTE Maritime put the world’s first LNG-fueled container carriers at sea. The ABS-classed ISLA BELLA ro/ro, seen here, is one of them.
For example, the German Federal Ministry of Transport now provides subsidies for building or retrofitting ocean-going vessels to burn LNG, and the European Union has implemented a policy requiring each Member State to have marine LNG bunkering facilities in coastal ports by 2020 and throughout the inland system by 2025. In France, soon after the CMA/CGM announcement, Prime Minister Edouard Philippe declared that his Government would modify regulations to support LNG bunkering in ports and consider changing tax rules to provide incentives on investments in new ships and alternative fuel technologies such as LNG. “We have to use this (energy) transition to differentiate ourselves on the market – in transport and in port services,” Edouard told the press.

And in Asia, the Maritime and Port Authority of Singapore (MPA) commenced its LNG bunkering pilot project, which provides various companies grants of up to USD$2 million per LNG-powered vessel constructed. So far, about USD$24 million has been committed to this funding. At the same time, the Yokohama-Kawasaki International Port and the city of Yokohama initiated an ambitious program intended to make the Port of Yokohama an international LNG bunkering station for ships traveling between Asia and North America, making an initial investment of some 6 billion yen (roughly USD$54 million) in the plan by about 2020.

North America, which currently vies with Europe and Asia in LNG bunkering, has numerous plans in various stages for new facilities to join those already operating in Florida, the U.S. Gulf of Mexico and on the northwest coast in Vancouver. Looking forward, the ports of Los Angeles and Long Beach in California reported being in discussion with fuel suppliers and bunkering companies to provide the infrastructure for marine LNG demand. That revelation was made in the final version of the San Pedro Bay Ports Clean Air Action Plan for 2017, which recognizes marine LNG fuel as a promising method for reducing ship emissions and bringing the ports closer towards their zero-emissions goal.

“A key consideration is the availability of LNG fuel for bunkering, which is not currently offered in San Pedro Bay,” the report says, and notes the “the ports will continue to discuss interest in LNG fuel with the shipping lines to gauge potential demand for future bunkering capabilities.”

**A CLASH OF HOPE AND CLARITY**

LNG trade has nearly tripled since the turn of the century, from roughly 100 million tonnes per year (mt/y) in 2000 to 293 mt/y by the beginning of 2018. That figure is expected to reach 340 mt/y by year’s end, and a further 30 mt/y is promised by commitments made last year. Nearly all the current LNG output goes for power generation, a demand that shows no signs of slowing. This demand gives some fuel analysts cause for concern.

According to Shell’s 2018 LNG Outlook, overall LNG demand grew by 11 percent in 2017, and is expected to grow at a rate of 4 percent per year, but “final investment decisions on LNG projects have nearly stopped.” Based on current demand projections, Shell sees potential for a supply shortage developing in the mid-2020s unless new LNG production commitments are made soon. “As LNG projects generally take more than four years to start production, new supply will not be ready until well into the next decade,” the report says.

This makes some industry analysts foresee pricing and availability issues arising for LNG fuel by the middle of the next decade, as the bunkering needs of a growing LNG-fueled fleet clash with the fuel needs of power generation plants. Others, however, see symbiosis in today’s relationship between growing demand and new production, and expect the two will be able to trend upwards in harmony and provide long-term market stability.

The lack of clarity on future availability and pricing of LNG as marine fuel is echoed in the traditional fuels market, which itself is preparing for immense change in 2020.
Shipowners, meanwhile, must choose a way of meeting the emissions demands of the IMO 2020 regulations – they are, essentially, being asked to bet on tomorrow under an umbrella of uncertainty. This uncertainty is among the drivers pushing gas as a preferred fuel and the advocacy around it, says Hatley.

“Vessel owners are in a completely new situation regarding fuel,” he says. “For decades they had one choice: burn residual fuels. It was simply a matter of finding the lowest-cost fuel oil and using the necessary technology to keep the engines running properly. Now, however, they are faced with a wide choice of fuel-related decisions: do I go with a scrubber? do I burn blended fuels? do I use higher-cost compliant distillate? or do I go for LNG as fuel?” he points out. “It comes down to a commodity play on fuel energy costs where they are seeking competitive advantage, something they didn’t have to face for decades, if ever.”

For many ships, more than half the operating costs go to fuel, which means that every fuel option involves a potential risk to the shipowner’s bottom line – for small fleets particularly, a bad play on 2020 fuel choice might put the entire enterprise at risk. On top of this, the tortuous path of the ballast water management journey only exacerbates industry anxieties about making expensive commitments to technologies that are tied to ambitious environmental regulations.

