Twentyfour7.

Wärtsilä Stakeholder Magazine

→02.**2019**

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*Wärtsilä Stakeholder Magazine**

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in detail

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editorial

At the crossroads of change

UP IN THE NORDICS, our famous winters are becoming markedly milder, shorter and more wet. The four distinct seasons we used to enjoy seem to be blurring together. Meanwhile, the people living in lower latitudes suffer from scorching heatwaves followed by flash floods. These unusual weather patterns are ominous signs that the effects of man-made climate change are accelerating and getting worse. Global statistics show that 18 of the 19 warmest years on record have occurred since 2001.

While those with power debate endlessly on proper policies, the younger generations have come to the forefront, going on climate strike and calling for fast and decisive action to stop global warming. Let's hope that youth prevails.

With technology, we can tackle this massive challenge head-on. In this issue of Twentyfour7., you will read about societies investing in energy solutions that phase out fossil fuels in favour of renewable energy. You will read how the maritime industry is speeding up efforts to reduce emissions and improve efficiencies. You will learn about cutting-edge research to develop clean fuels through the revolutionary 'Power-to-X' process.

All these first-hand accounts are examples of commitment and partnership with positive impact. They underline how we already have many of the answers for advancing a low-emission future. Many enterprises, including Wärtsilä, are genuinely concerned about the state of the environment. We are using our know-how to advocate for change. Our team, 19 000 strong, is a formidable asset in advancing clean maritime transportation and energy systems.

That is not to say the process will be easy. Businesses that have invested millions in building up their existing infrastructure are having to face hard choices, with questions being raised about the additional costs involved in making this switch. This will require serious long-term decisions by legislators, supported by incentives to pave the way. Meanwhile the expectations of investors and consumers are creating new opportunities for industries to be clean, green and successful at the same time.

The word is out. Everything we do leaves a trace, and it is up to us to determine what kind of an impact we will have on our planet. We have the resources; we have the expertise and we certainly have the smart technology. Join us in taking the necessary steps towards enabling a more sustainable society.

I hope you find the contents of this magazine inspiring and thought-provoking.

Atte Palomäki
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Speed should never sail solo

We are all familiar with the advantages of high-speed engines. Wärtsilä 14 adds the most complete marine offering on Earth to the equation, as well as the industry's largest lifecycle support and service network. Watch the benefits multiply.

WÄRTSILÄ

Read more at www.wartsila.com/wartsila14

*around the globe

Broadening Horizons

AFTER SUCCESSFUL EVENTS in Helsinki and Trieste, the latest Horizons event was hosted in Oslo. It attracted executives, academics, policymakers and figures from civil society to come together to create new solutions for clean shipping.

Even millennials were represented at the event. The members of Young Techno group (in the picture) came with an idea to help create a green shipping line between Norway and the UK. Their solution included an underwater submarine/rail hybrid vehicle for freight and passengers.

Also in the audience was 12-year old student **Amara A.** who has a keen interest in shipping, well beyond her years. She posts frequently about maritime issues on Instagram.

The Horizons event proved to be a hit, once again.

PHOTO: BENJAMIN A. WARD

[AROUND THE GLOBE]

News

BANGLADESH'S BIGGEST EVER SERVICE AGREEMENT

Wärtsilä signed two major maintenance management and operational advisory agreements with Summit Group - its long-standing partner and the largest independent power producer (IPP) in Bangladesh. The seven-year agreements represent the biggest signed service deals, in terms of MW generation, in Bangladesh's energy industry. The agreements are designed to meet the customers' needs for ensuring maximum availability of the installations, optimising operating costs and delivering reliable supplies to the Bangladesh's national grid.

In addition to the seven years of scheduled maintenance, the agreements include yearly maintenance management coordination and Asset Diagnostics, which keeps the thermal and mechanical load at an optimum level for operating conditions. It also enables savings in fuel consumption, while simultaneously providing a more environmentally sound operation.

Wärtsilä currently has in excess of 4,850 MW of installed or on order power generating capacity in Bangladesh. Of these, 1,100 are operated and maintained under contract by Wärtsilä. The new lifecycle solution agreements cover two power plants located in Gazipur, Dhaka owned by Summit Gazipur II Power Ltd, and Ace Alliance Power Ltd (Gazipur I), a subsidiary of Summit Power Limited, a publicly listed company in Bangladesh.

Wärtsilä GLOCAL WATCH

EXCITEMENT
RESPECT AND TRUST

ENERGY
MAKE THINGS HAPPEN

DO THINGS BETTER
EXCELLENCE

FINLAND:
Wärtsilä's Smart Technology Hub – a new centre of research, product development and manufacturing – has progressed from the planning phase to the implementation phase. In June, Vaasa City Council approved Wärtsilä's zoning plan and issued a construction permit. Wärtsilä also signed a leasing agreement with SEB Leasing for the facilities and ground lease agreements with Vaasa City and SEB. The total investment value of the real estate is EUR 130 million. The next step to appoint the main excavation contractor is scheduled for early autumn this year.

SOUTH EAST ASIA:
Wärtsilä signed a 100 MW/100 MWh energy storage system project deal in South East Asia. The region is aiming to leverage its abundant wind and solar resources and reduce its reliance on fossil fuels, especially as grid systems develop and economies grow. Wärtsilä's energy storage project will help provide some part of the reliability necessary to support South East Asia's transition to carbon-free resources. The energy storage system facility, including the Greensmith GEMS software platform will be used for grid support purposes, allowing grid operators to rely on renewables as baseload power.

SWEDEN:
Wärtsilä's hybrid power module solution, the Wärtsilä HY, is now fully operational on the 'Vilja', an escort tug owned by the Swedish port of Luleå. This solution's operating characteristics include a 'green mode' with zero emissions and no noise, a 'power boost' that delivers a higher bollard pull than any other comparable solution and 'smokeless operation' during engine start-up. Vilja will alternate between normal summer time operations and working in thick ice during winter. The tug's adapting Energy Management System (EMS) ensures the vessel's ability to maintain the highest efficiency performance in both situations.

WÄRTSILÄ JOINS THE 2050 SUSTAINABILITY CHALLENGE

TEXT: HENRY LOVELESS **PHOTO:** WÄRTSILÄ

Partnerships and joint efforts are key to securing the prosperity of people and the planet. Wärtsilä recently joined the ResponSea initiative alongside other Finnish Marine Industry (FMI) members to drive sustainable development across the industry.

TO PAVE THE WAY FOR A LOW-CARBON and sustainable future, efforts are being taken by governments, companies and citizens across the world to enhance sustainable development and ensure the planet's survival. Finland is playing its part by inviting actors from different sectors to collectively promote sustainable development in all its work and processes under the country's shared long-term vision, called Society's Commitment to Sustainable Development. It is a key instrument for implementing the United Nations' 2030 Agenda for Sustainable Development.

Organisations, companies and individuals in Finland are encouraged to pledge their own operational commitments to contribute to the implementation of the shared goals. These commitments are then accepted, published and monitored by the Commission for Sustainable Development.

The commitment shown by the Finnish Marine Industries (FMI) is a good example. In 2018, member companies of the FMI discussed how best to protect the world's oceans and seas, while ensuring their own businesses and ventures will develop sustainably and profitably.

"The FMI wants its member organisations to develop more environmentally sound solutions by which we can help improve the oceans' current state," says **Sari Luhanka**, Global Media Relations Manager at Wärtsilä and the company's representative in the ResponSea working group at FMI.

THE RESULT WAS THE RESPONSEA initiative, which brought maritime companies together to create a sustainable marine industry. As a part of this, FMI's members focus on making their products more sustainable and using their network to influence and bring real change in the industry.

"With the ResponSea Initiative, the Finnish Marine Industry and its members joined hands to give their own commitments for sustainable development within the marine network," says Luhanka.

In line with its own goal of building a sustainable society, Wärtsilä joined the ResponSea initiative with its own operational commitment. Wärtsilä's targets include the creation of a Smart Technology Hub (STH) in Vaasa, cutting greenhouse gas (GHG) emissions from its gas engines by 15% between 2015 and 2020 and reducing energy consumption by at least 7% in terms of absolute consumption (GWh) by 2025, compared with 2015.

"With these targets, Wärtsilä contributes to the FMI's themes of reducing the environmental impact of marine transportation and enhancing the circular economy and life-cycle efficiency," explains Luhanka.

"We decided to respond to the ResponSea challenge with a commitment that covers emission reduction in both our own and our customers' operations, as well as enabling more agile product development, seeking new, smarter and more sustainable practices," says **Alina Pathan**, Manager in the Corporate Relations and Sustainability Team at Wärtsilä.

THE UPCOMING SMART TECHNOLOGY Hub (STH) will be the latest step in the company's Smart Marine and Smart Energy Visions that will see collaboration and co-creation with different stakeholders to develop innovative and practical solutions for real-world problems. With the STH, Wärtsilä's customers and suppliers can work in tandem with universities and start-ups, exchanging knowledge and helping foster disruptive thinking.

"Whether we are talking about the UN Sustainable Development Goals, the Society's Commitment to Sustainable Development, the ResponSea initiative or Wärtsilä's own activities, the key for sustainable development is working together and seeking partnerships and new solutions," says Pathan.

The ResponSea initiative has been recognised by the Finnish Prime Minister's Office as an exemplary operational commitment, which enables different parties to commit themselves to the Finnish national sustainable development goals with concrete and creative commitments.

Wärtsilä will be reporting on the progress of the targets annually on the www.sitoumus2050.fi site, its own website and in its Annual Report.

[WORDS & NUMBERS]

USEFUL DEFINITIONS AND NUMBERS OF INTEREST.

OCEAN ACIDIFICATION
The process by which the hydronium ion concentration increases in the ocean, measured as decreasing pH. One cause of ocean acidification is the dissolution of carbon dioxide, which creates carbonic acid with water and then dissociates to yield hydronium and bicarbonate. A lower pH level impacts ocean life, including its soft and hard materials, and also human-made structures such as vessels.

THERM
A unit of energy equivalent to 100,000 BTUs (British thermal unit). It is usually used to measure the heat energy from burning natural gas or methane.

1–3%
The ozone layer that shields life on Earth from solar rays is recovering at a rate of 1 to 3% per decade, reversing years of dangerous depletion caused by the release of harmful chemicals into the atmosphere.

[TRENDS & SCENARIOS]

FUTURE PERSPECTIVES.

It's the small things that matter the most

How many times have you lost your keys, earbuds or other small items and wished you could track them down easily?

Enter a keychain-sized device called **Tile Mate Item Finder**! Simply attach a Tile tracker to any item and you can use the Tile app to locate it almost anywhere in Bluetooth range.

The Tile app uses your mobile device's location feature to communicate real-time location information to the app.

To locate your missing item, you can ring your Tile, view your Tile's last known location on the map or enable 'Notify when found' to enlist the power of your lost and found community.

Even without the app, you can still locate nearby items by making the Tile vibrate, flash or ring remotely. With similar gadgets in the market, you have a lot to choose from!

[CORPORATE CITIZENSHIP]

The future is calling engineers

Attracting young talent is a challenge for all modern-day companies. Wärtsilä boosts its presence in the lives of future engineers by collaborating with educational institutions. A prime example of this hails from the vast prairie of the north-western United States. Find out what takes Montana students to the heat of Florida.

TEXT: ANNE SALOMÄKI **PHOTO:** WÄRTSILÄ

GEOGRAPHICALLY, MONTANA STATE University–Northern (MSUN) in Havre, Montana, and Wärtsilä North America in Fort Lauderdale, Florida, are over 4300 kilometres (2700 miles) apart. However, when it comes to ideologies, the two organisations and their people are actually very close to each other.

"Valuing quality and professionalism is something both Wärtsilä and us share," says MSUN Chancellor **Greg Kegel**. "And we work hard every day to bring out these attributes in our students as well. We take pride in our outstanding students."

Since 2001, Wärtsilä and the university have been running a joint internship programme, offering top students summer jobs as trainees in Fort Lauderdale. **Juan Ruiz**, Field Service Resource Manager for Wärtsilä in North America, considers the partnership's return on investment very high.

"The students from MSU-Northern are very committed and they understand Wärtsilä's mission and values. We are very happy with the association and are currently ramping up the programme to go beyond the field of engineering," says Ruiz.

So far, 24 students have interned under this programme, and most of them have become permanent Wärtsilians after graduation.

Wärtsilä's presence in the students' lives begins at an annual career fair at the university. During this event, the company orients them to its operations and possible job opportunities. To apply, the qualifying criterion is that a student has a minimum GPA (grade point average) of 3.5. The figure, topped with an interview, helps Wärtsilä identify and select "the best of the best," as Ruiz puts it.

THE IDEA IS TO HAVE THE STUDENTS work for Wärtsilä for two consecutive summers. All interns complete a a programme of safety and workshop training and are appointed a mentor who supports them throughout the internship.

In the first year, interns rotate between different stations and workshops, learning as much as possible about Wärtsilä's different operations.

"The first summer consists of light tasks and learning the Wärtsilä way of working," Ruiz says. "When they come back in the following year, things get significantly more difficult and interns will be working together with their mentors."

The aim is that the second-year interns, after their last year of studies, should come back and join Wärtsilä as graduates. Ruiz says Wärtsilä is particularly keen on taking students who have long-term ambitions.

"We look for hard-working, responsible people who would want to travel, are able to fit in a multicultural environment, and are ambitious. Students from MSU-Northern have had a phenomenal record so far."

This doesn't come as a surprise to Chancellor Kegel.

"Many of our students have worked on motorcycles, trucks and snowmobiles prior to their studies, and they gravitate to hands-on work. That's why they are really good," he explains. "When they join a programme like Wärtsilä's, they embrace it, as it is something they've wanted to do for a long time."

WÄRTSILÄ, LIKE ANY OTHER technology company, does everything in its power to appeal to the best talent. One way to ensure that MSU-Northern graduates are familiar with Wärtsilä is the donation the company made in 2017: a 12-cylinder Wärtsilä 200 engine, topped with manual faculty training and specialised tools.

Chancellor Kegel notes that the equipment needed for practical training is extremely expensive, so educational institutions often rely heavily on industry partners. In his view, it's important to be able to use the same or similar tools that students will be dealing with when they join the industry.

"To have this relationship with Wärtsilä helps us very much," he tells. "The university wouldn't be able to purchase such state-of-the-art equipment on its own."

For Wärtsilä, the donation isn't just a goodwill gesture. Ruiz notes that as the students learn to operate Wärtsilä's gear and familiarise themselves with the company's working methods during their studies, they are being prepared to start working with the company as soon as they graduate.

[COLUMN]

Africa can lead the world in renewable energy

I BELIEVE AFRICA CAN EMERGE as the global leader in the drive towards 100% renewable energy. There are several compelling reasons for this.

With its abundant natural resources and large population under the age of 25, Africa is both the future and the hope of the world economy. It is in the world's best interests to help Africa improve core sectors like energy and education because they promote stability and growth. They also have a direct impact on GDP growth in both the short and long term.

Africa is also uniquely positioned to transition to Renewable Energy (RE) by directly leapfrogging from energy scarcity to the most modern and sustainable power systems in the world.

Renewables offer Africa the opportunity to access cheaper sources of energy, reduce dependence on oil and enable sustainable development.

A report on Electricity Access in Sub-Saharan Africa by AFD, the French development agency, and the World Bank states: "Currently, the unit cost of electricity to consumers in many countries in Africa is more than double the cost in high-income nations such as the United States (USD 0.12/kWh) and far higher than in many emerging markets such as India (USD 0.08/kWh)." RE can help bridge this gap and improve power supplies in unprecedented ways.

The Scaling Solar program is a good example of this. The abundant sunlight and wind in Africa's coastal belt combined with the dramatic drop in the price of solar and wind technologies brings 100% RE within reach. However, in our experience, African power grids struggle to absorb more than 30% renewable energy due to dispatch intermittency and lack of flexible power generation.

