Twenty four7.

Wärtsilä Stakeholder Magazine

→01.**2018**

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*Wärtsilä Stakeholder Magazine**

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in detail

Publisher: Wärtsilä Corporation | John Stenbergin ranta 2 | P.O. Box 196 | FI-00531 Helsinki | Finland | Telephone: +358 10 709 0000 | **Email and feedback:** twentyfour7@wartsila.com | **Editor-in-Chief:** Atte Palomäki | **Managing Editor:** Virva Äimälä | **Editorial team:** Marit Holmlund-Sund, Mari Kankaanranta, Dan Pettersson, Mirja-Maija Santala, Sanni Suominen, Mikaela Terhi, Minna Timo | **Editorial office and layout:** Spoon Helsinki | **English editing:** Michael Miller | **Printed by** Punamusta | Joensuu | Finland | **ISSN** 1796-2161 | WÄRTSILÄ® is a registered trademark | Copyright© 2018 Wärtsilä Corporation | **Paper:** cover Galerie Art Gloss 250 g/m² inside pages NovaPress Silk 90 g/m² | **Front cover photo:** iStock | **Other cover and sleeve photos:** iStock

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DISCLAIMER

I have an idea

THE DIFFERENCE BETWEEN BEING REACTIVE and proactive lies in timing and mindset. Being proactive means taking action to change before it's absolutely necessary, whereas being reactive means waiting for the changes to unfold elsewhere first – and only then following suit. In today's world, the safe reactive mode is just another word for 'too late'.

As our Head of Digital Innovation **Alid Dettke** rightly points out (p. 44), one can't shy away from the future. "We must roll up our sleeves, embrace it boldly and grow with it."

However, one can't jump head-first into the future without understanding what it might entail. A myriad of variables, ranging from public opinion to policies, regulations and environmental impact, have to be considered for every action. Since these factors may affect each other, making sense of their combined outcome is where a proactive approach becomes crucial.

At Wärtsilä, we are thrilled about the possibilities ahead. We understand that digital technology and connectivity are expanding the horizon everywhere – including maritime and energy markets. We have the appropriate tools at our disposal, and we cannot afford to play it safe by watching change unfold all around us.

Now is the time for thought leaders to grab the bull by the horns. Disruptive thinking leads to disruptive innovations, and today's thought leaders will be tomorrow's market leaders. As much as we need talented engineers to make these ideas a reality, without original thinking there's nothing new to build on.

This doesn't apply to technology alone. We can also strive to better the world outside of our immediate realm; after all, the wellbeing of our planet and the people inhabiting it directly and indirectly affects our ways of doing business.

In this issue, we're looking at things larger than life. A zero emissions society might sound like a pipe dream, but the magnanimity of it shouldn't deter us from going towards the shared goal of creating more sustainable ways of living and doing business. What's so bad about failing at being *perfect* if, while trying, you've successfully become much *better*?

Next time you hear someone say 'I have an idea', give it a think. It might just be the idea we've all been looking for.

Atte Palomäki
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Your shorter route to the gas age

COMBINED POWER PLANT
AND LNG INFRASTRUCTURE

REDUCE RISK BY GUARANTEED PRICE,
DELIVERY AND PERFORMANCE

WE TURN PROJECT
IDEAS INTO REALITY

INCREASE REVENUES
BY SHORTENING
PROJECT DEVELOPMENT
AND EPC LEAD TIME

REDUCE COSTS BY ADEQUATE
& STANDARDIZED SOLUTIONS

FROM IDEA TO SUCCESSFUL OPERATION

As a forerunner in gas and multi-fuel engines, fuel systems, technology and services, Wärtsilä participates in the global shift to gas also with LNG infrastructure projects. We focus especially on developing the small-scale LNG value chain together with our customers, offering technology both for liquefaction and regasification.

WÄRTSILÄ

Developing urban resilience

CITIES ACROSS THE PLANET are growing in size and population. According to World Bank, almost 70% of the world population will live in urban areas by 2050.

With ever growing cities come new problems to solve. Researchers are calling for 'urban resilience': it's the ability of cities and its inhabitants to face challenges (such as climate change), and ensure infrastructure development keeps up with the growth.

The role of public-private partnership in this context is crucial. Singapore is a good example. The government, local businesses and citizens there are working together on a joint project to make sure the city is sustainable, functional and safe. The country's dream to become the world's first 'smart nation' looks achievable now.

TEXT: LOTTA HEIKKERI **PHOTO:** iSTOCK

*around the globe

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[AROUND THE GLOBE]

News

SMART MOVES IN ARGENTINA

Wärtsilä expands its co-operation with the Argentinian energy company Pampa Energia S.A. Under the recently signed operation and maintenance (O&M) agreement, Wärtsilä takes responsibility for the operation of Pampa Energia's Smart Power Generation plant Central Termica Ingeniero White, located in Bahia Blanca, Argentina.

"We needed an experienced lifecycle services provider to operate the Ingeniero White power plant efficiently and reliably. Wärtsilä is already in charge of the operation and maintenance of Pampa Energia's Central Termica Pilar power plant, and we see them as the best partner to ensure the optimal performance of the Central Termica Ingeniero White power plant as well. Wärtsilä has the best expertise in multifuel installations," says **Luis Ruiz**, Engineering Chief, Pampa Energia S.A.

During the 10-year contract period, Wärtsilä ensures the optimal performance of the multifuel plant by means of continuously monitoring and addressing plant operation and maintenance needs.

The scope of the new O&M ensures optimal plant availability and reliability levels, extended equipment lifecycle, as well as reduced operational costs in a safe, reliable and environmentally sound way.

Wärtsilä provides performance guarantees related to power plant availability as well as to fuel and lube oil consumption, thus supporting the competitiveness and business targets of Pampa Energia S.A.

Wärtsilä GLOCAL WATCH

EXCITEMENT
RESPECT AND TRUST

ENERGY
MAKE THINGS HAPPEN

DO THINGS BETTER
EXCELLENCE

AZORES:
Greensmith Energy, a Wärtsilä company, will deliver an integrated energy management system based on its industry-leading Greensmith Energy Management System (GEMS) software for Graciolica Lda's microgrid power facility in the Azores. When completed, Graciosa Hybrid Renewable Power Plant will enable 1 MW of solar and 4.5 MW of wind power to be supplied to the local electricity grid, reducing the islands' reliance on imported fossil fuels and significantly reducing greenhouse gas (GHG) emissions. The order was booked in December 2017.