“Certainty breeds investment, but uncertainty creates pause,” Hatley says. “The swirling uncertainties over fuel today have made many owners, possibly the vast majority, decide to wait and see before committing capital to any single choice,” he observes. “Some owners have told me they ‘prefer to sip champagne rather than drink it,’ meaning they will use expensive distillates and slow-steam their vessels for fuel economy, some say they are planning to use HFO and scrubbers, and others are going with LNG. But a great many are just waiting to see what happens, and, in this financially challenging time, with very low charter rates, tenuous cash flows and high uncertainty, perhaps waiting is really all they can do for now.”

Asked for advice to owners stuck in a wait-and-see mode due to the swirling uncertainties surrounding IMO 2020 implementation, Green Tanker’s Daniel says “The only advice from my point of view is this: Don’t think about temporary solutions to continue with HFO operation, where it is feasible. Actual and upcoming restrictions for HFO operation are not the end. Others will follow. LNG as fuel remains the solution for the present and near future, but it is not the only and final solution – other existing technologies, for example batteries and fuel cells, will play bigger roles in the future.”
THE FUTURE OF LNG-POWERED VESSELS

The Forward-84 LNG-fueled kamsarmax bulk carrier design from Arista Shipping achieves a very impressive coup: gaining cargo capacity, rather than losing it, using Liquefied Natural Gas (LNG) as fuel. The foundation of this achievement is a novel engine room in which twin medium-speed dual-fuel diesel engines do all the work, providing propulsion and driving shaft generators that handle all electrical power needs. The space saved by eliminating gensets and other standard equipment gave the design team sufficient flexibility to stretch the capabilities of the kamsarmax hull envelope and bring into being a revolutionary vessel.

Driving their design spiral was the desire to lose no cargo space in developing it for LNG fuel. They needed the vessel to have fuel reserves to cover 40 days full-speed at sea, a period that would exceed the needs of the company’s typical longest-haul voyages. This meant an onboard storage capacity of 2,500 m³ of LNG. Such a volume renders conventional cylindrical storage tanks impractical in terms of space requirements, so Arista chose membrane system tanks because that type can be tailored to fit available space. After much experimentation, the designers found they could meet their goal by elongating the vessel slightly and placing a vertical fuel tank between two cargo holds amidships – an elegant solution, but not without its consequences.

Extending the vessel length introduced frictional losses that reduced the hydrodynamic efficiency of the hull – a big strike against satisfying IMO’s 2025 EEDI mandate. To remediate this, ABS worked with Deltamarin on extensive hull refinement through computational fluid dynamics simulations and developed extreme optimizations that recovered all frictional losses. At the end of the day, the machinery reduction, vertical LNG tank and ultra-optimized hull envelope gave the designers opportunity to increase the vessel’s cargo capacity from 82,000 dwt in the base design to 83,500 dwt in the final one.

Antonis Trakakis, Technical Manager of Arista Shipping, discussed the development of this groundbreaking design, and one very important expectation regarding its impact.

The Forward-84 “is a real, competitive, commercial vessel for global trade, not a ‘demonstration platform’ or a special vessel limited to regional voyages,” he said. “We have reduced costs, reduced emissions and satisfied all regulations in a way that makes transportation less expensive for the charterer and for the buyer, all in one – in other words, sustainability. We developed not only a new ship, but also a model for sustainable shipping. That for me is the most important outcome of the project,” he said.

Perhaps the last big piece of the puzzle for LNG to truly “go global” as a marine fuel is for it to penetrate the handysize sector, which in numbers constitutes the bulk of the world fleet over 500 GT. Given that many subsectors of the maritime industry have already seen commitments on their first LNG-fueled vessel designs, it is likely when conditions permit, the handysize sector will join in and send LNG-fueled ships into tramp service. Anticipating that requirement, Algoship, the design arm of the venerable GTR Campbell marine consultants company, took approval-in-principle (AIP) from ABS on an LNG-fueled handysize bulk carrier design named Seatransporter-LNG in December 2014. The design is the dual fuel version (LNG and MGO) of the company’s successful Seatransporter series of bulk carriers.

According to Algoship, the proposed vessel meets IMO 2020 requirements without sacrificing cargo capacity, is fully scalable...
to various vessel sizes, can be applied to wet or dry cargo carriers, and meets the IGF code, SIGTTO, and ISO requirements. The Seatransporter-LNG design is an IACS CSR-compliant 38,000-dwt multipurpose cargo vessel intended for unrestricted worldwide service, equipped with a 2,400-m³ LNG fuel tank that will, the designer reports, allow for approximately 100 days of travel. The vessel can carry out a trans-Atlantic return voyage without refueling.

The basic Seatransporter-LNG is conceived as a log-fitted, self-trimming double-hull fuel-efficient bulk carrier with a design speed of 14 knots, driven by a single fixed-pitch propeller and powered by a slow-speed dual-fuel MAN engine. The design allows for interchangeability of fuel (from LNG to MGO and vice versa) without loss of power.