Project development is also a significant challenge.

Wärtsilä is playing a crucial role in project development, working with our partners across the continent. We have already equipped and/or built over 530 plants with 1,300 engines producing nearly 7.2 GW of power in 46 African countries. Our smart power solutions, including advanced energy storage, help power producers manage flexible base loads while reducing emissions.

According to Bloomberg New Energy Finance, in 2040 renewable energy will account for 32% of the energy mix in Africa, followed by gas (30%), coal and hydro (16% each). That translates into nearly 300 GW in solar energy alone! The potential is huge. Moving towards 100% renewable energy in the region is an achievable goal; it just needs vision and willpower.

PEKKA TOLONEN
Director, Growth & Development, Africa
Wärtsilä Energy Business

IT IS IN THE WORLD'S BEST INTEREST TO HELP AFRICA IMPROVE CORE SECTORS LIKE ENERGY.

PHOTO: KATARIINA SALMI

TEXT: PAYAL BHATTAR **PHOTO:** 123RF

REIMAGINING 100% RENEWABLE ENERGY

A 100% renewable energy target is no longer a distant dream. Several countries, islands and regions across the world are working towards it as the cost of renewable energy technologies continues to fall. Find out what's driving this transition.

Åland is a group of 6,500 small islands in the Baltic Sea located between Sweden and Finland. Although this archipelago is part of Finland's territory, it is connected to a grid in Sweden for its electricity because of its proximity to the country. Åland has an ongoing Flexible Energy System Demonstration project (FLEXE) to pilot and demonstrate that a fully renewable, independent energy system on the islands is sustainable, technically and economically.

Inspired by this ambition, a few months ago, Wärtsilä engaged in a power system modelling of the islands to understand the cost-optimal pathways to go 100% renewable in electricity generation.

"In Åland, wind is the main renewable resource. The main point was to understand how much it would cost to take the last step from 85% to 100% renewables," says **Jyrki Leino**, Senior Manager, Wärtsilä.

"In our study and modelling, we compared different scenarios. In high renewable power system modelling, methods need to be chosen carefully so that all system constraints are considered properly. In this case, in order to reach 100% renewable energy power, we tested power-to-gas solutions and biofuels. In both cases CO_2-free fuels were used in Wärtsilä engines to balance intermittent wind production," explains Leino.

Wärtsilä modelled three scenarios for the study. First, a base case where the link to Sweden would be maintained and new capacity would be added on the lowest cost basis. The second scenario had the link to Sweden gradually cut by 2030 and new wind, solar, battery and BioLNG (engine) capacity added on the lowest cost basis. The third scenario had BioLNG replaced with a Power-to-Fuel (PtF) engine to convert excess energy from wind production to gas and then use this gas in Wärtsilä engines to balance intermittent wind production.

reportage

GROUND REALITY

The study concluded that assuming the existing generation fleet was used as-is (only wind), and that there was a demand growth of 1% per annum starting from 300 GWh, and no electricity was sold outside Åland, the archipelago could make a gradual transition to 100% renewables by 2030 in three stages.

Stage one will be renewables at 50%, which is optimum from a cost perspective given the current cost level of renewables, power-to-gas and biofuels and could be achieved by just adding wind and curtailing excess or balancing power from Sweden. At stage two, up to 80% renewable energy will be produced and the balance of 20% would still come from Sweden. During this step, there would be quite a lot of overbuilt wind generation capacity, some of which would be curtailed during periods of high generation. At stage three, the final push to 100% renewables could be achieved either with BioLNG or PtF. Given the current cost level of BioLNG and PtF, the system cost would approximately triple in the case of BioLNG and rise seven times in the case of PtF,. However, the costs of both solutions are likely to fall in the future, making the case for 100% renewable electricity production interesting to pursue.

In addition, local renewable energy potential, geographic conditions and electricity cost levels have an impact on the feasibility of going 100% renewable.

"One always needs to analyse the cost of generation with system-specific input data" says **Saara Kujala**, General Manager, Business Development, Wärtsilä.

"While we cannot draw any conclusion globally from a single country case, we do see that with the cost of wind and solar falling dramatically, in many cases countries can both lower the cost of electricity production and go up to 80-85% renewable generation even with current cost trends of renewables, storage and flexible generation solutions. And as we build our systems towards higher shares of renewables, we can continue to take advantage of new technologies as their costs fall," explains Kujala.

According to the International Renewable Energy Agency (IRENA), the share of renewable energy in the power sector is likely to increase from 25% in 2017 to 85% by 2050, mostly through growth in solar and wind power generation.

FALLING COSTS

The good news is that the costs of renewable technologies, particularly wind and solar, have fallen dramatically and are likely to drop even further. According to Bloomberg New Energy Finance's (BNEF) third-quarter outlook on the Global PV Market, solar panel system costs (fixed axis, utility segment) have decreased by 73% between 2010 and 2018. BNEF's third-quarter outlook on the global wind market estimates that the wind turbine price index has dropped from USD 1.75 m/MW to USD 0.85 m/MW from the first half of 2008 to the first half of 2018.

BNEF's New Energy Outlook 2018, an annual long-term analysis of the world's power sector until 2050, estimates that in the first half of 2018 alone, the benchmark global Levelised Cost of Electricity (LCOE) for offshore wind fell by 5% to USD 118 per MWh. It fell 18% for onshore wind to touch USD 55 per MWh and was 18% lower for equivalent solar PV at USD 70 per MWh. The prices of lithium-ion batteries too have declined substantially from USD 1000 per MWh to USD 209 per MWh since 2010.

BNEF expects battery prices to fall to USD 70 per MWh by 2030. It predicts that by 2050, the cost of an average PV plant will fall by 71% and the cost of wind energy will drop by 58%. It estimates that of a total USD 11.5 trillion to be invested in new power generation capacity between 2018 and 2050, USD 8.4 trillion will be invested in wind and solar alone and another USD 1.5 trillion will go to other zero-carbon technologies such as hydro and nuclear.

"It is commercially realistic to reach 85–95% renewable level within the next 30 years throughout the world, but the massive wind and solar power plant investments must be supported with short-, medium- and long-term balancing applications," explains **Veikko Kortela**, General Manager, Business Development, Wärtsilä.

"IN ÅLAND, WIND IS THE MAIN RENEWABLE RESOURCE."

reportage

FLEXIBILITY MANTRA

Engine power plants are a good way to ensure the lights never go out. They can be fuel-flexible and can handle varying loads to provide operational flexibility to the entire power system. Operational flexibility is paramount when it comes to increasing renewable energy generation because renewable sources are intermittent as they are dependent on natural conditions such as the number of hours of sunlight, wind speed and so on.

"Engine power plants will have a big role to play because they can provide balancing power using stored fuel produced with power-to-fuel technologies. During the transition period, natural gas will gradually be replaced with PtF fuels," explains Kortela.

Building excessive renewable capacities is also not ideal because it could lead to idle capacity due to commercially unviable large-scale storage and a scarcity of new technologies to convert excess renewable power to fuel or other forms.

"A huge amount of storage capacity is required in the last 5 to 15% of achieving 100% renewables. That increases the Levelised Cost of Electricity (LCOE) heavily. But over the next few years we expect technical improvements for storage and all other renewable production supporting technologies and also heavy price cuts due to mass production for some storage technologies," says Kortela.

But to achieve ambitious renewables targets that are 10 to 15 years away, utility companies have to ensure that the capacities they chose to invest in today remain relevant in the future. This is because it takes years to build power plants and the average life of a plant could range between 30 and 40 years.

So how can one future-proof their investments? Multi-fuel engine power plants are the best answer.

"In Wärtsilä engines, you can still use fossil fuels but if you want to give the final push to 100% renewables at some stage, you can easily switch to biofuels," says Leino.

"Typically, the capacity factor of thermal balancing capacity in a 100% renewable system is less than 10%, which means that the thermal units are not used much for energy and the price of the more expensive biofuel is not that important as it does not have too much of an impact on the total cost. However, it is essential to have this firm thermal capacity in the system for the periods when there is no wind or solar production, or when the duration of the batteries is not long enough," he explains further. Such a solution will also help to reduce the amount of energy storage needed in a fully renewable system.

FOR GREATER GOOD

Apart from financial feasibility, there's also climate change to consider. The International Energy Agency (IEA) estimates that limiting the rise in global mean temperature to well below 2°C would need the global energy sector to double investments to an average USD 3.5 trillion each year until 2050, decrease fossil fuel investments and offset it with a 150% increase in renewable energy supply investment, investment in nuclear power, carbon capture and storage, and in transmission and distribution grids.

IRENA estimates that renewable energy needs to grow at least six times faster for the world to meet the goals set out in the Paris Agreement of, 2015. As climate-change-related regulations get tougher, power companies investing in inflexible new capacities could find themselves saddled with high-emission plants that may be unusable in the future.

The overall consensus is that with renewable energy growing at a robust 7 to 8% annually, 100% renewable energy is not too far from reality. There's money to back it and it is technically feasible. So even though Åland may take a while before it makes the transition, there is no doubt that several geographies around the world will move towards the 100% renewable energy mark as RE technologies, batteries and synthetic fuels become more affordable.

"A HUGE AMOUNT OF STORAGE CAPACITY IS REQUIRED IN THE LAST 5–15% OF ACHIEVING 100% RENEWABLES."

TEXT: ANNA GUSTAFSSON **PHOTO:** 123RF & WÄRTSILÄ

SLOW STEAMING IS BACK IN THE GAME

Container ships on average spend 6% of their time, every year, waiting at anchor due to delays at port. Uncoordinated ship-to-shore operations often result in congested ports and further raise the risk of accidents. An obvious solution is slow steaming, which optimises a vessel's speed to match the arrival time to a slot opening at the port. This also saves fuel. However, it is not common practice. We explore why.

ONE OF THE MOST EFFECTIVE, QUICKEST AND EASIEST SOLUTIONS TO REDUCE EMISSIONS IS TO SLOW SHIPS DOWN.

International shipping accounts for around 3% of global CO_2 emissions. The amount of cargo carried by sea has grown and is expected to reach 12 billion tonnes by 2020. Growth in global trade also means growth in fuel consumption and, therefore, higher emissions.

One of the most effective, quickest and easiest solutions to reduce emissions is to slow ships down. Even micro-adjustments at high speeds have a massive impact on fuel consumption. According to a study conducted by the environmental group Seas at Risk, a 10% reduction in the speed of the world fleet would result in a 19% reduction in CO_2 emissions.

Slowing down the speed of a vessel also reduces the time it spends at anchor waiting for a port call. While waiting outside the port, ships consume energy, emitting fumes to the detriment of local air quality, and their cumulative presence heightens the risk of accidents.

Slow steaming and just-in-time port arrivals are two of the only practices where economic and environmental benefits don't contradict each other. Many environmental organisations have called for the shipping industry to act quicker in order to take on new practices to cut down emissions. The International Maritime Organization (IMO) has acted on the matter since the Kyoto Protocol in 1997 and called for a reduction of emissions caused by international shipping. Several policy options have since been launched. But no regulations on slow steaming have been tabled yet. So, currently, it is a voluntary practice.

GETTING ALL ON BOARD

Marine Traffic, a leading source of ship tracking intelligence the world over, has developed a real-time global database to track vessels while on a voyage and at port. **Argyris Stasinakis**, a partner and board member at the Oxford-based company, sees the problem as a complex one. However, according to him, the solution can be narrowed down to one single word: communication.

"The key is information exchange. Communication between the vessel, port authorities, terminals and other parties involved is not as dynamic as it should be," says Stasinakis. "In many cases, vessels are called to port two to six hours beforehand,

Matteo Natali, General Manager, Port Business Development at Wärtsilä.

and that is too late to make any meaningful adjustments to the vessel speed,” he explains.

Delays and congestion in ports are often due to inefficient communication between one player and another.

TECHNICALLY, READY!

Matteo Natali, General Manager, Port Business Development at Wärtsilä, addresses the issue. He notes that a port consists of several individual roles. “The port is actually a community with many different operators. There are terminal operators, port authority, logistics companies, agents, pilots, tug operators, other service providers and so forth,” explains Natali.

The good thing is that technical solutions already exist to support coordination between the different parties involved. For instance, Wärtsilä is involved in projects that aim to enable more efficient, real-time communication between all stakeholders.

Natali himself is working on one such interesting project – Portify, a digital communication platform that allows for smooth data exchange between the vessel and the port community. The platform thus helps actualise the benefits of real-time coordination and ultimately achieve speed and route optimisation for just-in-time arrival, based on the availability of the berth and all players involved in the vessel arrival operations.

While Stasinakis agrees that technical solutions exist, he points out that the culture of sharing information, which is currently business-driven, is a barrier.

“Stakeholders are reluctant to share information. But we have seen in other industries, like aviation or global retail, that when there is huge information flow, the data sharing leads to a higher understanding of the industry and improved efficiency,” says Stasinakis. Marine Traffic works on an open-source principle and has millions of monthly users.

THE DIGITAL TIDE

Some of the world’s busiest ports are leading the way by going increasingly digital to allow better real-time communication. Europe’s busiest port is Rotterdam, where 30,000 ocean-bound vessels and 105,000 inland vessels are handled every year. The Port of Rotterdam has developed a digital dashboard where real-time data on water, weather and opening slots at berth are updated.

“We were one of the first to initiate talks with other ports and shipping companies to find existing standards to maximise the benefits of sharing data,” explains Captain **Ben van Scherpenzeel**, who is the director of Nautical Developments, Policy and Plans at the Port of Rotterdam.

Captain van Scherpenzeel has a practical outlook and says that given the scope of data, the system should be as lean as possible.

“We are currently conducting very fundamental work, trying to define what is the minimum amount of data that would need to be exchanged. The next step is figuring out how to make data part of the current process. At least half of my working hours currently are devoted to this project.”

TEXT: BEN HARGREAVES **PHOTO:** 123RF

INTRODUCING ENERGIEWENDE

European powerhouse Germany has ambitious and far-reaching plans to transform its energy system over the next 30 years. Integrating ever-greater levels of solar and wind power onto the grid poses considerable challenges. Wärtsilä has a key role to play in enabling Germany to build a low-carbon, sustainable and reliable energy supply.

The effects of climate change are clear to see, and nations across the world are taking steps to reduce greenhouse gas emissions in an effort to limit global temperature increases.

Germany's Energiewende (the energy transition) is an ambitious programme of change to a low-carbon, sustainable, reliable and affordable energy supply, one that has been in the works since the year 2000. The country is targeting an 80 to 95% reduction in greenhouse gas emissions by 2050 relative to 1990 levels. It also wants to produce 60% of its energy from renewables such as wind and solar power by mid-century.

In fact, Germany intends to phase out all coal-fired power generation by 2038, and nuclear power by 2023, drastically changing the energy market in the country. According to Berlin-based policy institute Agora Energiewende, the speed and scope of the Energiewende are exceptional.

TAKING THE LEAD WITH RENEWABLES

How does the country plan on doing this? Germany has invested heavily in wind and solar power generation over the years. First, it created a market for renewables and then lowered the cost of renewable technologies. Allowing co-operatives, local initiatives and other business models to be part of the transition led to a situation where 31% of renewable energy production is owned by Germany's citizens.

"There has been consistent support for wind and solar power from the beginning and that is now seen in the ambitious Energiewende targets for phasing out nuclear power, and then coal," says **Melle Kruisdijk**, Vice President, Europe, Wärtsilä Energy Business explaining the country's success with renewable power. "Politically, Germany took a lead with renewables and that strategy is now paying off."

The share of renewables in the country's gross power consumption climbed to 38.2% in 2018. At its current rate of growth, Germany's target of 40 to 45% renewable energy by 2025 is within reach. This is especially significant since the plan is to do this without relying too heavily on hydropower, as most countries with high shares of renewable power generation generally do.