BRAZIL:
Wärtsilä has signed a memorandum of understanding (MoU) with Petrocity, the parent company of the new port facility being built in the Brazilian city of São Mateus-ES, to develop a harbour tug design. The prime consideration is to maximise the ecological operational sustainability of the vessel since the environmental demands of the new port are among the most stringent in the world. For this reason, the design will be based on the recently launched Wärtsilä HYTug, which features hybrid propulsion and energy storage using batteries. The Wärtsilä HYTug emphasises environmental sustainability, operational efficiency, and lower fuel consumption than is possible with conventional tug designs.

INDONESIA:
Wärtsilä has been contracted to deliver a 100 MW Smart Power Generation plant to PT Indonesia Power, a subsidiary of PT PLN (Persero). The Senayan Diesel Power Plant project will be used to provide back-up electrical energy to ensure the reliability and availability of power to Jakarta's new mass rapid transport system that is currently under construction. Critical to the selection of the Wärtsilä solution was the fast start-up and ramp-up time of the engines. The new plant will operate on six Wärtsilä 46 engines and is expected to be operational in early 2019.

SUSTAINABLY YOURS!

TEXT: LENA BARNER-RASMUSSEN **PHOTO:** iSTOCK

Wärtsilä made it to the Global 100 list of the most sustainable large corporations in the world. It shows that doing good for the environment around us is extremely compatible with doing well financially.

WHAT ARE SUSTAINABLE COMPANIES made of? If you look to the Corporate Knights' Global 100 ranking, it's the ability to pair 'superior value to society' with 'superior financial performance'. After all, if you can't present sound financial figures you are not going to make it in the long run.

Wärtsilä features on this list thanks to its extensive portfolio of environmentally sound products and solutions that contribute to sustainable global development.

The companies that made it to Corporate Knights' Global 100 list have been evaluated on 17 environmental, social and governance indicators.

"This recognition confirms that Wärtsilä is living up to its purpose of enabling sustainable societies with smart technology," says **Marko Vainikka**, Director, Corporate Relations and Sustainability, Wärtsilä.

Environmental indicators are only one part of the criteria, though. Social criteria include how strong the female representation is on the board and the size of the pay gap between the CEO and the average worker. The financial contribution to society is also another important parameter. The companies on this year's list paid an average of 27% more taxes, had three times more top female executives and generated six times more clean revenue than their global peers.

THE GLOBAL 100 RANKING clearly shows that doing good for the environment and society goes well with being a financially successful company. The first Global 100 ranking by Corporate Knights was done in 2005, making this year the ranking's 14th. During these years the Global 100 index has outperformed its benchmark index by close to a third, with a cumulative return on investment of 163%.

Longevity is relevant when you talk about sustainability, which is why the Global 100 ranking also identifies the year of origin for all ranked companies. Wärtsilä with its 184 years is an oldie in this company, although not the oldest. That honour goes to Norwegian Orkla ASA, founded in 1654. Of all the 100 companies, 36 of the 2018 Global 100 have been around for at least 100 years, while the average age of all the Global 100 companies was 85 years.

The Global 100 companies were selected from a pool of 5,994 publicly listed companies. The list of the 2018 Global 100 companies was released from a snow-packed Davos, where world leaders gathered for this year's World Economic Forum conference.

Finland-based companies were quite well represented on the list with Neste Oil, a refining and marketing company, at number two, and construction and engineering firm Outotec making it into place five. Number one on the list is French software company Dassault Systèmes.

[WORDS & NUMBERS]

USEFUL DEFINITIONS AND NUMBERS OF INTEREST.

SIMULATOR SICKNESS
The nausea which occurs in simulated environments, like virtual reality. Like its close relative seasickness, simulator sickness is caused by the conflicting information between our eyes and inner ear.

"AHOY-HOY"
Original telephone greeting suggested by Alexander Graham Bell, credited as the father of telephone. Nowadays only used as a running gag by the character Montgomery Burns in 'The Simpsons'.

111 MPa
...or 16,099 psi. That is the amount of pressure found at Challenger Deep, the deepest point in the seabed which lies almost 11,000 metres under sea level.

[TRENDS & SCENARIOS]

FUTURE PERSPECTIVES.

Earbuds from Mars

Just think of how many times you have wanted to have a conversation with someone but couldn't because you didn't have a common language.

Well, that problem could soon be history.

Enter wireless bluetooth stereo earbuds a.k.a **MARS Earbuds**! The innovative earbuds enable two people to have a chat despite a language barrier.

So how does it work? Each person wears one of the earbuds. As one person starts speaking, the system translates in real time and transmits it into the other person's ear. Voila!

The earbuds translate into nine languages so far. In addition, the earbuds are compatible with the digital assistant Clova, which means you can also use them to make calls or control IoT devices.

Finnish wheelchair racer Leo-Pekka Tähti at the Finnish Sports Gala.

[CORPORATE CITIZENSHIP]

The Sport called **Life!**

Finnish wheelchair racer Leo-Pekka Tähti is a five-time Paralympic gold medallist. Earlier this year he added another award to his mantle, this time for his work in sports, off-field. We asked him what motivates him.

TEXT: MAIJU KARHUNEN **PHOTO:** URHEILUGAALA

"SPORTS HAS HAD A HUGE IMPACT on my life and through my career I've gained a new perspective on things, which I'm very grateful for," says **Leo-Pekka Tähti**, setting the stage for the conversation.

He was given the Wärtsilä Philanthropy in Sports award at the Finnish Sports Gala for his charity work in improving education and social inclusion of children in sports and play.

Tähti collaborates with Plan International to collect funds for causes such as improving attitudes towards disabilities in Pakistani and Ethiopian societies. Children there are included in play and sports by modifying the rules, equipment, environment and teaching methods.

With fair play, taking other people into consideration and equal opportunities being important values to him, Plan International's work resonates with him. It furthers these values in places where they are not self-evident for all children, especially girls and kids with disabilities.

Tähti believes raising awareness is the best way to support children's equal opportunities.

This is perhaps why, when Plan International contacted him and suggested a fundraising campaign, he knew immediately it was something he wanted to participate in.

"The fundraising shares exactly the same values as I have in life. Equality is a very important thing for all of us. Unfortunately, it's not yet the reality in the developing countries.

"Luckily, many charities are doing great things to make the situation better," Tähti adds.

WÄRTSILÄ AND THE PEACE BROKER organisation Crisis Management Initiative (CMI) recognises such efforts. This year's award of USD 10,000 donated by Wärtsilä, went directly to the fundraising campaign that Tähti is part of.

It awarded Tähti at the Finnish Sports Gala in Helsinki earlier this year. The award was given out by Executive Vice President, Communications & Branding **Atte Palomäki** from Wärtsilä and **Tuija Talvitie**, Executive Director of CMI.