Algoships worked very closely with major fuel suppliers and with LNG containment system manufacturers during the design, developing both Type-C and membrane LNG containment systems, which can be used as operational profile and available fuel temperature require. The design progressed in parallel with the development of the draft IGF code, which gave the designer opportunity to actively contribute to the Code’s development.

HAZID studies for the design were conducted at Bonn, Germany with the involvement of the LNG containment system manufacturers, ABS, and a prospective owner-operator. The entire fuel management system was studied in detail from the perspective of inherent safety in fuel handling and bunkering, hazardous zoning and ventilation, and fail-safe boil-off gas (BOG) management including emergency shutdown, efficient fuel usage, optimal flexibility and redundancy of critical equipment.

A simulation tool named “LNG fuel manager” was developed to predict the behavior of LNG and BOG in the tank throughout the 100-day voyage, considering the usage patterns of the LNG and BOG consumers onboard. The tool helps monitor the variation of pressure and temperature inside the tank, LNG composition variation, LNG density and fuel quality in terms of the methane number throughout the simulated voyage, and its smart features engage and disengage cryo-coolers, depending on preset operational parameters. The LNG fuel manager can also simulate a deadship condition, with all LNG and BOG consumers gone silent – a very useful feature in discussions with statutory bodies, as it can demonstrate the design has sufficient flexibility for pressure buildup and a controlled venting-off, if required.

Algoship carried out detailed finite element analyses to verify the strength and vibration aspects of the design and used a statistical energy approach to predict the noise levels with an accuracy of ±3 dB. According to the company, the design is in a very advanced stage and production documentation can be extracted within a short timeframe.

A pressure pulse map made during vibration analysis
For the first time in history, maritime companies find themselves open to “impersonal” attacks that are, essentially, digital “crimes of opportunity” perpetrated by strangers who never knew them before the moment of the invasion. The unsettling truth of our new digital reality is that the security of the citadel is only as good as the security of its farthest-flung outpost, because in the cyber world everything is, or can be, connected, and those assets or systems that aren’t connected are often touched by things that are.

Thus, it was for Maersk, for example, which, although the victim of a huge cyber attack, was not actually targeted by the villains; neither were the three major ports and numerous associated businesses damaged as a result of the assault. That attack came through malware that originally infiltrated an accounting program in another country and, over time and through several hands, migrated into the Maersk organization as well as other large corporations. For an industry that is still “digitizing”, or coming to terms with the benefits, risks and realities of digital systems, safety in this new environment requires strange new thinking and a new kind of vigilance.

“Vigilance: the price of safety at sea” announced an old poster that once was commonly seen in merchant ship hallways. In the digital milieu, just as at sea, vigilance is the root of safety; the difference in the cyber world is that we are “onboard” at all times, and vigilance, therefore, must be maintained in all aspects of life. The level of commitment this requires can only be maintained when organizations (and the people within them) are aware of the seriousness of the threat and the extent of their vulnerabilities to it.

“The concepts of cyber-security and cyber risk management are new to many in the shipping industry,” says Laura Sherman, Operations Technology Officer for International Registries, Inc (IRI), the company that provides administrative and technical support to the Republic of the Marshall Islands (RMI) Maritime and Corporate Registries. “The term ‘cyber’ has a mystical quality to it since it is still a new and strange concept for much of the maritime industry, and the industry must evolve along with its new technologies and innovations,” she says. “The first step toward change is awareness.”

Raising awareness was the main point behind a live hacking demonstration that took place in Bremen, Germany earlier this year. Entitled “Crime Scene Ship”, the event was sponsored by the Maritime Cluster of North Germany (MCN), and featured live vessel infiltrations staged by Carsten Cordes, a White Hat hacker and security consultant for HEC, a Bremen-based IT development firm. The attacks were made through two of the most common avenues: an e-mail containing a malicious attachment that was sent out to a vessel’s crew, and a hack into a crew member’s mobile phone.

Cordes says one of the most illuminating lessons he learned from the demonstration was that there is almost no standardization in the maritime industry regarding cyber security. “Each harbor has its own regulations, and many are very dangerous from a security perspective – for example, Port Authorities sending Excel sheets with macros to vessels,” he says. “To solve such problems, the industry has to work together and take care of them as a whole. In my opinion, associations like the MCN provide good ways of cooperation in doing so.”

Laura Sherman, Operations Technology Officer, IRI
Systemic vulnerabilities, such as lack of standardized procedural protections, raise the question of whether the maritime industry is giving cyber security attention and resource commitment commensurate with the threat.