ON THE FLIPSIDE

An ambitious energy transition does have its challenges. According to J.P Morgan's annual energy paper from March 2019, grid imbalances are a problem for Germany and are putting pressure on Eastern European grids with unwanted power surges and blockages. To reduce curtailed renewable generation and re-dispatch costs, Germany will need to upgrade its transmission infrastructure. However, out of a projected need for 4650 kilometres of transmission lines by 2025, the paper claims only 900 kilometres have been built so far. Renewable energy is intermittent by nature, potentially causing interruptions in supply.

All this brings into question Germany's goal of cutting emissions in half by 2040. "Highly unlikely" is the verdict from J.P Morgan, whose report attributed this to "the very slow pace of de-carbonisation apart from the electricity grid, and the extent to which greater demand for energy offsets improvements in energy intensity, improved gas mileage in cars/planes, and more energy efficient devices/machinery/buildings."

Additionally, approximately 40% of the country's energy is still generated from coal. While Germany's goals of phasing out fossil fuels is admirable, it still needs flexible, smart solutions to ensure that it can do this without interrupting energy supply. Engines and energy storage will provide the needed flexibility to integrate renewables, secure reliability and ensure affordable costs of power systems.

SMART TECHNOLOGIES TO THE RESCUE

The question that has now seized the country's policymakers is how to maintain its renewable energy momentum and handle problems of intermittent supply.

Wärtsilä believes that the void caused by the nuclear and coal phase-outs in the German energy market should be filled with renewables and flexible engine-based power plants. As an energy system integrator, Wärtsilä has the capability to design, build and serve optimal power systems. Additionally, Wärtsilä envisions a 100% renewable energy future, a goal that perfectly complements Germany's own energy ambitions. Examples where the two can partner already exist. Take, for instance, smart power generation technologies such as Wärtsilä's Combined Heat and Power (CHP) engine power plants and flexible, reliable and efficient gas engines that can help by generating power to plug the gap and balance energy supply with demand during periods when the wind isn't blowing or the sun isn't shining.

These engine-based power plants run on natural gas – a relatively clean fuel – to generate electricity and heat. They can start up quickly and efficiently when needed and can also supply hot water for homes and businesses. CHP engine power plants also add comfort and improve the quality of life in cities as boilers will not be needed in apartments.

Wärtsilä has made inroads into the German market by supplying a 100 MW CHP plant to Kraftwerke Mainz-Wiesbaden (KMW) and a 90 MW CHP plant to supply electricity and district heating for Dresden, Germany – a deal announced in January 2019.

Germany's ultimate vision – to be a country in which renewable energy meets all energy requirements – is absolutely achievable, say experts – and that's a goal that's supported by Wärtsilä too.

"To be 100% green will take many years, but the commitment is there on the political side. You can see how ambitious Germany is when it comes to its targets for phasing out coal-fired generation, for example," says **Jan Andersson**, Market Analyst at Wärtsilä Energy Business.

WÄRTSILÄ AS AN ENERGY SYSTEMS INTEGRATOR

"Wärtsilä can help Germany along its transition as an energy systems integrator, enabling integration and optimisation of various generation assets including renewables, energy storage and engine power plants, to power the energy grid of the future. It is not just CHP that will play an important role in the Energiewende. Battery storage of electricity generated when the wind is blowing and the sun is shining is also critical," explains Kruisdijk.

CHP will continue to play a long-term role even as renewable energy comes online at greater levels than today in Germany. Ultimately, CHP plants could be fuelled by hydrogen or synthetic gases such as synthetic methane, making them carbon neutral. Kruisdijk envisages a future where synthetic liquid and gaseous fuels generated through "Power-to-X" technology are used to power CHP plants, developing a zero-emission future power system.

"Synthetic methane uses CO_2 from the atmosphere in its production and is therefore carbon neutral across its life cycle," explains Andersson.

As the Energiewende project gathers pace, it is the flexibility provided by smart power plants and advanced energy storage technologies that will play a key role in increasing the share of renewables in the country's energy grid. Germany has taken a leading stance – and perhaps other European countries will follow its path to a renewable energy future in the years to come.

TEXT: ANNA GUSTAFSSON **PHOTO:** 123RF

EYE IN THE SKY

From aerial photography to creating 3D models, find out how Wärtsilä is using drones for more efficient and accurate data gathering in power plant planning and construction.

WÄRTSILÄ HAS ALREADY EXPERIMENTED WITH DRONES IN MORE THAN 10 POWER PLANT PROJECTS AROUND THE WORLD.

Drone technology has advanced tremendously over the past few years, and in a short time it has become an indispensable part of data gathering and surveying in many industries, including energy. For instance, Wärtsilä is gathering geospatial data for its power plant projects using drones.

What goes into this process? Typically, a drone equipped with high-quality cameras is flown over power plant building sites or existing plant sites and premises, capturing images of the area below it. A drone mapping flight session can be as short as 10 to 20 minutes and doesn't require much manpower, with just one drone pilot equipped with a console being all that is needed. Multiple aerial photos are then combined and by photogrammetry the 2D pictures are turned into an informative 3D model. The three-dimensional presentation helps designers conduct site surveys, plan construction and figure out delivery timelines more effectively.

Civil engineering manager **Simon Nyman** works on supporting Wärtsilä power plant projects, including site action. He had previously explored the possibilities of using laser scanning to survey building sites, but got the idea for photogrammetry and using drones from a student who was looking for a bachelor thesis subject.

An orthophotograph is an aerial photograph that is geometrically corrected to have a uniform scale to follow a map projection and represents distances and surface areas realistically. Drone-operated orthophotography, Nyman realised, could prove to be very useful in the early stage of engineering, opening up intriguing prospects.

"Sometimes the geometrical data we receive from customers is outdated or insufficient, or in some cases doesn't exist. With drone-gathered data we can get accurate information on the geography and topography of the area, and this helps optimise things like plant layout and even volume calculation," he explains.

SPEEDING UP POWER PLANT CONSTRUCTION

Wärtsilä has already experimented using drones in more than 10 power plant projects around the world, from the Bahamas to Ireland, Curaçao and Australia. Drone-led surveys have prompted a positive response from both customers and engineering partners, says Nyman, with value being added in all phases of the building project, from sales to site progress, down to exploring possible extensions for existing power plants. Having a 3D model of the building site makes the construction phase run more smoothly, helping with project delivery.

"When we have accurate information on the topography and other features, we have a better starting point for optimising how the plant should be situated on the appointed lot," explains Nyman. "This can save time and money for the customer, as unnecessary excavation can be prevented."

That's not all. Drones also enable data gathering on the weekly progress of a project. For example, in Australia, drones were used to survey the construction process right from the start, with pictures of the project being sent to Wärtsilä every week on Friday and the finished 3D model in turn sent to the project team and engineers on Monday, helping them track current and plan future phases of construction. Having accurate information at their fingertips has helped Wärtsilä improve safety and quality planning of the power plant as well.

"The information which we can deliver helps keep the project on time and works as a quality inspection tool," says Nyman. "Visualisation increases the overall understanding of the project, and the data also helps if the plan needs to be changed during the building process. Developments can be tracked down week by week with the help of existing 3D-model pictures."

A FUTURE BUILT USING DRONES

Drone mapping is used in providing information on the area surrounding a power plant project as well. This helps factor in possible disruptions such as noise levels that might negatively impact other buildings nearby. Going ahead, Nyman sees drones being used even more extensively for site research, with the customer being provided a more realistic model of what the delivered plant will look like, together with all surroundings including existing buildings and units, once finished.

"Drone technology is already pretty much advanced enough for our purposes. We have already experimented using thermal vision cameras for drones, allowing for more cases for this fascinating technology," says Nyman.

While drones have the potential to revolutionise parts of the power plant project execution, there are limits to what the technology can achieve currently. Drones cannot be used in extremely cold climates and can be affected by heavy winds. Thick forest cover can also impede their progress as the drone's vision is impaired by foliage.

There are regulatory hurdles to consider as well, with countries that have still not formulated legislation to govern drone usage banning their use altogether until they have had time to review their laws.

That said, drones have become an indispensable feature of the construction industry and, thanks to Wärtsilä, in the energy sector as well. With drone technology constantly improving, the next few years could see drones being put to even more uses including power plant inspections and inspecting areas that are hazardous to humans.

Drone-led topographical surveys in locations like the Bahamas have produced a positive response from partners.

TEXT: DEREK SILVA PHOTO: 123RF

DECODING THE BALTIC DRY INDEX

Among a multitude of economic indices, what significance do shipping indices have, and why does the Baltic Dry Index (BDI) in particular stand out?

The business section of any publication is usually chock full of indices like the S&P, ZEW and CPI, all of which are used by investment professionals to help gauge the health of the economy. However, when it comes to the shipping industry, which is responsible for moving the vast majority of traded goods across the world's oceans, shipping indices are the best way to assess how well the market is doing.

There are a number of shipping indices, each of which tells a different story, based on ship sizes, ages and regional concentration. For instance, the Clarkson index, the Howe Robinson index and the Harper Petersen Index (HARPEX), among others, are charter rate indices used in the container shipping segment. Freight rate indices for the same segment include the China Containerized Freight Index, the Shanghai Containerized Freight Index and the Drewry World Container Index. Meanwhile, the Dow Jones Global Shipping Index is more of a typical stock index, as it follows the equity performance of 25 companies in the shipping sector.

A BAROMETER OF ECONOMIC HEALTH

Among all these indices, the Baltic Dry Index (BDI) is of special importance in gauging the health of the world economy. Created by the London-based Baltic Exchange, the BDI measures the supply and demand for bulk cargo, which is often just one kind of raw material per shipment.

Movements in the BDI give insight into the demand for metals, minerals, grains and building materials. Since the BDI materials are raw material inputs for making end products, the index is viewed by many as a leading economic indicator of industrial production and economic activity, forming the basis for political and economic decision-making.

"There could be a surge in Chinese iron ore imports to support infrastructure projects or a robust grain harvest in Brazil. Monitoring physical trade flows using aggregated satellite data of all the various vessel classes provides a much better view of not only the physical movement of goods, but also the distance they are being shipped," says **Court Smith**, a trade analyst at VesselsValue Ltd.

Smith says the general public too can use the BDI as a good proxy for the physical economy, and as an expert he finds it useful because, in times of higher volatility, it could explain a wide variety of events.

Additionally, the BDI has a lot working in its favour.

"Compared to other indices, the BDI is difficult to be influenced by governments, associations or speculators. It is driven by clear forces of demand for commodities and the supply of ships," says Captain **Amrit Singh**, a shipping analyst at Refinitiv.

READING IT RIGHT

While the BDI is difficult to manipulate, some experts claim it is not impossible.

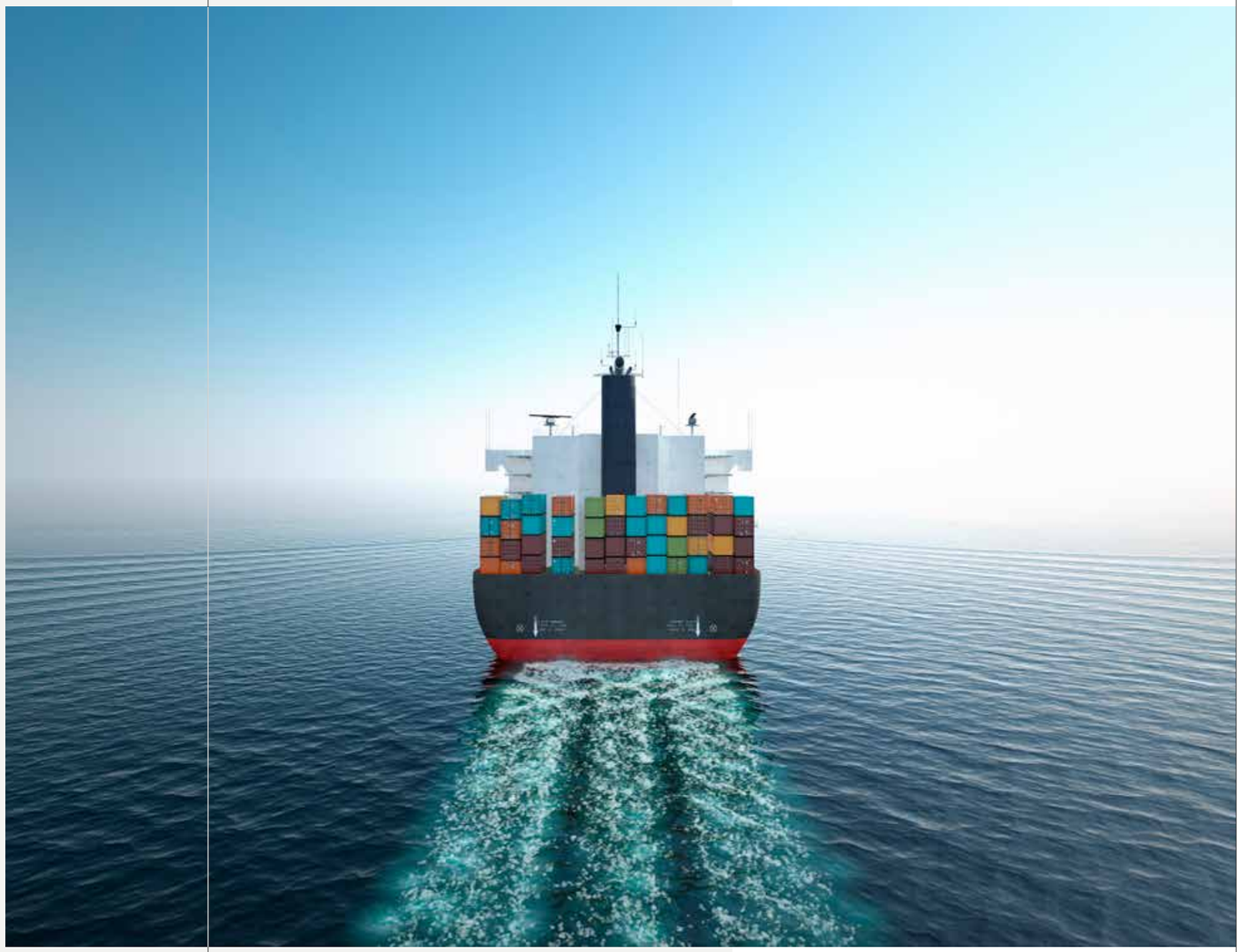
"The BDI is now biased towards the larger sectors in order to create more volatility for traders, so it's not the best way to look at how the market is doing," says **Peter Sand**, Chief Shipping Analyst at BIMCO Shipping Association.

Sand contends that the BDI reads the balance of supply and demand in the bulk sector only, and, while many analysts use it as a leading indicator for growth, they tend to forget that it's not only a demand-driven index and that they should also consider the ship supply side.

Instead, Sand prefers to follow individual Time Charter Equivalent (TCE) estimates for a basket of trades for individual ship types, such as Cape, Panamax, Supramax and Handysize, as he says they provide "much more information on profits and losses, as you can compare directly income (freight rates) to costs (operating and capital expenditures)."

Sand also argues that much of the global economy today is driven by intangible goods or services, with the movement of physical goods not as important as it was 40 years ago.

While that may be true, there is no denying that massive commodity price swings and trade conflicts have dominated the financial headlines from 2015 to 2018. In light of this, shipping indices like the BDI may prove to be just as valuable as ever in the current economic environment.



SHIPPING INDICES LIKE THE BDI MAY PROVE TO BE JUST AS VALUABLE AS EVER IN THE CURRENT ECONOMIC ENVIRONMENT.

TEXT: PAYAL BHATTAR **PHOTO:** WÄRTSILÄ

AUTONOMOUS OR AUTOMATED?