"With this award, we want to highlight the value of diversity and equal opportunities. Tähti is an outstanding role model. Together with Plan International he can impact attitudes on a societal level," says Palomäki.

"I am just very grateful to everyone who has helped me during my career," says Tähti, while humbly accepting the award.

"I want to project the image that everything in life is possible if you really want it and you have the passion for it."

True that.

Skipping technologies

I RELOCATED TO CHINA last autumn.

I must confess that I came here with very typical prejudices about the country. But this East Asian giant surprised me. Positively. China is extremely organised. Take the roads, for instance. Its highway networks can be listed among the best in the world. Even if heavy traffic seems like a downer, things don't spin out of control.

And what is noteworthy is the speed of change and adaptation of new technologies in the Chinese society.

AT THE MOMENT CHINA is experiencing technology leaps in many areas, meaning that some of the development phases that we have witnessed, for example, in Europe have been completely skipped. The country has leapfrogged into the next phase – the future. One such technological change is related to mobile payments. New players are entering the traditional banking space.

The banks and credit cards have lost their dominant position in consumers' daily payment transactions. Instead the money flows via social media and web store mobile apps (e.g., WeChat) that are actually cutting off the traditional banks from the customer interface. This positions them as "infra providers" to bank accounts and other heavier bank services.

THE TECHNOLOGY LEAP has also brought in a new wave of Sharing Economy. A good example of this is the bicycle rental system.

In Shanghai, there are several companies in this business and they have distributed millions of bikes on the city streets. The bikes can typically be found everywhere and the rental concept of course is managed by mobile apps. I use this service myself.

On my way to the metro station I grab the nearest bike, open the lock with my phone, drive a distance of two kilometres up to the metro station and leave the bike there. The 15-minute trip costs me around 12 cents, which is deducted from my app account automatically after I have completed the trip.

China is of course a big land with many stories. The new technology is not transforming the whole nation into a model country at once. There are many challenges to be resolved but there is no denying that China is on its way to becoming the top economy in the world. My advice is to let China seduce you and go with the flow. This way you will enjoy the benefits and possibilities it offers and finally, possibly, fall in love with it.

KARI PUNNONEN
Regional Director NEA, Wärtsilä Energy Solutions

MY ADVICE IS TO LET CHINA SEDUCE YOU AND GO WITH THE FLOW.

PHOTO: SAMI PULKKINEN

TEXT PAYAL BHATTAR **PHOTO:** 123RF

MINING INDUSTRY'S ENERGY PROBLEM

The global mining industry, which was so far the flag bearer for thermal energy, is in the midst of a gradual but powerful change. It's finally warming up to the idea of renewables. Find out why this change in tack and what it will mean for this energy-intensive sector.

reportage

It's said that every year, Australia's mining industry consumes as much electricity as all of Portugal. With transportation costs included, this sector consumes as much energy as all of Spain! Little wonder then that power is a matter of great debate and contention for the mining industry in the region.

According to reports, last June, Australian mining goliath Glencore sounded the alarm bells on what it called 'ridiculously high' energy prices, which had risen 100% over the past three years. Glencore was reportedly talking of shutting the copper mining operations at one of its subsidiaries, Mount Isa Mines. Ditto with BASF, the Tomago Aluminium Company and Rio Tinto.

To make matters worse, in September 2017, South Australia witnessed an extensive blackout. The region's grid-related issues coupled with a major storm left residential and commercial consumers totally crippled without electricity for days together.

Events like these, alongside a desire to lower their carbon footprint, is making Australia's mining sector, which was so far largely thermal energy dependent, consider renewables as a serious part of their energy mix.

Australia is not alone. The global mining industry, which consumes nearly 11% of the world's power, is making small but significant strides in tapping renewable energy for a variety of reasons.

GREEN LIGHT

Canada, which has several existing and new mines located in remote areas, is drawn to renewables to increase its mining sector's energy efficiency, reduce fuel transportation costs and bring down the sector's carbon footprint. South Africa and other parts of Africa like Ghana, on the other hand, are looking for solutions for their unpredictable energy supply on account of unreliable grids and frequent or rolling power cuts.

The mining sector in Chile in particular has emerged as leader in embracing renewables due to soaring thermal prices on the back of high fuel transportation costs as its mines are remotely located at an altitude. Chile is closely followed by India and China where miners have been in a race to meet their clean energy targets and have a more predictable power supply. So why is energy such a big focus area for miners?

"Following wages, energy is the second-highest operational cost (OPEX) in mining. The primary challenge for the sector is a decrease in ore grade, which leads to an increase in energy intensity (MWh per tonne, ounce or carat). To produce the same amount of mineral or metals, miners need more energy on a daily, monthly and yearly basis," explains **Arnoldus Mateo van den Hurk Mir**, General Manager, Renewable Energy and Mining International Observatory.

According to a report by Deloitte on renewables in mining, 'miners have the opportunity to drive down energy costs by up to 25% in existing operations and 50% in new mines through an effective energy management program, of which renewables are a major component. In addition to cost savings, the ability to reduce emissions and preserve the mine's social license to operate increases the size of the prize even more.'

THE HEART OF THE MATTER

'In emerging and frontier countries, the need for alternative energy sources is further amplified as mining and metal companies have to compete with both governments and communities for these scarce resources. Rarely does the economic value created with energy use come into allocation decisions. This has a direct impact

THE GLOBAL MINING INDUSTRY, WHICH CONSUMES NEARLY 11% OF THE WORLD'S POWER, IS MAKING SMALL BUT SIGNIFICANT STRIDES IN TAPPING RENEWABLE ENERGY FOR A VARIETY OF REASONS.

The mining industry is grappling with 'ridiculously high' energy prices.

reportage

MINING COMPANIES WILL HAVE TO TAKE MORE RESPONSIBILITY FOR SOCIAL AND ENVIRONMENT-RELATED CONSEQUENCES OF THEIR BUSINESSES.

Gold mine located in Waihi, New Zealand.

on the industry's all-too-important social license to operate. The role that renewables will play is not as remote or futuristic as you may think. The arguments for large investments in renewable energy go beyond sustainability and social responsibility, and have now become a solid economic reason for miners,' says a report by EY.

The good news for miners is that while thermal energy costs have been on the rise these past few years, the cost of renewables have been falling.

Jérôme Jouaville, Business Development Manager Africa, Energy Solutions, Wärtsilä, explains, "It is time now for renewables to enter this sector because economically, it makes sense. You have reached a point where the levelled cost of electricity (LCOE) is lower than ever and is better than what you get from thermal generation. So renewables are becoming more cost effective. Now mining companies are like everyone else. They want to get benefits from this reduction in cost of renewables sector. That's clear."