“In my opinion, cyber security is becoming a serious concern in all industries, and maritime is no exception,” Cordes says. “The maritime industry is paying at least some attention to the topic, but this attention is often superficial and lacks commitment in the long run. Often, companies are only interested in easy ways to fight cyber security threats, such as buying a new, ‘better’, expensive firewall instead of researching and taking care of their individual problems, which might be a lot cheaper to solve and provide sustained results,” he says.

Cyber security has been on the radar at IRI for several years, not only because it has the responsibility of managing the world’s second largest ship registry, but also because the organization experienced the dangers of the digital world first-hand.

“We had a hacking incident some years ago,” recalls Bill Gallagher, President of IRI. “We were able to recover fairly quickly, but the incident served to wake us up as to how vulnerable we actually were to cyber attack. In recovering from the attack, we spent a lot of money and resources on developing robust protections for our computer systems, that is, for the Marshall Islands registry,” he says.

“Sometimes you can take positives from your negatives,” Gallagher adds. “For us, the negative was that we got attacked; the positive was that we didn’t have much damage done and we learned our lesson, and really buttoned up our side of the fence.”

One of the ongoing efforts at the IMO is to forge a link between cyber security and the ISM Code – particularly with the Safety Management System onboard – and with port security as addressed in the ISPS Code. The first fruits of that effort were delivered in IMO Resolution MSC.428(98), adopted 16 June 2017, which encourages “Administrations to ensure that cyber risks are appropriately addressed in safety management
systems no later than the first annual verification of the company’s Document of Compliance after 1 January 2021.” In April this year, the RMI Maritime Administrator published a Marine Guideline to assist companies in developing cyber risk management (CRM) programs.

THE HUMAN AND NONHUMAN ELEMENTS
“The IMO and RMI regulatory requirements for cyber security do not take effect until 2021, but we urge companies to perform a cyber risk assessment and implement a strategy without delay,” Sherman says. “Studies suggest that 80 percent of all cyber-related incidents on vessels occur due to insufficient seafarer training and a lack of awareness of basic cyber risks. In other words, an educated, cyber-aware crew is by far the most cost-efficient and effective CRM strategy – awareness training is an extremely valuable risk management tool,” she says.

“If you think cyber security is just an IT issue, you don’t really understand what cyber security is all about,” Gallagher adds. “Cyber security is, primarily, a people issue, and that means it is very much about education – educating everyone, from the CEO to the mailroom, and from the oldest captain to the newest deckhand.”

After the human element comes the IT side of things, which means not only technology but also technical awareness – knowledge of the systems and ‘non-human’ infrastructure aspects that need protection. Then, once the human-element and IT strategies are developed, bringing the shoreside and shipside parts of the company under the same security umbrella is key.

One important part of systems protection is knowing exactly what there is to protect. That is not silly as it may sound. One long unrecognized and quite unpalatable fact of digital life for all industries is that many mission-critical systems are actually antiques waiting to be broken.

Not just aboard ships but throughout the world’s industries, there are many machines, processes, control systems and components of systems running programming written by many different people, at different times (even in different decades!), using many different operating systems and platforms – some of which is disturbingly old. One is reminded of the hacking attacks on certain Siemens industrial controllers from a few years ago, when hackers discovered that even the newest of these controllers were running decades-old programming that rendered them easy targets in today’s Internet-connected cyber environment.

For vessels and their operators, then, one essential step in cyber-securing a fleet is to create a cyber-inventory for all ships and for the company – a list of all programs and platforms running onboard and onshore.

“Developing software is a very complex process, and therefore prone to errors. Each and every one of those errors could be – but does not have to be – a vulnerability,” says Cordes. “This means you only know some of your inherent vulnerabilities at any given time, and that you will probably discover more in the future. That in turn means knowing all your technical vulnerabilities is not possible,” he adds ominously. “On the other hand, knowing about your attack surface, such as having a list of the software you use, is absolutely possible. A list like that would at least help you find out about the widely-known vulnerabilities for your software, and thus significantly reduce the risk of successful attacks. The problem is that the software you use changes over time and the list has to be maintained regularly, which is usually very time consuming and, therefore, expensive,” Cordes says.

YOU’RE NEVER CYBER-SAFE FOR LONG
The upshot is that ‘cyber security’ is merely a temporary state of being, one that requires a steady stream of effort and investment to maintain.