What is the difference between Autonomous Shipping and Automated Shipping? Well, the lines between the two terms are blurring fast, but the easiest way to explain the distinction is that autonomy will bring a sea change to the global maritime sector and automation will enable it.

Imagine several ships en route from departure port A to arrive at different ports around the world, each at a given time. These ships have no captain or crew on board and can navigate, dock, load, unload and refuel on their own and are maintained by sensors, robots and drones. The ships are navigated and controlled by computers from a fully automated port with no human intervention or interaction. The operating system of each vessel makes decisions and takes actions based on the situation it is in. That's Autonomous Shipping and it is very different from automated ships.

"The difference between the two is dictated by the degree of human intervention. An automated vessel does not have the level of intelligence or independence that an autonomous one has. The range between manual, automated and autonomous tends to be a sliding scale of different capabilities of man vs. machine. Autonomous is on the side where the vessel makes sufficiently complex decisions on its own and has zero human intervention," explains **Melvin Mathews**, Director, New Businesses, Wärtsilä.

REDEFINING 'SHIPSHAPE'

In May last year, the International Maritime Organization (IMO) defined a Maritime Autonomous Surface Ship (MASS) as a ship that to varying degrees can operate independently of human interaction. It enlisted several non-hierarchical degrees of autonomy that a ship could have for the duration of a single voyage as:

a) Ship with automated processes and decision support: Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated.

b) Remotely controlled ship with seafarers on board: The ship is controlled and operated from another location, but seafarers are on board.

c) Remotely controlled ship without seafarers on board: The ship is controlled and operated from another location. There are no seafarers on board.

d) Fully autonomous ship: The operating system of the ship is able to make decisions and determine actions by itself.

"Autonomous shipping will continue to evolve over the next 15 to 30 years. In the future, ship traffic control will move to the shore and a standardised framework very similar to what we have in aviation today will likely be established. This level of coordination will be needed in maritime. Planes are almost fully controlled by auto-pilot and in this sense, they are autonomous despite the fact that they still have crew on board to balance the risks in emergency cases. We cannot fully eliminate the human factor at sea, that's not the objective either, but I do foresee a similar future for shipping," says **Vladimir Ponomarev**, Vice President Solutions at Wärtsilä Voyage.

"The way how the fleet will be operated will be different. Operations of autonomous ships will be located in the fleet management office and there will be few people depending on the size of the fleet who will take decisions. They will be required to navigate through a lot of data. The major difference will be in the level of responsibility of ships. Today one man is responsible for one ship. In the future one man will be responsible for hundreds of ships," he elaborates.

MAN VS. MACHINE

BIMCO, the world's largest international shipping association, is of the view that so far there hasn't been a realistic business case for autonomous ships because the cost of building an autonomous ship is far more expensive when compared with traditional shipping. It believes that seafarers have an important monitoring role as far as power supply and engines are concerned, and replacing them with condition-monitoring sensors, which have so far not been very reliable, may not be the best idea.

Aron Sorensen, Head of Maritime Technology and Regulation at BIMCO, says, "Even with the most advanced automation, technical approach to shipping, complete redundancy and back-up from ashore it is difficult to

"AUTONOMOUS SHIPPING WILL CONTINUE TO EVOLVE OVER THE NEXT 15 TO 30 YEARS."

Auto-docking is a part of Wärtsilä's Smart Marine Ecosystem strategy.

Wärtsilä has been testing its auto-docking technology.

in-depth

“AUTONOMOUS SHIPS WILL FIRST APPEAR WHERE THERE IS A SIGNIFICANT RISK TO HUMAN LIFE, AT PLACES WHERE USING ROBOTS IS SAFER THAN USING HUMAN BEINGS.”

envisage how all the operational and maintenance duties currently carried out by crew can be solved. Many examples could be mentioned: Sensors that detect flooding can, for example, start pumps automatically, but how will the systems be able to find the cause of the water ingress and stop the leak?”

BIMCO states, “Fully autonomous (unmanned) ships in international voyages will take a long time to become a reality. Apart from the fact that new technology is needed and there needs to be a business case, other challenges are lack of regulation, insurance and market acceptance. We have already seen projects of unmanned ships being planned in national waters; however, as these so far have been heavily subsidised, it is not clear if they build on a viable business case.”

SAILING TOWARDS AUTOPILOT

Despite the fact that autonomous shipping could become a reality only in the distant future, many shipping companies, technology start-ups and ports have begun sailing towards it. For instance, Wärtsilä is exploring remote-controlled ships and autonomous ships via integration with a port system, a navigation and control system and a fleet operation system to help automate decision making for the ship. The company has also tied up with the Maritime and Port Authority of Singapore to promote maritime technologies and test an advanced intelligent manoeuvring system to avoid collisions based on computerised logic.

“Autonomous ships will first appear where there is a significant risk to human life, at places where using robots is safer than using human beings. And then it will come to areas where it is easier to control operations and ensure safety of traffic such as coast-to-shore navigation, ferries sailing on predefined routes and small cargo ships operating on cargo terminals. Ship management companies using autonomous ships will also be using their own terminals and ports,” explains Ponomarev.

Experts say that even though the divide between Automation and Autonomous is gradually shrinking, by their very nature the two terms cannot be considered one and the same. This means that we are in the age of accelerated automation, but we are several years away from autonomous shipping in its purest form.

TEXT: RICHARD ORANGE **PHOTO:** WÄRTSILÄ

FIGHTING UNDERWATER NOISE POLLUTION

Container ships emit on average around 170 decibels at source, about the sound of a loud rock concert. Underwater noise emitted by ships is increasingly seen as a form of pollution that needs to be reduced. Could Wärtsilä's EnergoProFin be the solution? The Vancouver Port Authority definitely thinks so.

This energy-saving propeller cap provides average fuel savings of 2%, with a payback time of less than one year.

ENERGOPROFIN MAKES PROPELLERS QUIETER.

For whales, dolphins and narwhals, the arrival of noisy container vessels, bulk carriers and other marine traffic into their habitats can be fatal.

These animals, like other marine mammals, use sound to communicate with each other (and even locate prey) underwater. Their sensitive hearing could be easily damaged by loud underwater noise.

"When the noise level is really high for them, they get confused. Their navigation systems fail, they get lost and can't find food, and then they die because they can't eat," says **Carlo Pestelli**, Wärtsilä's R&D Manager in Noise and Vibration. "It is sadly that simple."

Underwater noise can damage the ears of marine mammals, causing profound hearing loss.

The impact on other marine life is much less well known, but it is undoubtedly significant.

A NOISY PROBLEM

Tragically, the amount of underwater noise is growing almost everywhere. A 2014 study found that global marine traffic had increased fourfold since 1992.

"The noise is increasing by 3dB per decade. We can say sort of doubling every 10 years," Pestelli says.

Container ships emit an average of about 170 decibels of sound at source, equivalent to 111 decibels in air. This is about the same as a medium-sized helicopter or a loud rock concert.

The seismic air guns used for geological surveys for oil exploration globally emit up to 260 decibels, which one 2017 study showed was enough to kill two-thirds of zooplankton for more than a kilometre on either side.

"And there's no sign of it decreasing because there's not any strong regulation in place yet," notes Pestelli.

There may be no regulation in place, but it is certainly coming. The IMO in 2014 approved guidelines on reducing underwater noise from commercial shipping.

The Vancouver Fraser Port Authority this year included measures to reduce underwater noise in its EcoAction programme. Launched in 2007, the programme offers discounts on harbour dues to commercial cargo ships meeting voluntary environmental best practices that reduce emissions, underwater noise and other environmental impacts. These practices include obtaining third-party environmental designations, using cleaner fuels, and noise-reducing technologies. From the start of this year, ships fitted with Wärtsilä's EnergoProFin device will be entitled to a 23% discount on port fees.

Pestelli's colleague **Norbert Bulten**, Product Performance Manager at Wärtsilä's Hydrodynamics department, believes that other ports will follow suit.

"It's really coming from Canada, but if they do a good job I think it will spread to the rest of the world," he says. "In the old days, people only thought what came out of the funnel was an emission. Nowadays underwater noise is also regarded as an emission from the ship."

TECHNOLOGY FOR A NEW POLLUTION

Wärtsilä has had a head start in supplying solutions to the problem. Between 2012 and 2015, Pestelli and other Wärtsilä researchers collaborated with other equipment suppliers and academic researchers on the EU-funded SONIC project, which aimed to develop tools to investigate and mitigate the effects of the underwater noise generated by ships' propellers.

Engines can also be a source of marine noise, but that problem is easy to solve by using resilient mounting. This isolates the ship's hull from the vibration coming from engines.

Propeller noise is more challenging, though. Most propellers generate a hub vortex in their slipstream. This rotates so fast that the pressure in the inner core becomes low enough for water to evaporate, a process called cavitation. When the pressure begins to increase again, the vapour bubbles collapse.

"The collapse of the vapour bubbles creates an enormous amount of noise that can travel a long distance," explains **Anton Voermans**, Manager of Hydrodynamic Design at Wärtsilä.

This is where EnergoProFin can help. The propeller cap looks like a small extra propeller mounted behind the actual propeller.

EnergoProFin was initially designed to increase the efficiency of the propeller by about 2% by regenerating the energy lost to hub cavitation. But as a side effect, it also makes the propeller quieter.

"It's really this vortex killer, and therefore it contributes to lower noise," Bulten says.

Voermans's team has also produced a second efficiency-boosting device, EnergoFlow. which reduces propeller noise. EnergoFlow is a set of stator blades fixed to one side of the hull to direct the flow of water into the propeller (in technical terms, a pre-swirl stator). This reduces the sheet cavitation caused by the tips of the propeller.

"You have a much better inflow into the propeller. That leads to higher efficiency, but it also leads to a quieter propeller," says Voermans, technical director on both projects.

EnergoFlow is still at the pilot stage so it has not yet been put forward for the Port of Vancouver's EcoAction program, but similar products have been approved.

Both devices improve efficiency and reduce noise, a win-win that is unusual in propeller design.

"In general, measures to control cavitation come at the cost of efficiency," Bulten says. "They're conflicting. The highest-efficiency propellers will also be very noisy."

NEXT STEPS FOR FUTURE COMPLIANCE

Bulten expects regulation over noise emissions to follow the pattern set by sulphur and nitrogen regulations, starting in sensitive areas and then spreading and tightening from there.

Pestelli's noise and vibration research team is already in discussions with customers about developing sensors in future which could measure the underwater noise produced by the ship in real time. These could then be put together with control mechanisms allowing the crew to adjust speed to keep cavitation to a minimum, and make their ship compliant when entering controlled waters.

Wärtsilä has already supplied an ultra-silent propulsion system for a Faroe Islands research vessel, the propellers of which produce next to no cavitation. Frigates and submarines have also long been equipped with quiet propellers. But doing this means sacrificing perhaps 4 to 5% in propeller efficiency, a price no container vessel operator could currently pay unless forced to by regulation.

"Once they are willing to do so, then we are more than happy to design silent propellers for container ships and bulk carriers, because we have sufficient skills to do that," Voermans says.

TEXT: KAMALA GOVINDAN **PHOTO:** EMMI KORHONEN

The marine industry through the eyes of a veteran

Having spent over 40 years at Wärtsilä, Fred Danska has seen it all. We asked him what he thought about the changes that have taken place in the marine industry over the past four decades, and how he foresees it all turning out. Read on to know more.

"THIS DRIVE TOWARDS A ZERO-EMISSIONS INDUSTRY CANNOT BE CARRIED FORWARD BY ONE ORGANISATION ALONE. IT REQUIRES THE COOPERATION OF ALL STAKEHOLDERS."

Fred Danska has had many firsts in his long career at Wärtsilä. As a marketing manager at the Helsinki shipyard, he created Wärtsilä's first customer database using a Wang word processor. Then, in the 1990s, he created the company's first CRM system using Microsoft Access. This and other innovative programs shows in Danska an instinct to always be at the cutting edge of technology, using it to improve efficiencies and, ultimately, the bottom line. Little wonder then that he is today the Director of Cruise Business at Wärtsilä.

Danska is especially proud of his role in growing Wärtsilä's engine market for cruise ships, which grew to about 80% market share in the 1990s.

CHANGING WITH THE TIMES

As someone who always has his eye on industry trends, Danska has witnessed first-hand the technological and regulatory changes sweeping the marine industry. Of these, it is the environmental changes that he feels have had the most profound impact, both on business models and also the industry's way of thinking.

"Shipping has remained a fairly conservative and constant business, and seldom has more than one new innovation been introduced on a new ship," explains Danska. "However, changing environmental regulations have definitely been something we have had to plan for and tackle. It has changed the game, so to speak."

On 1 January, 2020, the International Maritime Organization's (IMO) global sulphur cap of 0.5% will come into effect, putting pressure on the shipping industry to adapt existing and future technology to meet requirements. This will have a major impact on the entire maritime industry, with ship owners scrambling to upgrade their fleets to ensure they are compliant. The cruise industry, says Danska, is no exception, although it has been an early adopter of environmentally friendly operations.

"Among all the different marine segments, the cruise industry has gone on to bigger ships to allow for more passengers. The growth has been consistent and shows no signs of slowing down," he explains.

"Naturally, cruise ship operators are trying to ensure that their vessels are as environment-friendly as possible."

In the cruise business, these changes have been happening at a time of growth. There has been a steady increase in the passenger capacity of the cruise ship industry, with bigger and bigger ships on order. Revenues have increased too, rising to USD 35.5 billion in 2016 from USD 23.3 billion in 2007. The focus on sustainability has never been greater.

"Sustainable tourism has been named one of the greatest challenges facing the cruise industry," says Danska. "At Wärtsilä, we have been working on a host of solutions to accomplish this, including the Wärtsilä 31DF engine, our LNG solutions, our waste-to-energy solutions and recycling systems. I have always believed that technology is key for all of this."

THE NEED FOR A SMART MARINE ECOSYSTEM

This, says Danska, fits in with Wärtsilä's purpose of using smart technology to enable sustainable societies. He also calls for the industry to come together to tackle sustainability issues by sharing knowledge, technology and know-how.

"This drive towards a zero-emissions industry cannot be carried forward by one organisation alone. It requires the cooperation of all stakeholders," he adds.

While environmental regulations are one part of it, achieving operational efficiency and boosting profitability is the crucial next stage. The three areas that see the highest amount of waste in terms of operational efficiency, according to Wärtsilä, are overcapacity, inadequate port-to-port fuel efficiency and waiting time associated with entering ports and high traffic areas.

Wärtsilä's SEA20 and 'An Oceanic Awakening' is an attempt to lead the industry towards this goal, using digitalisation and collaboration between all stakeholders to build a smart marine ecosystem. The importance of digitalisation, says Danska, cannot be overstated. With the changing technology landscape,

"Sustainable tourism has been named one of the greatest challenges facing the cruise industry," says Fred Danska.

it will soon be possible for the cruise industry to be run on an entirely smart ecosystem.

The use of big data analytics in the marine industry is expected to help vessels attain greater operational efficiency and improved levels of energy management. Intelligent vessels with fully automated processes and smart ports or marine-centric innovation hubs are other visions that Wärtsilä sees as the future of the marine ecosystem.

"These are areas where the smart marine ecosystem will also benefit the cruise industry, although it is too early in my mind to say to what extent," says Danska. "One example could be the bunkering process for fuel, and especially LNG. On the closer horizon, the benefits will likely be seen on merchant vessels first."

As technologies and processes develop, he believes that Wärtsilä will play a key role in spearheading the industry's transformation – one that will be spurred by the rapid pace of development taking place.

"During the 'diesel era,' innovation was perhaps slow because the R&D work, testing of products and verifying took many years. Today we have products that have a much shorter development cycle" he explains. "I see Wärtsilä getting more committed to a sustainable future of the society and developing both the products and operations to reflect this commitment."

"I SEE WÄRTSILÄ GETTING MORE COMMITTED TO A SUSTAINABLE FUTURE OF THE SOCIETY."