A WIN-WIN SITUATION

Indeed. Apart from falling costs, the mining sector is uniquely positioned to harness the benefits of renewable energy. Traditionally, availability of land has been one of the biggest deterrents for renewable energy. Fortunately for the mining sector, there is an ample amount of instantly available 'free land' that can be used for installation of renewables, particularly in the case of open-pit mining. Financing renewable projects is the second big hurdle. Here too it is relatively easier for most mining companies to raise finance as they are fairly large in size and have relatively easy access to capital including finance for off-the-balance-sheet projects.

Experts say that as the challenges of including renewables in mining lessen, companies will have to gear up and gradually change their business models. They will have to work on finding an optimal energy mix so that their power plants run at maximum capacity while having lower reserve requirements, shortages and breakdowns. Since renewable energy is known to be intermittent in nature, miners may also have to invest in power storage systems like batteries and build hybrid systems that can provide them the best of both the worlds.

"If you have a life of say 10 years or 20 years you may have different solutions. But ultimately it's going to be hybrid solutions. You will have some renewables, some storage and some engines because it's the best combination that gives you the best LCOE. If you go all renewables, then your investment cost is too much. If you go only thermal, then the operational cost is too much. So for any specific mine you need to make the evaluation and simulation of what solution is the best fit for the particular mine," explains Jouaville.

As miners strive to find the best energy combination for themselves, one thing is certain. The landscape of the world of mining will never be the same again. Mining companies will have to take more responsibility for social and environment-related consequences of their businesses. This means that the use of green energy by the sector is no longer a matter of choice but a necessity.

TEXT: STEVE ROMAN **PHOTO:** 123RF & iSTOCK

COULD CHINA SHAPE THE WORLD'S ENERGY FUTURE?

As China begins to make good on its promises of a renewables-focused 'energy revolution,' analysts are debating its potential impact on worldwide market trends and whether the changes could accelerate the global transition to clean energy.

THE WORLD'S ENERGY FUTURE WILL BE WRITTEN IN BEIJING.

A third of the world's solar PV and wind power will be housed in China in the coming decades.

President **Xi Jinping** had more than enough compelling reasons four years ago when he rolled out the idea of an 'energy revolution,' a long-term reduction in the country's dependence on fossil fuels coupled with heavy investments into renewables. Millions of premature deaths from smog as well as concerns about long-term energy security were at the top of the list. On the political front, the country is positioning itself as a leader in the fight against climate change.

Whatever the motives, the ambitious plan is already bearing fruit. In early 2017, the country announced that it would invest USD 360 billion into renewable energy by 2020 as well as cancel plans to build 85 coal-fired power plants. China is also poised to install a third of the world's solar PV and wind power in the coming decades, according to the International Energy Agency's latest World Energy Outlook report. In just the next three years, wind power capacity is set to be boosted from 130 to 210 GW and solar from 40 to 110 GW, numbers so enormous they're hard to fathom from a normal market perspective.

Even before these targets were set, the country's successes in greening its energy production were gaining the attention of many industry watchers, with some stating that China was paving the way for other fast-growing economies to follow suit.

John Mathews, professor of strategy at MGSM, Macquarie University in Australia and author of "Global Green Shift," is one such expert contacted by Twentyfour7.

"What we see is a consistent, rational energy and resources strategy being implemented. You can already see how China is benefiting by becoming progressively less dependent on fossil fuel imports, as well as moving to world leadership in renewable-energy businesses, from solar to wind to energy storage," he wrote.

"Rising industrial powers like India, Brazil and South Africa are already looking to follow China's lead in this new 'green growth' model of development. These countries want to remove constraints to their economic growth."

POWER GRIDLOCK

Despite the encouraging developments on the renewables front, anyone hoping for a leaner, greener China may have to wait. Coal continues to dominate the country's energy profile, providing nearly two-thirds of current demand. Plans to add more hydro, solar, wind, nuclear and gas into the mix aren't expected to make a large dent in coal use if overall energy demand continues to grow along with the economy.

This is one reason **Kari Punnonen**, Regional Director for North East Asia at Wärtsilä Energy Solutions, believes that the term 'energy revolution' is overly dramatic.

"There are still lots of coal-fired power plants under construction in China. Even though the authorities have cancelled several of the licences, worth some 50 to 100 GW, the ongoing projects will be rolling for years and some tens or maybe hundreds of gigawatts of coal power is still coming on line. Over the next five years at least, the coal-fired capacity will keep on growing," he said.

Punnonen also points out technical and regulatory roadblocks to absorbing all the new wind and solar power into China's grid.

"From a purely economic operation point of view, the situation is not good," he said. China currently lacks a reasonable way to balance the wind power it currently produces, relying on coal plants running at an inefficient 50% load. Because the balancing cannot be done properly, the wind power has to be curtailed and often even shut down.

The country also has yet to organise a market for peaking power, which would provide the necessary economic incentive to invest into real balancing capabilities, he says.

TECH EXPORT

Another aspect of China's 'energy revolution,' one that could have the most profound impact on the world's future energy choices, is investment into green tech development. Specifically, China has overtaken the EU in investment into clean energy systems and is the world's leading producer of solar panels, as Mathews points out. The country is also a major producer of batteries designed to store energy for utility purposes.

Advances in technology and production efficiency have already pushed down the price of these Chinese-built components. Further development could make them better and cheaper, providing a carbon-free option for countries or even small communities in need of affordable infrastructure.

Of course, it's impossible to say with any precision what effects China's green tech exports, its strategy model or its fuel trade will have on the global energy outlook of coming decades. But as the country is on track to surpass the US as the world's largest economy around 2030, there's no doubt that China's decisions will have an outsized impact. The world's energy future will be written in Beijing.

TEXT: EIJA POHJANSAARI **PHOTO:** iSTOCK

SMART PORTS COME OF AGE

The maritime industry is having its 'smart' moment. Everything from ships to land logistics is being swept by the digital wave, with ports being the latest addition. Smart ports are now fast becoming a reality. Does this spell good news? Here's our take.

feature

NEW SMART TECHNOLOGIES CAN IMPROVE PRODUCTIVITY AND ENVIRONMENTAL SUSTAINABILITY IN SEVERAL WAYS.

Smart ports are here. The combination of Internet of Things (IoT), smart data solutions and high-speed connectivity is ushering in an era of modern ports that promise to leverage the efficiencies derived by the use of these digital technologies.