“Even though knowing all of your vulnerabilities and therefore being ‘one hundred percent safe’ is not possible, there are still many things that can be done to drastically lower the risk of successful attack,” Cordes adds. “For example, learning about attacks, evaluating your attack surface, raising awareness and keeping your software up-to-date...
Sherman agrees, and adds that “The scope of a vessel cyber risk assessment reaches beyond the cyber inventory to include potential sources of all cyber risk. This may include the SATCOM service provider, company policy (such as the use of seafarer personal devices), and connections from the ship’s operational technology to the company network on shore. The industry’s increasing dependence on technology and its shift toward digitalization means that companies and shipyards will have to start incorporating cyber risk management systems and procedures to reduce cyber threats for new tonnage. The industry’s increasing dependence on technology and its shift toward digitalization means that companies and shipyards will have to start incorporating cyber risk management systems and procedures to reduce cyber threats for new tonnage. This is part of what we call a holistic approach to cyber risk management. Shipowners and operators must embrace the development of a cyber risk management culture just as they embraced development of the safety culture onboard,” she says.

“The good news is that the shipping industry is already very familiar with the concept of risk management and the fact that risk cannot be completely eliminated, but only mitigated,” adds Gallagher. “Shipping companies have already embraced safety and security cultures, and the implementation of risk-based culture is an integral part of the maritime industry. Now it is time to add one more element to the mix,” he says.

As to how that mix can be made, Sherman says that “a company’s culture usually comes from the top down, so I urge senior management to involve themselves in the cyber risk management discussion. Be sure you are aware of the risks and potential consequences and keep those in mind while your cyber risk management program is developed. Like the development of a safety culture, becoming ‘cyber-secure’ is not an end game but a continuing process of improvement,” she says.

One roadblock to continuous cyber improvement is lack of collaboration and communication on the issue. Many companies are unwilling to openly discuss their cyber events, possibly for reasons of pride or for fear of a negative impact on their reputation or share value. Whatever the motivation, the effect of this embarrassed silence is to make a kind of folklore out of the anecdotal incident reporting that naturally follows these events, thereby creating the impression that the problem isn’t as great as it seems and preventing the industry’s overall progress in cyber security.

“Many companies indeed seem to have a hard time admitting that they became the victim of a cyber attack, even though this would help other companies in protecting themselves,” says Cordes. “I think that in most cases this is due to concerns about the company image taking damage; this way of thinking will probably not change any time soon. But, in my opinion, the industry has to work together and share efforts to be able to face cyber threats. Networks and communities of practice like the MCN provide an ideal environment for companies to share their experiences and learn about other companies’ strategies to defend themselves.”

“Over the past two years, shipping industry associations, class societies, P&I Clubs, government agencies, and private companies have developed tools to assess cyber risk for vessels and shipping companies,” says Sherman. “The means to perform a quality cyber risk assessment and to implement a solid, customized maritime cyber risk management plan exists today, and I strongly urge every shipowner and operator to do so as soon as practicable. While the maritime industry and has made improvements, additional emphasis and investment must be made, and the time to act is now.”
The approaching global sulfur cap and related IMO 2020 regulations raise issues that have taken over a great deal of focus at the IMO and, indeed, within the entire maritime industry. Even more dramatic than dropping the sulfur content limit of marine fuel worldwide from 3.5 percent to 0.5 percent under Regulation 14 of MARPOL Annex VI, is the uncertainty now rippling through the shipping community regarding the fuels they will use to satisfy the requirement. Many ship owners and operators today find themselves facing mystery and doubt exacerbated by rumor and myth as they try to properly prepare for the end times of conventional HFO.

BRINGING ORDER OUT OF CHAOS

Although it feels like an overnight change, it is important to remember that these are not new issues. These are items that have been debated for well over ten years, ever since MARPOL Annex VI underwent a comprehensive revision shortly after its entry into force.

One fundamental aspect to all the Annexes under MARPOL is the basic principal that, if measures are being put in place on industry to restrict discharge or air emissions, measures must also be put in place to enable ships to comply.

In that spirit, when Annex VI was adopted, a stepwise approach towards Regulation 14’s aggressive sulfur emissions limits was agreed upon, in order to allow for development of the technologies that would enable compliance. Another agreement important to the adoption of the regulation was the requirement for an availability study to be carried out, to determine availability of fuel oils that comply with the global limit and to help decide whether to retain 1 January 2020 as the effective date or to postpone it for an additional 5 years.

“The study was completed and the decision taken in 2016 that availability would be met and that, although some regions would have deficits, measures could be taken to account for regional availability issues,” says Nick Makar, Regulatory Affairs Advisor to International Registries, Inc. (IRI), which provides administrative and technical support to the Republic of the Marshall Islands (RMI) Maritime and Corporate Registries. As one might expect, 2020 gets quite a lot of his attention. “The reason to take this decision early was, very specifically, to provide legal and practical certainty for the industry to be able to adapt and comply with this very dramatic shift in sulfur content,” he says.