TEXT: NIKHIL SIVADAS

AFRICA'S ENERGY REVOLUTION

The **world's second-largest** continent.

54 different countries.

1.25 billion people.

THE NEXT ECONOMIC POWERHOUSE

POWER

Developing stable regional **electricity grids** in the region has been a challenge.

An estimated **600 million** people in the continent have no access to electricity.

In spite of this, electricity demand is expected to grow **threefold** until 2040.

RESOURCES

Nearly **30%** of the world's remaining natural resources.

22% of global gold production.

55% of global diamond production.

10% of global oil exports.

ECONOMY

External financial inflows to Africa grew to **USD 193.7 billion** in 2017.

Economic growth is projected to accelerate to **4.1%** in 2020.

Average inflation is expected to fall to **8.1%** in 2020.

Working-age population is expected to hit **1 billion** by 2030.

CHANGE IS COMING

Coal-fired power plants are being replaced by **renewable energy**.

Gas is becoming the **dominant fuel** in the African energy market.

Solar and **wind power generation** is expected to double by 2020.

WÄRTSILÄ IN AFRICA

Totalled installed base of **7200 MW**.

The company has installed **2700+ MW** of capacity over the past 10 years.

Service hubs in **Senegal, Kenya** and **South Africa**.

Wärtsilä started its operations in Africa in **1975** and is today present in **46 countries**.

#1 in medium-speed engine market in terms of installed capacity.

TEXT: RICHARD ORANGE **PHOTO:** 123RF & WÄRTSILÄ

HELPING SINGAPORE'S TUG MASTERS WITH SMART TECHNOLOGY

IntelliTug, the first project launched by the Wärtsilä Acceleration Centre in Singapore, is combining some of the most advanced Smart Marine technologies and putting them to the service of PSA Marine's highly skilled Tug Masters.

Smart navigation system.

THE GOAL OF INTELLITUG IS TO DEPLOY SMART TECHNOLOGIES IN A WAY THAT THEY HELP SKILLED MARINERS CARRY OUT ONE OF THE MOST CHALLENGING JOBS IN THE INDUSTRY.

Even though dark and ragged clouds covered the sky above the Pasir Panjang container terminals in Singapore, the surrounding waters were still bustling with port activities as the world's busiest container transshipment hub operated throughout the night. At 4 AM, a team of Wärtsilä computer scientists, robotics engineers and UX experts were at work on the bridge of the PSA Polaris tugboat, as part of a user research trip for the IntelliTug project – a joint project with PSA Marine, the Maritime and Port Authority of Singapore (MPA), Lloyd's Register and the Technology Centre for Offshore and Marine Singapore (TCOMS).

"The weather condition can have a disorientating effect on you unless you're a seasoned mariner," says **Jan Grothusen**, Director, Wärtsilä Voyage Solutions, "Although the whole horizon and quayside is illuminated, it's surprising how much your perception can be altered at night."

It is possible, the Wärtsilä team discovered, to mistake the twinkling lights of ships in the night for the celestial skies above. They also found it challenging to remain constantly fully aware of the busy surroundings. "The situation can be highly complex and unpredictable, like many operations when different humans and multiple vessels are involved," explains Grothusen.

PSA Marine's fleet of 40 tugs carry out more than 90,000 towage jobs per year in the busy waters of the Singapore port. By 2040, when the final construction phase of the Tuas next-generation mega port is completed, Singapore's port capacity and traffic are envisaged to double.

KEEPING THE HUMAN IN THE LOOP

The IntelliTug project has grown out of the Singapore's Sea Transport Industry Transformation Map, which calls for the development of autonomous systems, robotics, data analytics and AI to maintain the port's global edge. It is also the first project to be launched by the Wärtsilä Acceleration Centre in Singapore and part of the MPA Living Lab initiative.

The goal of IntelliTug is to deploy smart technologies in such a way that they will help skilled mariners like **Amir Hamzah Hasan**, PSA Marine's Senior Tug Master, carry out one of the most challenging jobs in the industry. That is why Wärtsilä is retrofitting the PSA Polaris with an advanced marine grade sensor suite and joystick manoeuvring system, all integrated in a light-weight, human-centric smart navigation system which, collectively, will provide collision avoidance capabilities and smart navigation support during transit and when virtually anchored.

Chris Chung, Wärtsilä's Singapore-based director of Digital Innovation & Strategic Projects and IntelliTug's ecosystem and overall programme lead, says the aim of the co-creation partnership is to combine Wärtsilä's Smart Marine capabilities with PSA Marine's wealth of experience and expert knowledge to develop and test-bed smart capabilities.

Bernard Wong, Head of Fleet Management at PSA Marine, is convinced that his Tug Masters will maintain the central role but will have amplified capabilities through the IntelliTug. "There are many instances in towage operations where we feel that the Tug Master is still very much needed," Wong says. "They rely a lot on their skills and the training provided, and even their instincts. But we believe that more can be done to aid them in their day-to-day work."

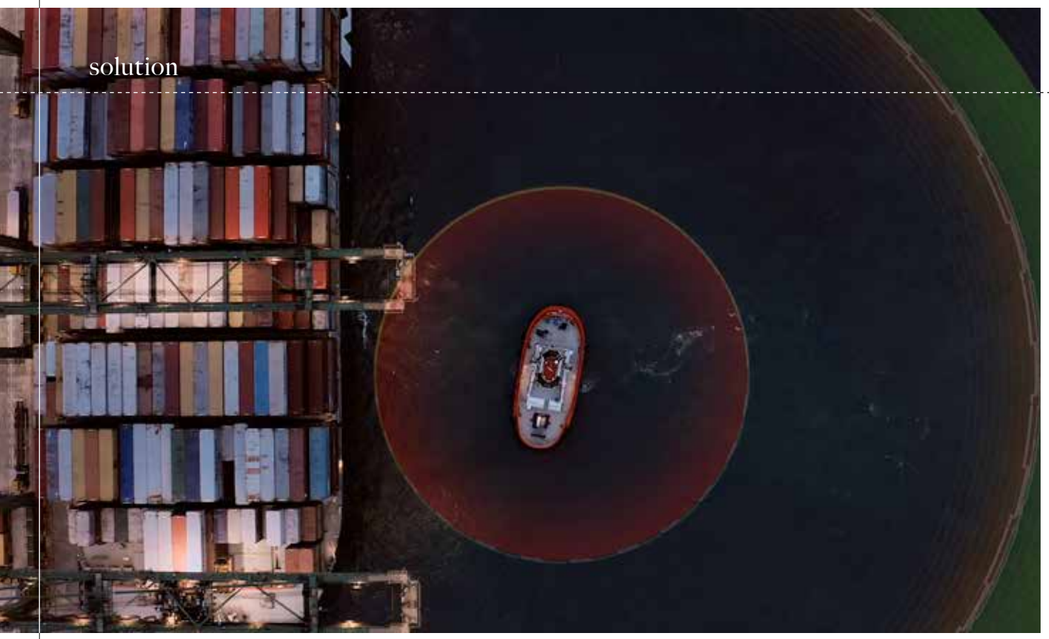
This, he says, might include the ability to "fuse sensor data and incorporate it into a human-centric interface that will allow Tug Masters to digest and make sense of all the information more easily."

In summary, the planned features include passage planning with collision detection and avoidance and virtual anchoring with enhanced situational awareness at night and in complex conditions. Wärtsilä is using the data gathered to further refine its sensor fusion algorithms, test new features, study how the tug behaves under manual operation, verify sensor detection capability under different conditions, and look for any anomalies and performance issues.

THE ROLE OF REGULATORS

In January, the IntelliTug project had its kick-start week, where it brought together experts from various Wärtsilä business units in true "OneWärtsilä" spirit.

Wärtsilä's Voyage Solutions team is currently creating a digital simulation of the PSA Polaris, which will be used to test capabilities in both real-life recorded situations and imagined scenarios. Meanwhile, next steps for



WÄRTSILÄ WILL SPEND THE COMING MONTHS INTENSIVELY CONDUCTING USER TESTS WITH A WÄRTSILÄ TUG DIGITAL SIMULATOR BEFORE TESTBEDDING IN THE SEA.

Wärtsilä's Dynamic Position team include equipping the tug with its joystick module, which can then work both with the simulator and the new smart navigation system.

Much of the ecosystem development and partnership is led by the Singapore Digital team, which is leading the engagement with ecosystem stakeholders and ensuring a user-centric approach will solve a real-world challenge.

Chung stresses that it is important to work with forward-thinking partners and regulators to ensure technology is deployed safely and sustainably.

The MPA is providing a "regulatory sandbox" for IntelliTug. This is a set-up that is used to accelerate innovation and testbedding in Singapore – with many successes in adjacent industries such as fintech and telemedicine services. The sandbox provides a controlled environment, allowing technology to be tested safely. Data and learnings will mean MPA can continue developing the appropriate regulatory framework based on real world experience whilst the technology develops. The tug's capabilities will also be thoroughly tested in a virtual environment before the technology is released into the testbed. Experts from Lloyd's Register have been closely involved from the start of the project, providing expertise and insights to ensure potential technology risks are identified, managed and mitigated.

NEXT STEPS

Wärtsilä will spend the coming months intensively conducting user tests with a Wärtsilä tug digital simulator before testbedding in the sea – all the while working alongside PSA Marine's experienced Tug Masters to develop a fit-for-purpose and useful system that will bring together smart technologies to amplify the capabilities of the crew – enabling them to be safer, smarter and more effective than before.

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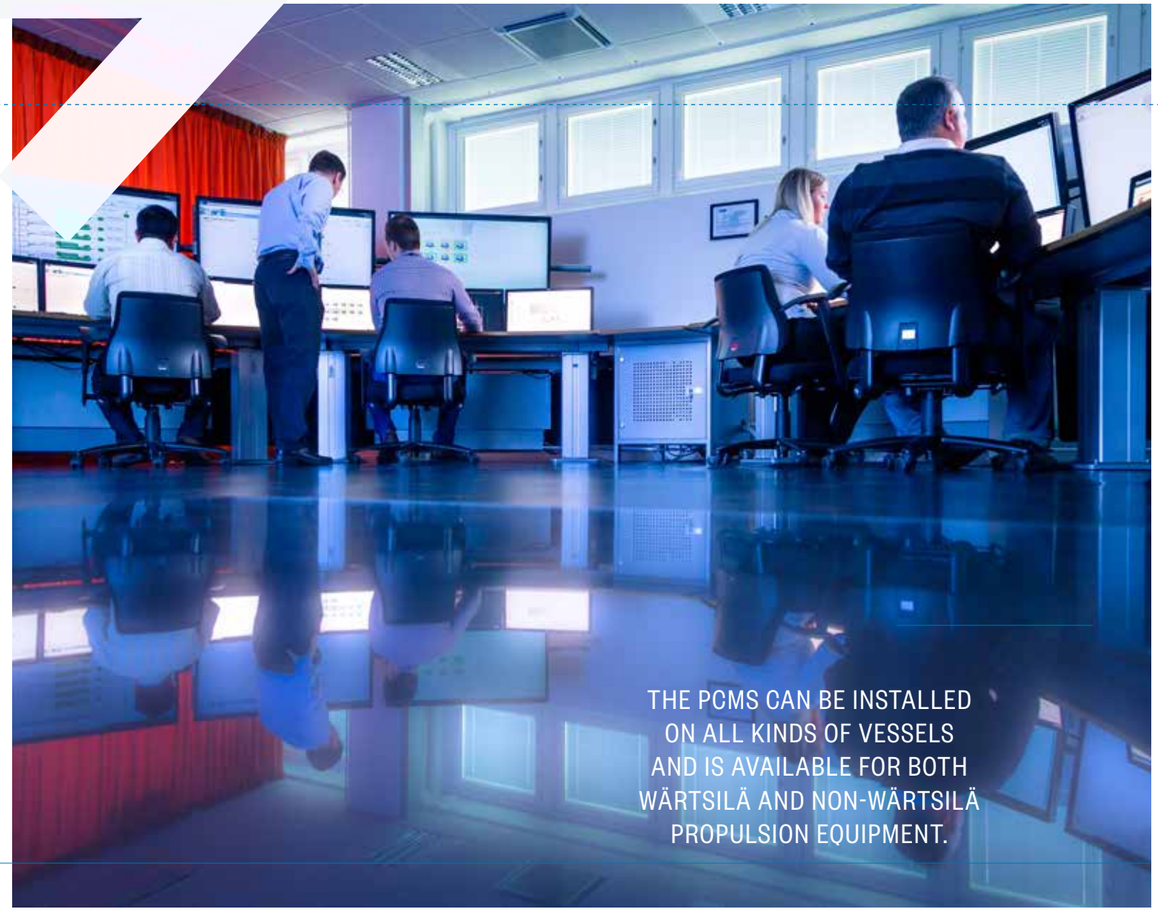
SOLUTION TO PREDICTIVE MAINTENANCE AND OPTIMAL UPTIME

▶ **TEXT:** ISABELLE KLIGER **PHOTO:** WÄRTSILÄ

WHEN WÄRTSILÄ'S PROPULSION Condition Monitoring Service (PCMS) was launched in 2010, it was the first of its kind. The latest version of the service is a state-of-the-art tool designed to facilitate preventive maintenance and help maximise uptime for Wärtsilä's customers across the globe. Here's a closer look at the offering.



The Propulsion Condition Monitoring Service (PCMS) is Wärtsilä's Condition-Based Maintenance (CBM) solution for propulsion equipment. By carrying out measurements of critical parameters such as vibrations and oil condition, as well as operational parameters including steering angles, rotational speeds and pitch angles, the Wärtsilä PCMS provides customers with real-time advice and periodic reports on the condition of their machinery, as well as crucial information for maintenance planning.

Since its launch in 2010, the Wärtsilä PCMS has been successfully installed on hundreds of applications. Late last year, Wärtsilä released a new, more cost-effective version of the solution, based on third-party hardware, featuring even higher-quality vibration data and reduced on-site maintenance requirements.

WHY DO CUSTOMERS NEED THE WÄRTSILÄ PCMS?

The PCMS enables Wärtsilä customers to improve the availability, reliability and profitability of their vessels while reducing risks and maintenance costs. By monitoring and analysing the parameters that affect the condition of the propulsion equipment, Wärtsilä's experts can predict an upcoming failure and also advise customers on the best action to take to mitigate its impact.

The Wärtsilä employees responsible for analysing the data produced by the PCMS have extensive experience and in-depth knowledge of both the propulsion equipment itself and the operational context in which it is used. Once a problem is detected, Wärtsilä will not only make the customer aware of the issue but also provide expert advice on how to address the problem and minimise operational disturbances. For example, this might involve reducing the load on the thruster in order to complete an ongoing voyage and scheduling maintenance once the vessel reaches a port.

To make optimal use of the PCMS and other CBM equipment of this kind, they are best combined with a long-term Wärtsilä service agreement. This allows Wärtsilä not only to detect a possible future failure but also to schedule and carry out the required maintenance in a way that minimises stoppages and costs and maximises uptime and operational efficiency for the customer.

The Wärtsilä PCMS enables ship owners and operators to:

- Base operational decisions on the actual condition of their equipment
- Maximise the availability of their vessel by performing overhauls only when needed
- Reduce the likelihood of breakdowns by being proactively informed of faults
- Increase the lifetime of equipment and preserve its condition by obtaining feedback on the factors that cause excess wear and failures
- Reduce the total cost of ownership and maximise profitability

RELIABILITY OF WÄRTSILÄ PCMS

Wärtsilä is recognised as a Condition Monitoring service supplier by four of the world's major classification societies: the American Bureau of Shipping, Lloyd's Register, the China Classification Society (CCS) and DNV-GL. These societies have acknowledged that the Wärtsilä PCMS can determine the condition of propulsion equipment and enable the extension of required visual internal inspections.