Port of Hamburg, one of the busiest ports in Europe, is a shining example. It opted for an IoT platform to counter the expected rise in traffic and increasing negative externalities (e.g., traffic congestion, pollution and road safety) caused by the seaport's activities. The results have been noteworthy. The port now boasts of everything from smart traffic lights to smart parking to predictive and preventive maintenance capabilities.

And this is only the beginning.

Ulla Tapaninen, Adjunct Professor of Maritime Logistics and Senior Adviser in charge of the Helsinki City maritime cluster programme, believes future smart technologies will enable smart transport chains, which in turn will enable more efficient use of resources.

"In future, automated ships will be guided to automated ports. Owners of ships and cargo will know exactly where their vessels and cargo are at any given time. Ports will form one part of the transport chain and can be, for instance, integrated with industrial plants," Tapaninen envisions.

SMART MARINE ECOSYSTEM

"The industry is moving to a new age," says **Andrea Morgante**, Head of Digital in Wärtsilä Marine Solutions. Wärtsilä has recently fortified its position by acquisitions and is currently launching Digital Acceleration Centres to serve as incubators for new promising ideas by bringing together Wärtsilä's experts and other stakeholders to develop a new product to be evaluated or piloted by customers.

"Creating a Smart Marine ecosystem will reduce waste by shifting the focus of optimisation from vessels to fleets and entire logistics chain. Data exchange platforms will connect ships and shore through cloud analytics, while technologies like blockchain ensure full component traceability. And these are just few examples of the business innovations ahead," says Morgante.

"We have long history of utilising IoT and we already have applications, which communicate with the bridge and crew to suggest route and speed based on historical and real-time data and boundary conditions, like weather," says Morgante.

"The question is really how to amplify technologies to the next level, creating a platform-based strategy where there is one platform, where all the products can talk to one another and where new services and product features can be easily deployed," he adds.

DIGITALISING CONNECTIONS BETWEEN SHIP AND SHORE

Project Portify is a case in point. "Portify is a data exchange platform providing dynamic information on the estimated time of arrival and departure from vessel to terminals and updates on berthing slots from terminals to vessel," says **Matteo Natali**, Senior Project Manager in charge of project Portify at Wärtsilä, which aims to digitalise ship-to-port interactions.

Natali says the scope of Portify can be extended to a common port-call service platform, where vessel operators can identify, book and pay port services from other players within the port environment, such as bunkering suppliers, logistics providers, tug operators, maintenance companies or authorities.

"Our purpose is to create a smart, connected marine ecosystem," he explains.

At the moment, most of the information is exchanged with traditional point-to-point connections, causing delays and difficulties in planning workload due to unexpected changes in ship calling schedules. "The port value chain is quite long, so impacts from lack of information are multiplied," he explains.

New smart technologies can improve productivity and environmental sustainability in several ways. "For example, vessels can switch to slow steam if berthing slots change, thus saving

Port of Hamburg is one of the busiest ports in Europe.

feature

Everything from ships to land logistics is going digital.

“BIG DATA AND NEW APPLICATION OF INNOVATIVE TECHNOLOGIES WILL EVENTUALLY ENABLE SMART, FULLY DIGITALISED PORTS.”

fuel, rather than sailing at regular speed and then waiting at anchor,” says Natali.

Wärtsilä is leading this change. “Wärtsilä is the most natural candidate to lead the reshaping of marine industry,” says Natali, “because of several competitive advantages, such as the most comprehensive product portfolio in the market, unique capabilities in data collection and analytics, as well as prediction on ship operations.”

TECHNOLOGICAL LEAP

That said, smart technologies are expected to come to the maritime industry at different speeds depending on segment, application and regulatory framework. At the moment, most of the solutions offered by digitalisation are still to be invented. Optimising operations that involve many separate agents requires integration and data exchange. According to Tapaninen, the main challenges are safety, reliability and controlling information flow.

Morgante notes that the first vessels to go fully digital are small ones, such as short-route ferries. Unmanned large ocean liners are probably not coming up very soon, although digital solutions, such as Wärtsilä’s con-supporting Smart Predict, are already making cruise ships safer.

“Big data and new application of innovative technologies like blockchain, monitoring sensors and induction charging will eventually enable smart, fully digitalised ports,” predicts Natali.

A change in mind-set is required, though. Customers have to be willing to share their information. They need to be convinced that the information they share can be transformed into value for themselves and the whole industry,” concludes Natali.

TEXT: PAYAL BHATTAR **PHOTO:** iSTOCK

WEATHERING THE STORM

The Caribbean islands have been reeling under the severe aftermath of two deadly hurricanes – Irma and Maria. Lives have been lost, islands wiped out, and critical infrastructure like utilities destroyed. So what will it take to power up a stronger and more resilient Caribbean? Let's find out.

feature

St. John, US Virgin Islands, two days after tfie Hurricane Irma.

IN THE WAKE OF THESE TWO DESTRUCTIVE HURRICANES, ALL EYES ARE SET ON BATTERY-BASED SOLUTIONS.

There's an uneasy calm after the hurricanes in the Caribbean last year. Even as help pours in from all quarters, life is literally being rebuilt brick by brick. In the meantime, millions of people will have little or no access to essentials like water, gas, drinking water and electricity.

Energy supply in several islands such as Puerto Rico, St. Maarten, Anguilla, Dominica, the Turks & Caicos Islands, British Virgin Islands and US Virgin Islands has dwindled to a trickle as transmission and distribution systems are severely damaged, impacting key facilities like healthcare and communication. Moody's estimates suggest that the financial cost of Hurricane Maria alone is around USD 40 billion in terms of lost economic output due to loss of power, roads and communications, and up to USD 55 billion in property damage.

Catastrophe-modelling firm AIR Worldwide is also reported to have estimated that Hurricane Irma caused USD 32 billion to USD 50 billion in insured losses in the US and the Caribbean and insured losses due to hurricane Maria in the Caribbean may range between USD 40 billion and USD 85 billion. Insured losses are barely a fraction of the total economic loss in the Caribbean because the region has a lower rate of insurance take-up.

LIGHTING UP A MILLION LIVES

The financial implications of the damage are huge and the Caribbean is in dire need of big-ticket investments in utilities and the energy sector. Fortunately, financial aid is pouring in and investors are queuing up. For instance, Wärtsilä, which has an installed base of over 3000 MW in the region (the majority of that capacity with regional electric utilities), has lent a helping hand by donating USD 50,000 to Caribbean Electric Utility Services Corporation (CARILEC) for supporting its members to recover from the recent hurricanes.