Although leading refiners have said compliant fuels will be widely available for the implementation date, they haven’t yet given out maps and numbers, so questions and anxieties persist as to the extent of that availability and, more importantly, to the quality of the fuels that will be available. Two key items are stability (whether a fuel will separate over time or under particular conditions) and compatibility (whether two fuels brought into contact will separate). The sludge that collects at the bottom of a bunker tank after separation can block filters and lead to engine failure. But beyond the fuels themselves are pressing concerns about whether shipboard systems will need modification in order to be able to handle them.
“Clearly a period of preparation will be needed with regard to fuel systems onboard, and IMO, and we at IRI, are very actively involved in helping industry take the necessary action so as to be in compliance by 1 January 2020,” Makar says. “One important variable during that transition period will be the amount of time that will actually be needed, on a ship-specific basis, to ensure compliance, that depends on the type of fuel each vessel is designed to use, and whether its systems will require modification. That is one source for much of the industry’s uncertainty,” he adds.

“In addition, there are questions among certain groups with respect to the quality of the fuel oil that will be available, that the quality will vary from supplier to supplier and from port to port, and that there will be regional variations as to how fuels are blended together,” Makar says. “This raises compatibility concerns; as I understand it, ISO and the refining industry are looking very carefully at ways of finding appropriate, comprehensive means to perform fuel testing onboard.”

Despite the uncertainties, the IMO position right now is that 1 January 2020 is a date set in stone. The driving idea when the IMO Subcommittee on Pollution Prevention and Response (PPR) began looking into implementation issues was not to postpone the date, he says, but to look at measures and means for flag States and industry to be able to apply this regulation consistently on a global basis. One of the proposed consistency measures is a regulation preventing ships from even carrying 3.5-percent sulfur fuel.

“When the decision was taken to keep 1 January 2020 as the effective date, concerns were raised related both to enforcement and to the idea that, for this regulation to work, a level playing needed to be maintained in order to avoid commercial distortion due to the costs of compliance,” Makar explains. “The carriage prohibition was among a set of amendments to Regulation 14, which, as currently structured, controls the sulfur content of fuels in use; the amendment adds a provision that also prohibits the carriage of those fuels. It’s a simple, elegant proposal to simplify enforcement – if you are not supposed to use high-sulfur fuel, why have it onboard? That was the intention,” he says. “It was also intended to aid enforcement, principally at sea, when ships aren’t within port or local jurisdiction.”

The amendment was approved at the last session of the MEPC, earlier this year. Under IMO’s tacit
approval procedure, amendments have to be circulated six months before adoption by the committee. These have been circulated with a view to adoption at the next session of the MEPC in October. If they are adopted, there will be a 10-month acceptance period followed by a six-month period prior to entry into force. This means the earliest the carriage ban could enter into force would be 1 March 2020.

**LOOKING FOR ANSWERS, RAISING QUESTIONS**

One organization to which the maritime community turns for answers on fuel matters is the International Bunker Industry Association (IBIA), which has spent a lot of time lately trying to dispel 2020 fuel myths.

Pointing out that bunker fuel is generally sold on the basis of conformity with ISO 8217 specifications, the IBIA says “expectations are that fuels complying with the 0.5 percent sulfur limit will be blends rather than fuels fitting ISO 8217 distillate marine (DM) grade specifications, and that they will also be different from most residual marine (RM) grade specifications used today. Because of this, ISO has been asked to revise the specifications so that it can better reflect the quality of fuels likely to dominate supply in 2020. The latest revision of ISO 8217 was published in 2017 and the next revision probably won’t be ready until 2021 at the earliest,” the organization says. “However, compliant fuel blends will still be able to conform to existing ISO 8217 specifications; it’s just that more fuels will be sold as RM grades because a few quality parameters will exceed limits for DM grades, but they should be comfortably within the limits for RM grades. Meanwhile, the ISO is developing a PAS (Publicly Available Specification) which it aims to publish in 2019 to provide detailed guidance to fuel suppliers and users on the type of fuel blends that are anticipated in 2020.”

The idea that the kinds of available fuels and blends are only “anticipated”, and not already known, is another source of widespread concern in shipping circles.

“If only a percentage of distillates will be available, then the remaining balance is going to be made up of residual blends; this raises variability and supply shortage questions,” Makar explains. “The concern there is how to be sure that unsafe fuels don’t enter the market, fuels that are not blended or adjusted appropriately, simply because the science behind this is not always entirely precise.”

That ISO 8217 provides only limited protection became painfully apparent this past June when a load of contaminated HFO entered the market and caused numerous problems for more than a hundred vessels, ranging from blocked filters and seized pumps to loss of main engine power. As this issue went to press, the matter was still
under investigation and the actual nature of the contamination and its provenance remained unknown.