The exceptional reliability of the equipment enables Wärtsilä to carry out optimised maintenance, whereby service is only carried out when necessary and not according to a fixed, time-based schedule. The result is significantly extended service intervals and the reduction of both service-related costs and downtime. For example, a thruster may only require two overhauls over a 15-year life cycle, instead of three.

WHAT'S NEW?

Released in December 2018, the new version of PCMS, which is based on third-party condition monitoring hardware systems, is significantly more cost efficient than the previous version of the solution. Customers who sign up for the new PCMS will obtain even better-quality vibration data. Moreover, the new system requires fewer software updates and less maintenance, thereby significantly reducing the need for on-site service.

The PCMS can be installed on all kinds of vessels and is available for both Wärtsilä and non-Wärtsilä propulsion equipment including transverse thrusters, steerable thrusters, electric pods, controllable pitch propellers, gearboxes and water jets. Going forward, Wärtsilä intends to expand the scope of its condition monitoring services to include all types of rotating equipment such as pumps, generators, electric motors and compressors. One of the major benefits of the new PCMS is that, unlike the previous version, which could only be applied to propulsion equipment, the new version has made it possible for these types of generic rotating equipment to be included in the scope.

HOW DOES THE WÄRTSILÄ PCMS WORK?

In a vessel with two propulsors, both are equipped with PCMS sensors and connected to one PCMS cabinet. The cabinet acquires and processes data from sensor readings and the propulsion control system according to the set operational parameters.

The data is processed onboard and sent to an assigned technical expert at Wärtsilä. A dashboard (an optional feature) installed on the bridge or in the engine control room allows the operator to monitor the condition of the vessel's propulsion machinery using both real-time and trend data with advice available in case of irregularities.

The central PCMS server continuously processes the data and sends an immediate alert to Wärtsilä's certified experts if an issue arises. If daily follow-up is included in the PCMS agreement, a thorough analysis will be carried out the same day and, if abnormalities requiring immediate attention are detected, the CBM expert will inform the operator.

All Wärtsilä PCMS customers receive a periodic report detailing the latest findings and recommendations from their propulsion monitoring. The report also describes the condition of the propulsion equipment, the recommended maintenance interval and advice for how best to keep the equipment in optimal condition.

THE PCMS AND ARTIFICIAL INTELLIGENCE – WHAT DOES THE FUTURE HOLD?

The CBM systems we know today are based on sensors and techniques such as trend- and vibration analysis. While they are effective, they rely on engineering rules and their application is limited to specific failure modes. In short, every issue that needs to be monitored requires an engineer to design a rule to detect it.

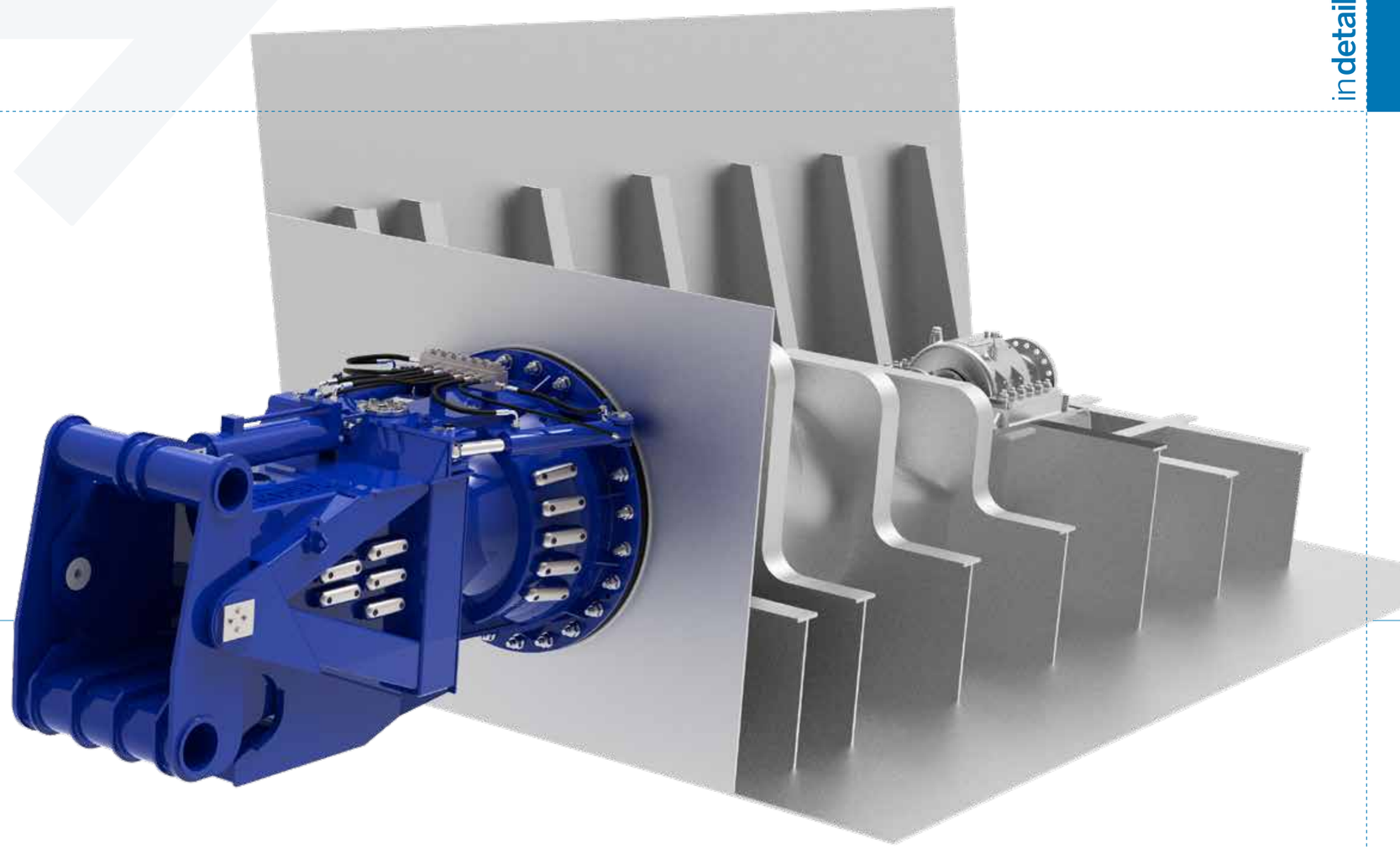
Looking to the future, advancements in Artificial Intelligence (AI) and automation stand greatly to enhance the sophistication of CBM systems such as the PCMS. With the advent of Machine Learning (ML) technologies such as Google's TensorFlow, the world of CBM stands before a major paradigm shift. In the coming years, there is reason to believe that these systems will come to rely less on the rigid rules of engineering and more on the flexibility offered by ML algorithms. Holistic solutions will replace point solutions and periodic reports will be a thing of the past, as real-time reporting becomes the new normal. Backed by the enormous processing power of AI, the ML algorithms will immediately and automatically analyse all incoming data, enabling human experts to dedicate less time to crunching numbers and troubleshooting, and more time to supporting customers and delivering support and value-adding optimisations.

In short, AI will make us more proactive, helping us detect and solve problems more quickly and accurately. Customers of the future will be able to expect enhanced levels of service, more precise prediction of problems and faster planning and execution of preventive maintenance. The work that currently has to be carried out by humans will eventually only need to be supervised by humans, allowing Wärtsilä to provide a faster, more reliable service than ever before.

WÄRTSILÄ WATERJETS SURGE AHEAD

▶ **TEXT:** ANNA GUSTAFSSON **ILLUSTRATION:** WÄRTSILÄ

THEY HELP POWER some of the world's biggest and fastest vessels. Find out why Wärtsilä's waterjets have gained a reputation for being lightweight, powerful and durable.



At the Armon Gijón shipyard in north-west Spain, one of the world's largest LNG-fuelled high-speed catamarans, a multi-hull watercraft featuring two parallel hulls of equal size, is coming to life. Once completed, the 125-metre-long ferry will carry 1,200 passengers and 500 cars at speeds ranging from 35 to 40 knots, or about 65 to 75 kilometres per hour.

Built for Spanish ferry operator Baleària, it is scheduled to start operations in the summer of 2020. The new ferry will "shape the future of high-speed, gas-powered catamarans and trimarans," says **Juan M. Paino**, CTO at the Armon Gijón shipyard.

The new ferry is equipped with several Wärtsilä technology solutions, including four Wärtsilä LJX1500SRI waterjets, four Wärtsilä 31DF dual-fuel engines, LNG storage and supply systems as well as auxiliary systems. The storage tanks will allow the ferry a range of 400 nautical miles.

The combination of Wärtsilä dual-fuel engines and waterjets being commissioned to the same high-speed vessel is something that excites the waterjets team at Wärtsilä, especially since waterjets were not always considered a natural extension of the broad portfolio of marine technology solutions that Wärtsilä offers.

"Waterjets are commonly used in combination with high-speed engines, so a combination with the Wärtsilä 31DF engines is exciting," explains **Jeroen Vedder**, Sales Manager, Waterjets at Wärtsilä.

However, the recent launch of the Wärtsilä 14 high-speed engine in 12 and 16-cylinder configurations has now opened up a plethora of new possibilities to offer complete packages including waterjets.

MIDSIZE TO MODULAR JETS

Wärtsilä's waterjet portfolio consists of two types: midsize and modular waterjets, which have a range of approximately 500 kW up to 33,000 kW. The main difference between the two is in the way they are delivered to the customer.

"The strength of the midsize is the shorter delivery time and the use of aluminium components built together on a skid. The modular waterjet, on the other hand, offers a high-level of customisation with a wide variety of options available depending on the vessel type," says Vedder.

Both the midsize and the modular waterjet have their own unique selling points. For smaller-sized vessels, a pre-assembled, plug-and-play waterjet that is mounted on a skid and has a significantly short delivery time is great. It reduces installation time at the shipyard and therefore can reduce costs.

"The midsize waterjet, including the inlet duct, is completely built in-house at Wärtsilä. However, this way of building limits the size to a smaller range, as otherwise the package would be too big to handle," explains Vedder. "On the other hand, the modular waterjet is more customisable and can be used for many special one-off projects."

Wärtsilä is now concentrating on developing the midsize and modular waterjets even further.

BOTH THE MIDSIZE AND THE MODULAR WATERJET HAVE THEIR OWN UNIQUE SELLING POINTS.

BRAND-NEW SERIES

Vedder is working on a redesign of Wärtsilä's Modular waterjets at the moment. The last time the modular waterjet design had a big revamp was in July 2006, when Wärtsilä introduced the LJX range of waterjets. The new waterjet with an axial pump design comes with a 25% reduction in mounting flange diameter, a 10% overall weight reduction and a 35% increase in cavitation margin compared with its predecessor, the LJ type with a mixed flow pump design. The redesign will see the LJX-series evolve into the new WXJ-series.

This new modular WXJ waterjet series will feature an improved axial pump design, which will boost performance with an increased thrust of as much as 3%, while the improved cavitation margins will help reduce environmental impact by lowering noise levels.

"This is very much in line with Wärtsilä's 'Smart Marine' vision, which is to lead the maritime industry into a new era of ultra-high efficiency, improved safety and reduced environmental impact," says Vedder.

The new axial pump structure is already a factor that sets Wärtsilä apart from its competitors in the market for larger size waterjets. Compared with the mixed flow structure, the axial pump needs much less space in the vessel's transom and increases cavitation margins for better operational flexibility. Furthermore, there is a significant weight difference that tilts the argument in favour of the axial pump rather than the mixed-flow pump.

The new WXJ pump has been tested extensively, both with computational fluid dynamic (CFD) simulations and with model testing. With this successful upgrade, Wärtsilä is now in a position to deliver waterjets worldwide, including to promising markets like China and other Asian countries.

A CLASS APART

Vedder lists other advantages that set Wärtsilä waterjets apart from other products in the market. For instance, all Wärtsilä waterjets have an inboard mounted thrust bearing. Technically, this means that the thrust bearing is not within the water flow of the jet, which means there is never a risk of oil leaking into the water.

"Usually the equipment that makes the jets steer and reverse is located outside the vessel, and is being exposed to the sea water," explains Vedder. "This means it can sometimes be difficult to maintain and repair. But we have the option to install them inside the vessel, which allows early and easy detection of possible oil leakage."

Meanwhile, the Wärtsilä waterjets team is continuously working on innovative solutions that will open new possibilities for Wärtsilä's new and existing customers.

"The team has listed a number of revolutionary ideas. I am looking forward to the future with enthusiasm," says Vedder.

DID YOU SAY SYNTHETIC FUELS?

▶ **TEXT:** TOMMI RINTAMÄKI **PHOTO:** WÄRTSILÄ

AS WÄRTSILÄ CONTINUES to pursue a 100% renewable energy future, one emerging technology that looks set to play a major part in the process is synthetic fuel production. Find out how the generation of synthetic fuel from excess CO_2 emissions – the so-called 'Power-to-X' process – holds the key to a carbon-neutral future.

Up until now, renewable energy generation has been driven by weather, but renewable energy can also come from a range of other processes where any kind of excess is created, and – perhaps most crucially – from those that generate excess carbon in the form of emissions.

Power-to-X is an umbrella term for a number of different emerging technology solutions for electricity conversion, energy storage and energy reconversion, all of which use surplus power in one form or another.

Power-to-X is going to play a key part in the future of energy generation – from power-to-gas solutions, where electricity is used to split water into hydrogen and oxygen through electrolysis, to solutions where hydrogen from an electrolyser is combined with carbon dioxide and the two gases are converted into synthetic renewable methane, as well as other potential power-to-fuel solutions that can be developed to create synthetic fuel.

SYNTHETIC FUELS TO MITIGATE CLIMATE CHANGE?

There is a growing consensus that synthetic fuel is set to play an important role in mitigating climate change. What makes the possibility of generating fuel from excess CO_2 such a compelling prospect is that it has the potential to create a circular carbon economy, whereby the CO_2 that would otherwise be released into the environment is instead reused, thus minimising the climate impact of CO_2 and preventing new fossil resources from being exploited for fuel.

Instead of continuously using more and more of the planet's precious fossil fuel reserves, Wärtsilä envisages a future in which it will be possible to capture the CO_2 that is emitted from combustion processes from the air and recirculate it in what could potentially be an infinite energy loop.

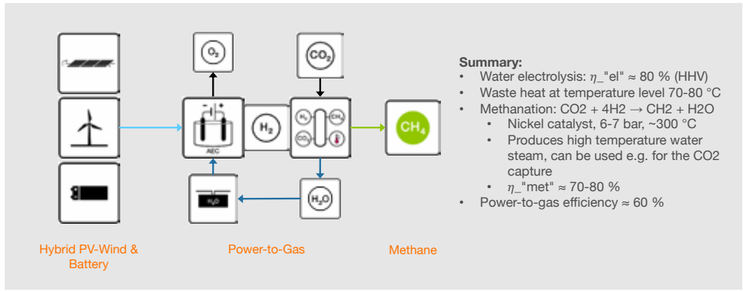
Power-to-X currently remains the missing piece of the puzzle as Wärtsilä seeks to achieve its vision of a 100% renewable energy future. However, this year, measures are being put in place to ensure that these technologies will be made available to be incorporated into future products and services from Wärtsilä.

DIRECT AIR CAPTURE OF CO_2

So what goes into the process of capturing and reusing CO_2 in order to form synthetic fuel?

There are three key ingredients: carbon dioxide, hydrogen and renewable electricity. Hydrogen can be obtained from water using an electrolysis process, which splits it into hydrogen and oxygen. Meanwhile, carbon dioxide comes from various industrial processes as a waste stream or is captured directly from air. The two are combined together through a chemical synthesis using catalytic conversion technology

POWER-TO-X IS GOING TO PLAY A KEY PART IN THE FUTURE OF ENERGY GENERATION.