"Rapid repair and rebuilding work to the T&D system is key to restoring power first to critical services such as hospitals and then to consumers at large. CARILEC has always been at the forefront as the coordinating agency to provide assistance to member utilities that need help in getting their T&D systems back on track," says **Rodney George**, Vice President - Caribbean Wärtsilä Energy Solutions.

Wärtsilä Services has also been deployed in some of the affected islands to assist with restarting Wärtsilä-powered generating plants which fortunately did not suffer significant damages.

OFF-THE-GRID SOLUTIONS

But these are long-term solutions and will require years in the making. Rebuilding the power sector in the current circumstances is a race against time because speed and efficiency will impact the lives of millions of people on these islands on a day-to-day basis.

Take the case of 85% of Puerto Rico, which had no electricity until mid-October last year. During a recent news conference, Puerto Rico Gov. **Ricardo Rossello** stated that his goal was to restore 30% of the island's power by the end of October, 50% of it by 15 November and 80% by 1 December, 2017. But many experts were of the view these targets were too ambitious to be achieved in the stated time frame. They pointed out that the power infrastructure in Puerto Rico was in shambles even before the hurricane and therefore it will take at least six months to restore power to the pre-hurricane levels.

"The key factor here is speed. In the aftermath of a hurricane, particularly in a small island setting, typically the entire island will be without power, and restoration efforts have to be well planned and executed. The logistics do not only involve moving qualified and experienced personnel but also specialised vehicles and special tools have to be brought in quickly," explains George.

Experts point out that that there is no single solution or agenda that will help rebuild a more resilient power sector in the Caribbean as quickly as possible. The region can't be dependent on renewables alone as electricity supply is intermittent in nature. The need of the hour is to have reliable electricity supply that can meet growing demand.

That is only possible through an optimal mix of turnkey solutions like ultra-flexible and efficient smart power plants, which can easily switch between heavy fuel oil (to start with) and liquefied natural gas (LNG) (later), utility-scale solar PV, energy storage and integration solutions. This is where global energy majors like Wärtsilä can play a leading role.

TEXT: NATALIA VALTASAARI **PHOTO:** WÄRTSILÄ

2017
A YEAR OF SOLID SALES AND STRONG ORDER INTAKE

The year 2017 developed in line with our expectations. While increased power plant deliveries supported some growth in net sales, profitability was in line with the previous year. The clear highlight of the year though was the growth in order intake in all of our business areas.

Activity in the service markets was steady thanks to a somewhat improved demand environment in the second half of the year. Net sales were solid at EUR 2.2 billion, while the increased demand for long-term service agreements in both the marine and energy markets resulted in 13% growth in Services order intake. The highlight of the year was the strategic, performance-based partnership with Carnival Corporation. According to the agreement, Wärtsilä will handle all engine maintenance and monitoring work for 79 Carnival vessels and the agreement includes our latest digital solutions.

Market trends created a favourable demand environment for our Energy Solutions business. Order intake grew by 16%, thanks to increased investments in modernising power infrastructures in the emerging markets, and the growing need for flexible power capacity to support the transition into renewable energy sources. In addition to engine-based power generation solutions, we received orders for energy storage and software projects in the USA, Singapore, and Portugal, as well as our first solar PV projects in the Middle East and Africa.

The year 2017 saw a recovery in vessel contracting from the record low levels of the previous year, despite certain challenges related to overcapacity and a lack of financing. The improved sentiment among merchant customers, together with a healthy demand in the cruise and gas carrier segments, supported the 15% growth of Marine Solutions' order intake. Noteworthy orders included a contract to equip two new vessels being built for Höegh LNG with dual-fuel main engines and regasification technology, and a sizeable order for four shuttle tankers from TEEKAY. The shuttle tankers will feature a wide range of Wärtsilä's latest technology innovations, which enables them to reach a new level of economic and ecological performance.

WE SEE A GOOD DEMAND FOR OUR SERVICES BUSINESS, THANKS TO THE INCREASING TECHNOLOGICAL SOPHISTICATION OF OUR INSTALLED BASE.

MEUR	2017	2016	Change
Order intake	**5,644**	4,927	15%
Order book at the end of the period	**5,064**	4,696	8%
Net sales	**4,923**	4,801	3%
Operating result[1]	**552**	532	4%
% of net sales	**11.2**	11.1	
Comparable operating result	**590**	583	1%
% of net sales	**12.0**	12.1	
Comparable adjusted EBITA	**626**	618	1%
% of net sales	**12.7**	12.9	
Profit before taxes	**506**	479	6%
Earnings/share, EUR	**1.95**	1.79	
Cash flow from operating activities	**430**	613	
Net interest-bearing debt at the end of the period	**234**	150	
Gross capital expenditure	**255**	146	
Gearing	**0.10**	0.07	

[1] During the review period January-December 2017, items affecting comparability amounted to EUR 37 million (51), of which EUR 36 million (48) related to restructuring programmes and EUR 2 million (3) to acquisitions and other costs.

2018 PROSPECTS

Our strategic aim is to increase customer value with energy efficiency, lifecycle optimisation and innovative solutions. During the year, we launched our marine hybrid module, developed our capabilities for remote vessel operation, introduced new service concepts, and expanded into energy storage and software solutions. These are all excellent examples of steps we have taken to support the realisation of our strategy, and they are fully aligned with our company purpose of enabling sustainable societies with smart technology.

Looking at 2018, our demand outlook has improved somewhat. We see a good demand environment for our Services business, thanks to growth opportunities related to our portfolio of long-term agreements and the increasing technological sophistication of our installed base. The demand for our energy solutions is anticipated to remain at a good level, supported by a healthy project pipeline and favourable market trends. In the marine industry we expect market conditions to improve, and this will support a solid demand outlook.

Natalia Valtasaari
Director, Investor & Media Relations, Wärtsilä Corporation

TEXT: DAVID BERGMAN **PHOTO:** iSTOCK

POWERING BANGLADESH

Electricity consumption in Bangladesh is rising. To meet the growing demand, the sector is focusing on expanding its power generation capabilities, improving its distribution network, and securing maintenance for its equipment. Is that a tall order? Well, not if you have a plan in place.

in-depth

Bangladesh's electricity demand is rising rapidly.

BANGLADESH IS PUTTING THE PEDAL TO THE METAL TO REVAMP ITS POWER SECTOR, WHICH IS THE BACKBONE OF ITS OVERALL DEVELOPMENT.

All eyes are set on Bangladesh's growth story.

The South Asian country's economic growth, coupled with rapid urbanisation, has been remarkable to say the least. And to sustain this momentum, Bangladesh is putting the pedal to the metal to revamp its power sector, which is the backbone of its overall development.