Traditional HFO is a refinery waste product and, as such, contains compounds that relate not only to the original crude oil but also to specifics of the refining process that was used. These processes vary and, as a result, HFOs can contain incompatible substances – those most cited being asphaltenes – that, when mixed, turn into ship-stopping sludge. It is known that ISO 8217 cannot address compatibility between batches of HFO, for which reason ships already segregate fuels from different suppliers. One fear of future fuels concerns the compatibility of blends containing residuals (it is not an issue for purely distillate fuels and blends as they do not contain asphaltenes).

The IBIA says that, “for blends containing residual fuel oils, operators need to be fully aware of the potential for different batches to be incompatible. Just like the case is today, it will not be possible for suppliers to guarantee compatibility as blend formulations will vary widely, hence ships will, as they do today, have to consider the risk of incompatibility,” the organization says.

Concerns about the safety of fuel blends post-2020 are being addressed by the PPR subcommittee, but for now it seems shipowners just have to look out for themselves, as guidance from their flag States and industry groups develop. Or, as the ISO representative is reported to have told the PPR subcommittee meeting: “Recognizing that some degree of mixing of different fuel oils onboard the ship cannot be avoided, many ships today have already procedures in place to minimize co-mingling of fuel oils with bunker segregation being always the first option. We would therefore encourage ship operators to evaluate further their segregation policy.”
A panel discussion held in June at the Stavros Niarchos Cultural Center in Athens, Greece, brought together several shipping luminaries for a wide-ranging look at LNG, both as a cargo and as a marine fuel. Organized by ABS, the panel addressed numerous topics of interest, including the evolution of the LNG shipping business; changing trends in charters and the pros and cons of long- vs. short-term hire for LNG carriers; the impact of shale gas; how digital technologies could improve operational efficiencies; and the possible effects on overall quality and safety of inexperienced owners entering the various new LNG-related sectors.

Although it is impossible in this space to transmit all the insights offered by the panelists in the two-hour session, we present here a few comments of interest.

INDUSTRY TITANS SHARE THOUGHTS ON THE FUTURE OF LNG

ON TECHNOLOGY AND LNG CARRIAGE, AS CARGO AND AS FUEL:
“Technology is allowing us to find the right balance between cargo maximization and ship efficiency, the right combination of active and passive measures to manage everything from cargo boil-off to fuel consumption. Because the traditional advances accomplished through naval architecture have largely been optimized, I expect that, going forward, the next big technology improvement is going to be in how data analytics and digital technologies are applied to improving cargo boil-off rates and operational aspects like reliability, performance and fuel consumption.”
– Chris Wiernicki, Chairman, President and CEO of ABS

ON EVOLUTION OF THE LNG MARKET
“The LNG shipping market has evolved as the value and size of the trade has increased. Larger vessels are now the standard, charterers are moving toward shorter-term periods and the spot market is growing. New owners are moving into the sector, so the question is how much experience will matter to charterers and will they be willing to pay for it.”
– Michael Tusiani, Chairman Emeritus, Poten and Partners
ON CREWING:
“I suspect that, collectively, biggest problem facing industry today is finding good people, training them and retaining them. We feel very strongly not only about having our own crews, but also about working hard to make sure the people know they are a valued part of the company. Yes, every vessel at sea has its problems now and again, but it is a great thing to have your own people crewing your ships – they are proud to work for us, loyal to the company and work hard onboard. Even the charterers recognize the value of this.”
– John Angelicoussis, Chairman and Chief Executive Officer of Angelicoussis Shipping Group

ON LNG AND THE BUSINESS OF SHIPPING:
“The LNG shipping business is going through an evolution, as LNG grows as a commodity and the services around it become commoditized. We are in a macro growth trend.

“But, at the same time, more and more companies are entering in the LNG sector and the competition is fierce. We have seen recently that, for some new entrants, quality was not as important as was their price. This sends a very wrong signal to the market and is a great disappointment. On the other hand, without competition you don’t have progress.”
– George Procopiou, Chairman of Dynacom Tanker Management Ltd.

ON LNG AS FUEL, AND ITS EXPANSION INTO SMALL SECTORS:
“It is inevitable that LNG will become the primary fuel source for marine transport. We need to address the life cycle of existing assets and the development of bunkering infrastructure, which is acting as a brake on adoption, but this should accelerate. The train has left the station and cannot be stopped.”

“The emergence of small- and medium-sized LNG vessels is exciting and inevitable, not only for the use of LNG as a bunker fuel, but also in the distribution of LNG in smaller parcels to smaller power projects. We have only seen the beginnings of this; there will be, I believe, very strong growth in that sector”
– Peter Livanos, Executive Chairman of Gaslog Ltd.
The great Spanish philosopher Miguel de Unamuno was not speaking of industry and its problems when he cautioned “Isolation is the worst possible counselor,” but the thought that we only overcome our greatest challenges through the many forms of teamwork captures well the spirit that drives people to seek out the collaborative opportunities at important industry events such as Gastech.