The power-to-gas process.

and renewable electricity as a power source. The process produces synthetic fuels. There are various conversion processes available to produce a variety of synthetic alkanes.

When combined together, carbon and hydrogen produce hydrocarbons, or alkanes, such as methane, methanol and dimethyl ether (DME), all of which can be used as fuel across a variety of power generation and transportation applications.

Whereas traditional hydrocarbons are refined from crude oil, synthetic hydrocarbons are created through a chemical synthesis process such as the one detailed above. Both synthetic and traditional hydrocarbons can be used as fuel.

SEEKING SYNTHETIC FUEL PARTNERSHIPS

Up to now, "quick-fix" technologies designed to resolve the climate change issue have been regarded with suspicion by the global scientific community. However, plans to capture CO_2 directly from the air – essentially imitating the natural behaviour of trees – have begun to gain more and more credibility.

This concept was, in fact, first developed by German physicist **Klaus Lackner** in the mid-1990s, but has more recently been adopted by a number of companies around the world, as direct air extraction has become an increasingly viable prospect.

Earlier this year, Iceland's Carbon Recycling International (CRI) was named the winner of the SparkUp Energy Challenge, a competition arranged by Wärtsilä to identify start-ups in the Power-to-X technology field and to jointly develop future technologies with them.CRI's solution is based on a technology that uses CO_2 and hydrogen made with renewable power and turns them into synthetic methanol. Through the SparkUp Energy Challenge, Wärtsilä has taken a new approach in exploring business opportunities in emerging technologies, bringing the Wärtsilä venturing model to life through start-up collaboration.

CRI is already producing renewable methanol from carbon dioxide, hydrogen and electricity on a commercial scale for fuel applications, greener chemicals and products at its production facility in Grindavík, Iceland. It also has the capacity to engineer, build and operate emissions-to-liquids methanol production plants. The company will be collaborating and co-creating solutions alongside Wärtsilä's energy experts, with a view to maximising the synergies between the two companies.

A FUTURE PACKED WITH POTENTIAL

Synthetic fuels can effectively be applied everywhere that fossil fuels are currently in use today – from aeroplane engines to cars, trucks, power plants and seagoing vessels.

From Wärtsilä's perspective, there is also good potential to use synthetic fuels in engine-based power plants as well as across other Wärtsilä engine products. The precise area of application will depend on the type of fuel that needs to be used.

For example, whereas synthetic methane would typically be used in a gas engine, synthetic methanol and synthetic DME would be most suited to a diesel engine with dual-fuel pilot injection.

At this time, synthetic fuel production is still in its infancy. The processes, systems and technologies required to make this vision a reality are still in the pilot stage and will need to be extensively evaluated for both commercial and technical feasibility before they can be scaled up and industrialised. However, with evidence suggesting that this fuel option could be 100% CO_2 neutral, it is widely regarded as a very promising prospect, one that could be further developed over the next five to 10 years.

As things stand, Wärtsilä remains firmly committed to developing Power-to-X concepts in general, and synthetic fuels in particular, to the point where they will be ready to realise their full potential and have a truly positive impact on the future of the planet.

ARE YOU READY TO BID?

TEXT: SAMI ANTEROINEN **PHOTO:** 123RF

IT IS NOT ELECTRICITY alone. Heating energy needs to become clean as well. In an award-winning paper, Wärtsilian Jan Andersson discusses the feasible bidding strategies under the new Combined Heat and Power (CHP) Act with the German CHP auctions as a case in point.

Electricity prices in Germany have been falling thanks to the growing use of renewable energy sources. To spur the transition towards a more flexible and modern energy system, Germany adopted Electricity Market 2.0 in June 2016. Under this new electricity market system, which is designed to help the country make a smooth transition into renewables, the German Federal Parliament revised regulations under three main categories to reorganise Germany's power system: the power market law, a capacity reserve decree and a new law on the digitalisation of the energy transition.

While these are new changes, the Combined Heat and Power (CHP) Act (Kraft-Wärme-Kopplungsanlagen, KWKG) has been in place since 2002 and is another key element in making this energy transition successful. CHP plants generate heat and power simultaneously whilst keeping carbon emissions low. Thus, the German Federal Ministry for Economic Affairs and Energy has been incentivising investment in CHP installations with the aim of raising the level of CHP-based power generation.

The Act is quite flexible, and the government has been revising it from time to time to give greater incentives to quicken the adoption of the technology. The latest amendments came in 2017 when the government decided to have an auction for innovative CHP systems. According to the ministry's website, "This new category of funding is intended to open up promising new prospects for combined heat and power and to provide incentives for necessary investment in flexible technologies."

This offers great possibilities for German utilities, since an auction serves as a driver to enhance innovation and flexibility in CHP production.

Jan Andersson, Market Development Analyst, Energy Business, at Wärtsilä, has studied the CHP auction scheme closely. In his paper "Flexibility is the New Black – How Flexibility Enhances Value in CHP Portfolios", Andersson analyses three bidding strategies and explains how innovative and flexible technology adds value for utilities in this new market landscape. His work was awarded the Best Paper at Electrify Europe 2018 (formerly known as PowerGen Europe).

Here are the highlights of his paper:

UNCERTAIN CHP AUCTIONS

When the subsidy rates for traditional CHP plants of 1 MW up to 50 MW were auctioned for the first time in Germany, on 1 December 2017, a pall of uncertainty descended on the participants before the auction. What results could be achieved through an auction? Which bidding strategy would be successful? And how could the overall profitability of CHP projects be presented under these framework conditions? These were some of the many questions they worried about.

The capacity of the first auction was 100 MW. With subsidy rates of up to EUR 70 /MWh, participation in the auction was attractive for many companies.

Finally, the first auction was cleared at the range of EUR 32–50 /MWh for a total of 83 MW.

Ever since, there has been an increasing interest among the participants to bid into the upcoming auctions. This interest is also partly fuelled by the fear that the CHP subsidies could be discontinued in the future, and thus any investment needed for replacement or extension should be undertaken as soon as possible and under the regulations of the current CHP Act.

THE ART OF AN AUCTION STRATEGY LIES IN FINDING A BID LEVEL FOR THE PROJECT THAT ACCURATELY REFLECTS THE RETURN VERSUS RISK APPETITE.

The current KWKG Act aims to increase the co-generated power generation to 110 TWh in 2020 and to 120 TWh by 2025. The central instrument here is the auctioning of KWKG subsidies for the generation of CHP electricity.

EVERYTHING BUT COAL

Participation in the tender is compulsory for all new and modernised CHP plants with an electric CHP capacity between 1 MW and 50 MW. However, a transitional provision stipulates that facilities that were ordered in 2016 or have been granted a permit in accordance with the Federal Immission Control Act (BImSchG) and were to be put into operation in 2018 are eligible to participate in the tender procedure.

The promotion of CHP power generation is basically possible for all fuels except coal. This means that CHP plants, for example, based on biomass (solid, liquid, gaseous), waste-based plants, as well as gas-based CHP plants, are eligible to participate in the auction.

The auction distinguishes between traditional CHP and innovative CHP schemes. The auction held in December 2017 only considered traditional CHP, whereas the auction in June 2018 also included innovative CHP schemes.

TRADITIONAL VERSUS INNOVATIVE

Let's start with the traditional CHP scheme. This focuses on the CHP performance of fuel-fired plants, which is similar to the guaranteed CHP scheme for plants larger than 50 MW. No additional technological specifications are made for this scheme. The legal framework provides for a maximum CHP bonus of EUR 70 /MWh to traditional CHP plants. In addition, subsidies for conventional CHP plants are limited to a total of 30,000 full-load hours. Also, twice a year, 75 MW of KWKG subsidy is auctioned under the traditional CHP scheme.

The innovative scheme, on the other hand, includes CHP plants that are combined with renewable heat generation technologies and additional power-to-heat technology, meaning CHP plants that combine heat pumps, solar thermal or geothermal energy. Here, the share of renewable heat must amount to at least 30% of the annual total heat production from the plant.

For innovative CHP systems, the maximum subsidy rate is EUR 120 /MWh and this subsidy is limited to 45,000 full-load hours. Twice a year, 25 MW of KWKG subsidies is auctioned under the innovative CHP scheme.

In addition, there is an annual limit for the subsidised amounts of energy. To encourage more flexible plant operation, the subsidy is paid for a maximum of 3500 full-load hours per year. Only the first 3500 full-load hours of a year are eligible for a subsidy.

Herein lies an optimisation challenge: the plant should run for the 3500 hours with the highest electricity prices during the year. However, it does not mean that the plant cannot be operated after reaching this annual limit of full-load hours. It only means that these excess operating hours will not be eligible for a subsidy.

SELECT THE RIGHT STRATEGY

This is where choosing the right strategy comes into play.

Before bidding on the auction, a bidding strategy should be worked out. The art of an auction strategy lies in finding a bid level for the project that accurately reflects the return versus risk appetite. However, this should not be a decision based on gut feeling. Instead, it should be anchored on a sound analysis of the energy market.

There are no simple strategy recommendations. An individual strategy development that includes the following three factors is necessary:

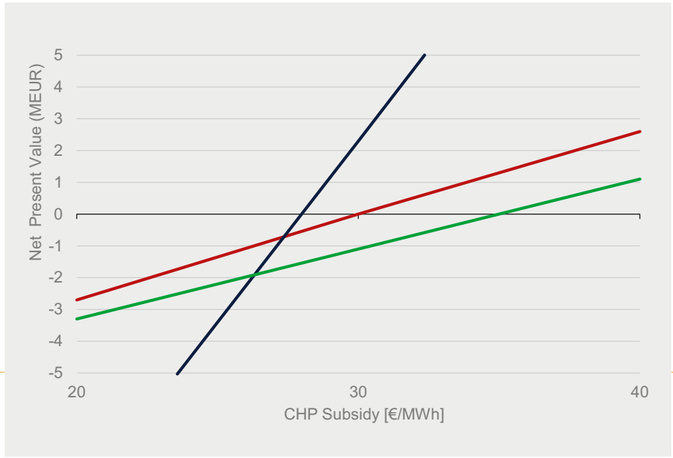
1. Successfulness: It is necessary to realise that the project plays an important role, i.e., that there is a need to replace an existing CHP plant or increase capacity in order to maintain the heat supply of customers.

2. Risk appetite: The risk preference differs from bidder to bidder and from project to project. Certain companies will be prepared to accept a lower probability of success if the expected return is favourable while others may not.

3. Competition: Not only the costs of your own project are relevant, but also the costs and bid strategies of your competitors. This requires an analysis of which projects might be included in the auction round and at what cost. Once an assessment of the above-mentioned topics has been done, a promising bid strategy can be defined based on an optimised bid markup and the probability of winning.

THE MATH BEHIND THE BID

In a pay-as-bid auction, every successful bid receives the amount with which it went to the auction. Therefore, the optimal bid is the one that is as close as possible to the last bid still to be cleared. Thus, unlike the



CHP subsidy versus net present value.

THE HEATING SECTOR IS OFTEN OVERLOOKED WHEN DISCUSSING EMISSIONS AND REDUCTION TARGETS.

pay-as-cleared method, pay-as-bid auctions require strategic bidding behaviour.

However, since no bidder knows the marginal price at the time of participation, there is an inevitable trade-off: the higher the bid, the lower the probability of winning but better profitability in the event of a successful bid.

Methodologically, in past pay-as-bid auctions, it has helped if the bidding strategy was determined in two steps. First, determine the minimum bid or the so-called indifference price. Second, determine whether it makes sense to bid above the indifference price, also referred to as the strategic bid markup.

The indifference price is the bid price at which the bidder does not care whether he or she wins the bid or not. The basis for determining the indifference price is formed by accurate estimates of cost, revenue and risk structure of the project. Auctions mean competition, and any competitive advantage can be converted into a higher probability of winning or obtaining better project returns. Therefore, accuracy is very important here.

One of the main aspects of setting the indifference price is costs, especially investment costs. Investment costs can be determined relatively accurately; however, the critical point here is to consider the full scope of the project. The second part is determining a risk-adjusted minimum return for the project. It is often seen that most internal discussions are around this topic as the operation of a CHP plant is not a risk-free business. Even if the CHP subsidy is safe, technical risks and, of course, the electricity-price risk remains.

Hence, the next natural step is to make an estimate of future market developments: electricity price, gas price, heat revenue and other variable factors.

It is important to make the decision-making process and calculations to arrive at the indifference price as objective as possible. It is also important to keep in mind the internal interests of the company and, if necessary, include a third-party perspective. If all the above points are taken into account carefully, the result is a neutral indifference price.

LESSONS LEARNED

What is the overall picture of the profitability of the plants? The figure above shows the determined break-even CHP subsidies of the plants. The point where the lines intersect the X-axis is the "break-even CHP subsidy rate".

Overall, the level of subsidy rates required is low. The plants considered here, larger gas engine power plants, can hence be very competitive in the auction.

The level of subsidy required for traditional plants is in the range of EUR 25 to 30 /MWh. The bigger plants tend to have lower break-even rates, meaning they have a lower need for subsidies. This is due to the lower specific investment and operating costs of the plants.

For the innovative scheme, the break-even value lies at approximately EUR 35 /MWh, which is less than what could be anticipated considering the small size of the plant and the additional capital cost of solar collectors and heat pump. However, the longer eligibility period of 45,000 full-load hours is one obvious explanation. In addition, a couple of conclusions can be made based on the result.

One, the inclusion of renewable heat generation equipment gives more flexibility even to the heat generation side. This gives the opportunity to optimise heat generation irrespective of electricity production.

Two, despite the positive effects of renewable heat generation assets, the related investment cost still outweighs the benefits. However, decreasing investment costs and increasing emission costs could change this rapidly.

GOING FORWARD

The first auction held in December 2017 cleared in the range of 32 to 50 EUR/MWh with two plants greater than 30 MW capacity. After analysing the results of the December auction, it is clear that the above method picked the low end of the subsidy rate and tends to favour larger projects over smaller ones. The higher end of the interval is clearly below the maximum of EUR 70 /MWh, which is also an indication that the bidders did more than speculative bidding.

Since KWKG does not include any fuel switch premiums for coal replacement projects in the auction segment, the economic effects of this additional remuneration were not taken into consideration. However, it is apparent in the market that many projects are attempting to project larger systems (greater than 50 MW) and thus obtain the fuel switch premium outside of the auction segment.

The heating sector is often overlooked when discussing emissions and reduction targets. The fact is that the generation of heat in Germany accounts for roughly the same amount of CO_2 emissions as electricity generation. Therefore, the initiative to include renewable heat generation as a special segment in the KWKG shows the will of the German government to reduce emissions in the heating sector as well. Even though renewable heat generation technology still requires higher investments, it is pointing towards a new, more environmentally friendly future for CHP.

PHOTO: COURTESY OF GOLDEN GLOBE RACE / CHRISTOPHE FAVREAU / PPL / GGR

EXT. HARRY LAWRENCE

Tapio Lehtinen's adventure of the seas

After spending 322 days at sea, **Tapio Lehtinen** became the fifth and final skipper to finish the 2018 Golden Globe Race. Marking the end of the competition, he arrived at Les Sables-d'Olonne on 19 May 2019.

Lehtinen, in partnership with Wärtsilä, set off on his boat, the Asteria, on 1 July 2018. Only 12 days into the expedition, his high-frequency radio stopped working properly. While dealing with this problem, he also had to nurse an infection on his hand and adjust to a new self-steering system. Then in August, as he passed the equator, new problems arose with his engine and solar panels. Lehtinen knew that losing even one power source would mean that he might need to stop over in Cape Town, which would halt his progress.

In the face of adversity, Lehtinen chose safety and pragmatism. On 15 August, he sent the message, "FIXED DAMAGED SOL PANEL AS CLD, CHANGING PANEL CONNECTIONS."