Less than a decade ago, eight to 10 hours of load-shedding, a day, was a stark reality for Bangladeshis. But now, things are beginning to change. Investments are pouring in and partnerships are being fostered.

Case in point is Wärtsilä's growing presence in Bangladesh. The company started supplying engines for power plants in Bangladesh in 1996 with a total output of 100 MW of energy. Within a little over 20 years, the company has already installed, or is committed to doing so, a total of 4200 MW of energy.

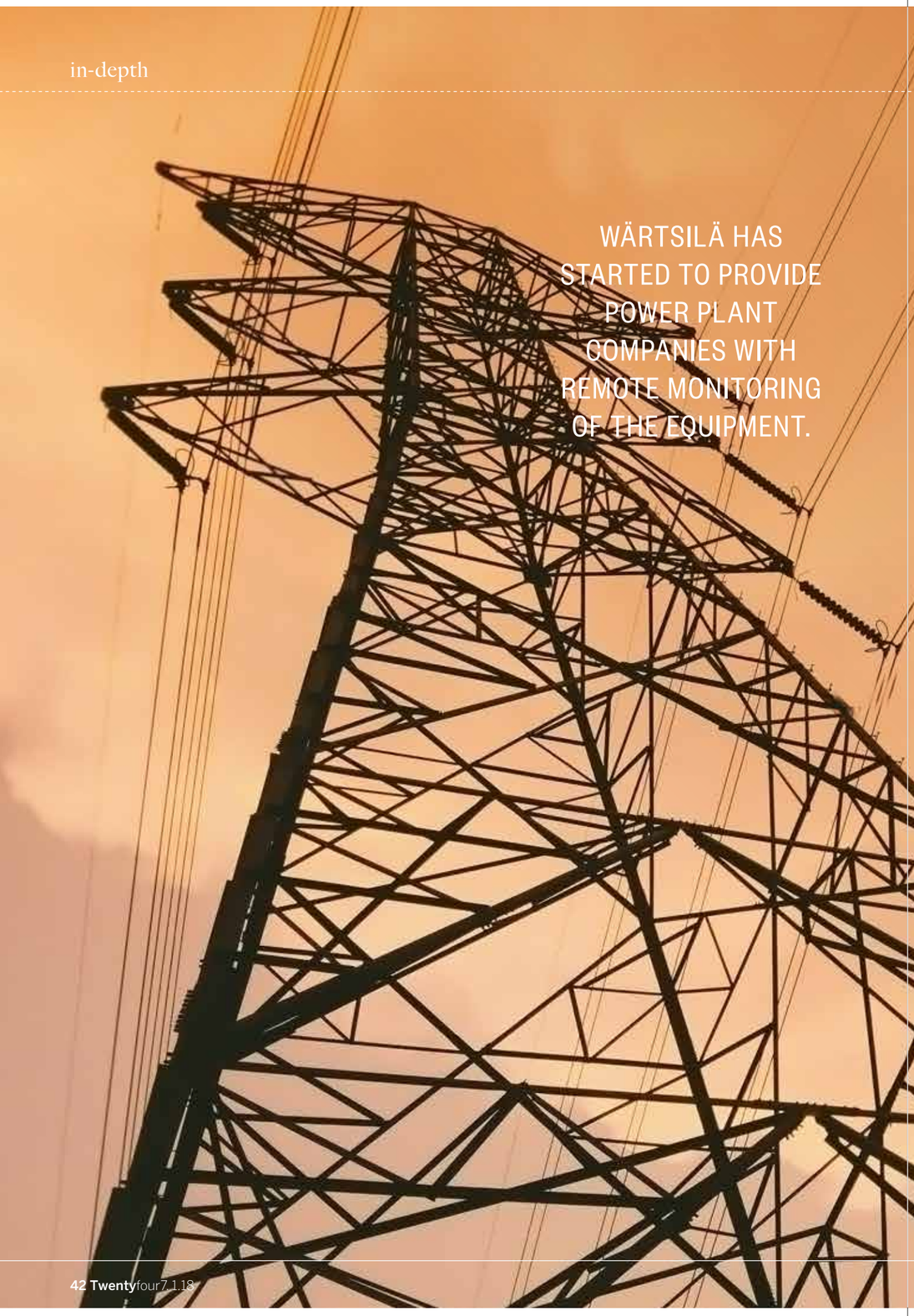
"We now have a booming business in Bangladesh," says **Mostafa Zahed**, who heads Wärtsilä's services team in Bangladesh.

Zahed puts the current success in the area to Wärtsilä's ability to supply excellent power plant solutions, execute fast-track deliveries and provide high quality services, in order to foster good customer relationships.

"Wärtsilä can locally support its customers 24 hours a day in Bangladesh. In 2006, we only had eight people working in the Field Services in Bangladesh, but this has increased tenfold to around 80 people, who are working in the field directly with customers."

"Most of our customers operate in base load mode so the power plants are running continuously. This inevitably means that maintenance and services availability needs to be arranged

in-depth



WÄRTSILÄ HAS STARTED TO PROVIDE POWER PLANT COMPANIES WITH REMOTE MONITORING OF THE EQUIPMENT.

accordingly. We can provide that using our local engineers in Bangladesh," Zahed adds.

Wärtsilä's capabilities, providing lifecycle support and service solutions, has given it a competitive edge and is one of the key reasons why energy companies choose to buy Wärtsilä's solutions.

"Our Services team on the spot is always there to support the customer," the head of Wärtsilä Services in Bangladesh says.

CLOSER TO THE CUSTOMER

That said, the company is now developing an even higher level of service for its customers by establishing warehouses in Bangladesh where key parts of the engine are stored, supporting the company's target of keeping power plants up and running as scheduled.

At a recent Wärtsilä Power Meet conference held in Dhaka the new warehousing system, exchange spare parts concept, turbo charger services, and Wärtsilä Online Services were introduced to customers.

"It was a very well attended event involving all our Bangladesh customers. They were so excited about the speed of support that we will be able to provide them with stock stored in the country, real time visibility and access to technical information through Wärtsilä's Online Services portal," says Zahed.

In addition, Wärtsilä has started to provide power plant companies with remote monitoring of the equipment. This means Wärtsilä's engineers from different monitoring centers (Dhaka, Chennai & Vaasa) can see what is happening in the Bangladesh plants, real time.

"This will help to maintain the high availability of the installations which is crucial for our customer's business on IPP market Zahed concludes.