For decades, Gastech has been the premier event that focuses both on the gas industry and the maritime companies involved in gas transport. It is a much-anticipated gathering where people come to learn about the latest technologies, to gain insight from presentations on high-profile projects, and to find inspiration in discussions about cutting-edge innovation. At the last Gastech, for example, some of the most stimulating discussions involved the idea of adding power generation capabilities to FSRUs – an exciting concept not only in its commercial aspects, but also in its potential for delivering life-changing electrical power to isolated regions and areas hit by natural disasters.

This year marks the 30th Gastech Conference and Exhibition, and at such a milestone it is appropriate to reflect on the intersection point between industry’s newest issues and its oldest concerns: the human element.

Take, for example, the digital control and analytical technologies at the foundation of the gas revolution, which are enabling gas – mostly natural gas, stored onboard as LNG, but also alternatives such as ethane and LPG – to take its rightful place as a common ship’s fuel. As the pioneering class society in LNG technologies, and the one with the greatest experience in using LNG and other gases as fuel, ABS is proud to be part of the vanguard making this onetime dream a reality. But, amid the new technical and logistical challenges of building a global infrastructure to support both the use of gas in power generation and as a marine fuel, industry must never forget the importance of cultivating the labor pool that is both the source of its achievement and the bedrock of its reliability.

Consider the rapidly growing fleet of non-LNG carriers using LNG as fuel. In this relatively young community, one human element issue of immediate concern is crew awareness. The crews, and even management, of many shipping organizations that lack experience with
LNG exhibit a disturbing tendency to regard this new fuel as just another bunker – a mindset that must be shifted to a state of constant awareness, in which the people onboard respect the fuel as much as they do the cargo. This applies to the shoreside organization as well. Many new players in gas and gas-fueled trades will need not only education and training, but also an adjustment in corporate culture such that management provides proper support to the people now dealing with LNG on a daily basis.

At present, this raising of awareness is a matter of voluntarily action. Whether it remains so for long is an open question. In the area of sustainability, for example, many leading companies already press their marine service providers to demonstrate responsible practices; it thus seems reasonable to expect, at some point, charterers will exert pressure on ships carrying LNG as fuel to demonstrate that they treat the material with the same respect and sense of responsibility as do the vessels carrying it as cargo.

Regarding LNG, as cargo and as fuel, future technology advances will come in the ways data capture, analytics and other digital technologies are used to improve vessel performance, reliability and fuel consumption, and in finding better ways to manage cargo boil-off. In the development of LNG-fueled bulk carriers, for example, a simulation tool was developed to predict the behavior of LNG and BOG during a voyage, and to help monitor conditions such as the variation in pressure and temperature within the fuel tank, LNG density and fuel quality. Soon, sensors will join other technologies monitoring LNG in the tank throughout a voyage and smart automated systems will be able to, for example, engage and disengage cryo-coolers, depending on operational parameters.

But, unlike with “mechanical” advances, each step forward in the digital world must be accompanied by a step forward in cyber security.

The one major modern challenge that is identical in all industries around the world is cyber security. A hacking demonstration in Bremen earlier this year showed that cyber security is as much a human element issue as it is an IT issue; that very emphasis pervades the ABS CyberSafety program, the first in our sector to place cyber education, for management and staff, on par with development of a robust information technology (IT) / operational technology (OT) cyber security program.

As Gastech is particularly concerned with technology, it is worth noting that ABS also developed a groundbreaking cyber risk measurement methodology working with the Stevens Institute of Technology: the FCI Cyber Risk™ model, which quantifies cyber security risk associated with OT systems. The ABS FCI cyber assessments are specifically focused on OT controlling core ship functions, such as navigation, steering and propulsion – providing a risk index score for vessels and fleets. The method evaluates not only the operational systems controlling vessel functions, but also all vessel connections as well as the human and machine identities, clearly enumerating the level of cyber risk exposure.

The digital technologies being developed today are building blocks of our industrial future, but if we do not shape them with the user in mind we run the risk of hindering progress as much as helping it. For example, it cannot be over-stressed that IT and OT are only one-half the equation in cyber security, and that the human element aspect of cyber security extends beyond individual solutions. Cyber threats are threats to everyone, and only when all stakeholders in our industry overcome the uncomfortable silence that usually follows a cyber attack, and meaningfully share our experiences, failures and successes, will we be able to continuously protect our companies and our assets.

In sum, to successfully confront the challenges of our increasingly complex world, the entire industry must collaborate to advance in technology and environmental responsibility without compromising on reliability and safety. The challenges we face going forward are many and varied, but so are the opportunities. Working together, we will overcome the former and make the most of the latter, and thereby develop an industry that is sustainable, self-improving, beneficial and safe.