On 10 September, Lehtinen rounded the Cape of Good Hope, neck-to-neck with US sailor **Istvan Kopar**. After facing a large storm, he managed to push ahead of Istvan and find some good wind conditions. This move proved to be vital as the Asteria's engine stopped working at the beginning of October.

Ever the optimist, Lehtinen insisted he did not need the engine to keep sailing. "I love sailing, and I love the sea. Making the boat bigger or adding gadgetry doesn't improve the sensation or experience. In my opinion, it makes you duller towards the essentials."

Even without a fully functioning engine, October felt like much more of a break for Lehtinen as he sailed close to Kopar for 5,000 km eastwards through the Southern Indian Ocean. However, this momentum ground to a halt on 29 October with what was arguably the biggest setback of the entire journey – he discovered a goose barnacle infestation on the underside of his boat.

The continuously bad weather throughout November meant there were no opportunities to fix the barnacle problem. As soon as the weather became good enough to allow him to dive into December, a pair of sharks circled his boat for an entire day.

To find out what happened after that, read the full story on wartsila.com/twentyfour7.

Sign off

TEXT: DAVID J. CORD **PHOTO:** BENJAMIN SUOMELA

[AT YOUR SERVICE]

A matter of life and death

AS THE ENVIRONMENT, HEALTH and Safety Development Manager at Wärtsilä, **Ville Sulonen's** business is to make sure people stay safe and healthy.

1 HOW DID YOU BECOME THE ENVIRONMENT, HEALTH AND SAFETY DEVELOPMENT MANAGER AT WÄRTSILÄ?

I began doing this 15 years ago at a shipyard. We had a major incident with an employee who was an 18-year-old boy. I spent that day with his best friend, who was also a co-worker. When the boy died, I had to tell his best friend. That was the worst day of my career. This is why I do what I do: save lives.

But I was always keen on protecting the environment. I went to school for Environmental Engineering Technology. Along the way I had the option to study safety engineering and became interested in it. As I got deeper into it, over time, I realised this is really about people. Today I'm passionate about it. These past eight years at Wärtsilä have been really to-the point with what I enjoy the most!

2 HOW IS DIGITALISATION CHANGING HEALTH AND SAFETY?

Digitalisation is important because it gives us new tools. For instance, we implemented the WeCare mobile app, a comprehensive programme for accident, near miss and hazard reporting. I hope this is part of our DNA now: a way for us to keep our eyes open.

We also have the Job Safety Analysis tool. This helps field service personnel check emergency exits, the condition of tools, the general housekeeping of the site, electrical isolation and a variety of issues. This is a great tool and one of the best in the industry.

3 WHAT ARE THE MAIN CHALLENGES YOU FACE IN MAKING WÄRTSILÄ A SAFER PLACE TO WORK?

The first challenge is the individual's mindset. For instance, if you hurry or are a little tired you can have really simple accidents. The second big challenge is how to enable a safe workplace in any challenging location. This is important on the management level when we are planning a job and setting the resources.

I think my greatest accomplishment is helping change the safety culture at Wärtsilä along with my colleagues. We have worked to change the mindset of people so they are conscious about safety. Our future is zero accidents. We have already seen many positive results and we have reduced incidents a lot already, but we still have opportunities to improve. We have a lot to do yet and there is a long way to go.

"I THINK MY GREATEST ACCOMPLISHMENT IS HELPING CHANGE THE SAFETY CULTURE AT WÄRTSILÄ ALONG WITH MY COLLEAGUES."

ILLUSTRATION: SHUTTERSTOCK

[CLASSIC]

Sphere of influence

The retail price tag of over EUR 6000 may explain why the ball chair is more easily found on the covers of style magazines than in actual homes.

Aarnio installed a red telephone on the wall of his chair. Newer versions have options for MP3-player integration. The unusual shape and overall weirdness has earned the ball chair cameos on "The Prisoner" TV series and the sci-fi comedy "Mars Attacks".

Though the chair's dimensions have grown over the years, the manufacturer insists you can still squeeze it into your room so long as your doorway is at least 80 cm wide.

The globe-shaped chamber blocks out sounds from the outside, creating a calming atmosphere and privacy for the user.

ORIGIN

In 1963, Finnish designer **Eero Aarnio** spun his need for a comfy, at-home working space into what's now a 20th century furniture icon. More than just a "room within a room," the ball chair put the mod in modernism and became emblematic of what the future seemed like for the moptop generation.

TECHS & SPECS

Designer
Eero Aarnio

Dimensions, weight
110 cm × 97 cm × 120 cm, 40 kg

Materials
Acrylic frame, steel pedestal, fabric or leather upholstery

[CULTURE WATCH]

[SCIENCE]

The brain link between taste and odour has long been known, but new research indicates that your tongue can, in fact, smell. Scientists at the Monell Chemical Senses Center in Philadelphia discovered that their lab-grown taste cells contained the same sensory molecules found in the olfactory system. The news suggests that the tongue's tasting process is far more complex than the "sweet, salty, sour, bitter and savoury" we all learned in school.

[LITERATURE]

If you are any kind of maker, in the widest sense of the term, you'll find inspiration in *Every Tool's a Hammer: Life is What You Make It* by **Adam Savage**. In his famously entertaining style, the tech guru and serial blower-upper of things on "Mythbusters" shares practical advice about tools and techniques, as well as perspectives that will motivate you to follow your creative passions, be they in carpentry, coding or poetry.

[TECHNOLOGY]

Joke all you like about Facebook users having one foot in the grave. A recent study from Oxford using UN mortality data estimates that the number of zombie profiles, i.e., those of the dead, on the site will outnumber those of the living by the year 2070. This virtual crypt would no doubt provide an unprecedented treasure trove of data for future historians, though the research also raises critical questions about how social media platforms should manage our digital remains.

TEXT: SILJA KUDEL **PHOTO:** PAT WOOD

"I have noticed genuine changes in the environmental conscience of everyday youth," says Seabin Youth Ambassador Portsea Turton.

[AMBITION]

More power to Seabin

Seabin Youth Ambassador Portsea Turton is inspiring young Australians to turn the tide on ocean plastic pollution. Read on to find out how she has turned her passion for the waves into a force for good.

"The sea, once it casts its spell, holds one in its net of wonder forever." This oft-quoted line by **Jacques Cousteau** holds true both for **Portsea Turton** and the kids she educates as a Youth Ambassador at Seabin, a global project dedicated to finding a long-term solution to the alarming problem of ocean pollution.

Turton, a student of Marine Science at Queensland's James Cook University, came under the spell of the sea while growing up on the East coast of Australia. "My family has been camping, boating, snorkelling and diving for as long as I remember. My admiration for the ocean has led to a natural passion to preserve it," she states.

Her passion finds a welcome outlet at Seabin, a project started in 2015 by two Aussie surfers who literally got sick of swimming in garbage and decided to do something about it. Together they pioneered an innovation: a suction-powered garbage skimmer that sits in the water sucking in plastic and other floating debris.

But the Seabin Project is about more than just a clever garbage bin. Embracing various educational initiatives, the project unites governments, industry leaders, advocates, artists and schoolchildren in a quest to fight the sea of plastic that threatens to clog up our oceans.

There are currently 719 Seabins installed in harbours, ports and marinas around the world, with future models moving off the dock and out into open water. One Seabin gathers as much as 3.9 kilograms of waste per day – water bottles, cigarettes, plastic bags and Styrofoam – with 14,916 kilograms of debris captured globally to date.

Turton jumped at the chance to join a project she sees as offering a solution to tackling the marine debris crisis. "I feel confident that with so many passionate and innovative minds involved, there's no better time to turn the tide on plastic pollution than now," she states.

EVERY DROP COUNTS

Wärtsilä was the first major industrial company to partner with Seabin in 2017, playing a critical role in the early phase and has by now sponsored 35 Seabins around the world. The company's involvement in the project continues to deepen; besides donating more Seabins, Wärtsilä is active in spreading awareness and joining forces with other like-minded organisations. Currently, one of Wärtsilä Seabins is touring with the Zero emission team and educating people in European sailing races. In September, Wärtsilä's voluntary diving group is scheduled to take part in Project AWARE to pick up trash from the bottom of the sea.

To gain insights on the true impact of Wärtsilä-donated Seabins, a special 'data weeks' event is being organised this summer to monitor the type and volume of waste that is captured in each bin.

Among the various educational initiatives in which Wärtsilä is involved, the Trieste team in Italy is conducting a joint marine waste study with the local university. Wärtsilä Norway has hosted events where kids take part in emptying Seabins and engaging with experts.

Educating youth is also the focus of Turton's work at Seabin, which includes video-calling school kids and interacting with them around topics related to marine pollution.

"Recently I video-called a kindergarten in Melbourne, and I was blown away by the unique and innovative concepts developed by the students. Following our call, the class partook in a Seabin-inspired World Oceans Day event where they upcycled materials to create a series of clever items," she enthuses.

As a World Oceans Day Youth Advisory Council Member, Turton works with motivated youth from around the world to tackle plastic pollution.

"I have noticed genuine changes in the environmental conscience of everyday youth. I personally hope to continue working with the Seabin Project and would like to encourage everyone to make small actions and swaps in their everyday life to change their own habits," she urges.

"Don't be overwhelmed by the scale of the problem. An action as simple as bringing your own reusable coffee cup or picking up rubbish left on the ground is enough to influence onlookers. Begin with your own actions and work up from there."

"MY ADMIRATION FOR THE OCEAN HAS LED TO A NATURAL PASSION TO PRESERVE IT."

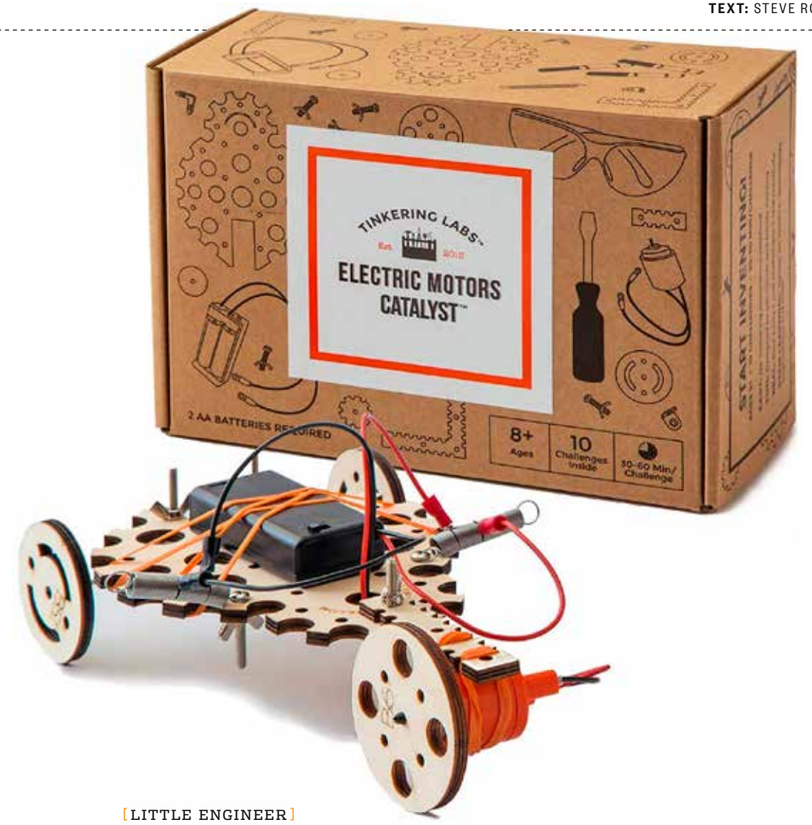
[THE GEAR]

Whether or not you are heading into any sketchy areas, you'll be guaranteed peace of mind with the Stylesafe anti-theft sling backpack from **Pacsafe**. Its villain-foiling features include slash-proof materials, security zippers and RFID blocking. It also has loads of handy pockets and space for a 10-inch tablet.

Travelers who use the vacuum-bag method for packing will love the **Vago Portable Luggage Compressor**. Fed by your micro-USB charger, the lightweight, 7 cm dynamo generates 225 mmHg (millimetres of mercury) of suction power, shrinking most packs in just 5 minutes.

Here's a clever way to stay hydrated during your journey while avoiding those pesky single-use plastics. The 750 ml **Imikoko Collapsible Water Bottle** is made of squishy, food-grade silicone so it can be folded for easy storage. It is completely dishwasher safe and comes in four eye-catching colours.

TEXT: STEVE ROMAN



[LITTLE ENGINEER]

Tomorrow's Teslas

TRY ASKING EIGHT-YEAR-OLDS to plan for a low-carbon, electric-powered future. Notice the confused stares? You might as well have told them to explain cosmic expansion or eat their veggies. A much better way to nudge youngsters onto the path of creative problem-solving comes in the form of the **Electric Motors Catalyst**, an invention kit that lets little engineers build and rebuild endless robotic devices.

Concocted by Silicon Valley-based Tinkering Labs, the set comes packed with dozens of electric and wooden components, bits of hardware, tools and child-sized safety goggles.

Young inventors are prompted into action by 10 Challenge Cards listing projects like building a model car, a doodling robot or a machine that can scramble an egg (egg not included). Though there's a Techniques Booklet to get things rolling, you won't find any step-by-step instructions here. Instead, kids are encouraged to find their own unique solutions, even if those involve adding Legos, bits of string or whatever else is handy.

The fun doesn't stop when the challenges are complete, since there's really no end to the number of mad machines can be fashioned together. If further inspiration is needed, you can visit the tinkeringlabs.com website to see what other little geniuses around the world have come up with.

Recommended for ages 8 to 12.

PHOTO: BENJAMIN SUOMELA

The marathon task of transforming an industry

IF YOU GO BY RECENT EVENTS, it's no exaggeration to say that the planet is suffering thanks to mankind's hubris.

Europe has seen record heat waves. Arctic ice is melting, the Amazon is burning. Microplastics are everywhere. 91% of the world's population lives in places where air quality exceeds WHO limits. The latest IPCC report warns that we have less than a decade to avert a climate catastrophe by limiting global warming. People worry these events portend certain doom.

But I firmly believe the maritime industry can be at the frontier in devising and providing clean solutions for a brighter future. Approximately 90% of world trade, worth at least USD 24 trillion in goods and services, generating a GDP of USD 2.5 trillion annually, is carried by sea. This gives us enormous leverage. Yet, at the same time, slow adoption of new technologies has resulted in massive inefficiencies. The silver lining - we can solve these problems very quickly if we work together.

This is what makes global initiatives such as An Oceanic Awakening and SEA20 so important. They provide an open invitation to the planet's best and brightest to cooperate, innovate, legislate and embrace new solutions in marine and energy.

The response has been overwhelming. We are delighted to see cities join SEA20 and hope to exceed the promise we made in 2018. To date, we have reached out to over 250 potential contributors, held interviews, and will be publishing a Global Analysis on Marine and the Environment by the end of the year. The first high-level SEA20 meeting held in Helsinki attracted mayors, politicians, and industry leaders, together with whom we agreed to develop the SEA20 2020 principles - all in support of preserving our oceans and creating a sustainable future.

Ultimately, we must change consumer mindset to focus beyond price and consider the impact and footprint of every decision we make. This is a marathon that will stretch well beyond 2020. As a result of An Oceanic Awakening, we hope to see SEA20 grow organically across the globe and become a trigger to meet and exceed IMO's 2020, 2030 and 2050 goals, while helping the maritime industry embrace digitalisation and create an efficient, interconnected and sustainable ecosystem.

At Wärtsilä, we are proud to be part of this global movement. We will continue to invest our time and expertise in this inspirational journey of transformation. The question is: will you join us in delivering a future we can all be proud of?

Andrew Calzetti
Marketing Director
Wärtsilä Marine Business