WÄRTSILÄ POWER PLANTS IN BANGLADESH

50 POWER PLANTS

Wärtsilä provides over

25%

of the grid capacity in Bangladesh with an installed base capacity of more than 4000 MW.

WÄRTSILÄ DELIVERED POWER PLANTS UNDER AGREEMENTS IN BANGLADESH:

- Operation and maintenance: **44 MW**
- Maintenance agreements & Long term service agreements: **905 MW**
- Spare parts supply agreements: **2288 MW**

TEXT: LOTTA HEIKKERI **PHOTO:** WÄRTSILÄ

SPARKING UP SOME SERIOUS COLLABORATION

How to match an almost 200-year-old corporation with start-ups? Just ask Wärtsilä. Their new venture model aims to accelerate fresh ideas and form long-lasting relationships.

"You cannot shy away from the future. We must roll up our sleeves, embrace it boldly and grow with it."

This is the attitude that **Alid Dettke**, recently appointed as Vice President, Digital Innovation, says will bring Wärtsilä into a more innovative and collaborative future.

Crucial to this strategy is thinking outside the box and partnering with the right people. And Wärtsilä plans to achieve this through its new corporate venture approach, a five-stage model that aims to speed up collaboration with different partners including start-ups and universities.

"I believe this will help bring in new and fresh ways of thinking to help us with our work," explains Dettke as she compares the model to forming a relationship, where you get to know someone better and then progress into something more serious. "We in Wärtsilä are looking for a special someone," she emphasizes.

THE START-UP APPROACH

One of the key activities through which Wärtsilä is spreading the word about the new venture model is by launching it in different forums, as seen with the launch of the SparkUp Challenge, at the start-up event Slush towards the end of November.

"Once we identify promising start-ups with really innovative ideas, we will partner with them under this corporate venturing model, provide mentorship, finance and, in the future, even partnership opportunities," Dettke explains.

The first phase of the challenge focuses on Wärtsilä's recently launched Smart Marine Vision. With the challenge, Wärtsilä seeks innovative start-ups to develop ideas for the smart shipping value chain in its Digital Acceleration Centres (DACs). First launched in Helsinki and Singapore, these hubs are where projects are developed at unprecedented speeds, often in collaboration with start-ups and other partners.

And the SparkUp Challenge is not about tying up with start-ups because it's fashionable, cautions Dettke, "but a sound strategy to build an effective and fruitful long-term partnership. This is an amazing opportunity to co-create with us, and really accelerate the development of innovative digital services. For up to six months, we will provide the winning teams space and exposure to our experts' advice. The winners will also get a capital grant of EUR 50,000."

NEW WAYS OF WORKING

This will help Wärtsilä as the energy and marine sectors are going through a digital transformation, with the old ways of doing business changing. According to **Marco Ryan**, Chief Digital Officer for Wärtsilä, this means a shift to become an "as-a-service" smart technology company.

"We at Wärtsilä are renowned for spotting trends and innovation. But the innovation tends to happen around products. One of our main challenges is to work more collaboratively," he says. Reflecting this shift in the mind-set, Wärtsilä introduced Slush visitors to **George Newstein**, an eccentric character who is reluctant to share his brilliant ideas with the world.

This is where teaming up with start-ups plays an important role, with large companies like Wärtsilä benefitting from the agile and collaborative way of working that start-ups are famous for.

"There are aspects that are very powerful, like the strong focus on service design, on innovating at pace and focusing on customer needs. This is how we work in our accelerators," explains Ryan.

The best results will happen, he says, when data scientists, business people and engineers sit together and work collaboratively towards a common goal.

The application for start-ups to submit new ideas under the SparkUp Challenge was open until the end of January 2018. First leg of the SparkUp Challenge resulted in close to 150 entries. These included pitches from both Slush Helsinki and via the Venture Board site. The second phase focusing on Smart Energy begins in the summer of 2018.

THE FIVE STAGES OF VENTURING

Wärtsilä's venturing model consists of five levels.

- In the first phase, Wärtsilä invests in existing accelerator and incubator programmes in the marine and energy sectors.
- The second phase is about co-operation and includes the SparkUp Challenge for start-ups. The winners of the challenge are invited to co-create their ideas with Wärtsilä.
- The third stage is about forming strategic partnerships with start-ups and other small companies.
- And in the fourth stage, joint venture opportunities are explored with these partners.
- Finally, the fifth stage of the collaboration will be all about acquisition.

An eager participant pitches at Slush.

TEXT: NIKHIL NARAYAN SIVADAS **PHOTO:** iSTOCK & SAMUEL VALKOLA

Watching history unfold

Witness the great American energy market go through its most dramatic change yet as renewable energy shakes up the status quo. Wärtsilä's Matti Rautkivi brings this epic transformation to life in his book 'Goodbye to Deerland'.

passion

"MY BOOK IS A WORK OF FICTION, BUT IT IS BASED ON HARD FACTS."

"He'd built this coal plant, decades ago. It was his baby, and now the city of Ironstone, Texas stood against not only the plant, but against Bob and the utility he headed."

It is a story as old as human history. As new technologies come in, industries scramble to keep up, relegating older technologies to the backburner. And this time around, it is the energy sector that is in a state of flux.

In his new book, *Goodbye to Deerland*, **Matti Rautkivi**, Director of Sales and Marketing, Wärtsilä Energy Solutions, paints a gripping picture of the American energy market which is coming to terms with the rise of renewable energy. He does this through the fictional character of Bob Sinclair who is fighting to keep his coal-powered power plant 'Deerland' alive.

"My book is a work of fiction, but it is based on hard facts. The American energy market is in the middle of a massive transition. Many utility companies are wondering what the future holds. This story is intended to make them understand what they can do and why they must do it," emphasizes Rautkivi.

THE AMERICAN ENERGY TRANSITION

The facts are simple. Renewable energy which was once considered expensive is now considered a near-perfect power system, having become more affordable, while containing none of coal's environmentally-harmful emissions. So much so that renewable energy sources such as solar power and wind power are being called as the renewable baseload by the utilities.

"As in many other types of power generation, America is once again the forerunner in this. We are seeing utility companies that did not have renewables in their portfolio four years ago now going anywhere between 40% to 80% renewable," explains Rautkivi.

"Wind is now the cheapest source of energy in so called Wind Corridor from Texas all the way to North Dakota with Texas by itself having over 20 gigawatts of installed wind capacity in 2016."

Which brings us to the challenge faced by Bob Sinclair in the book, and by so many utility companies in real life. Most utilities in America have been living by the tried-and-tested model of building bigger and working on getting the economies of scale right. Many have been resisting the move to renewables citing its costs. But with renewables becoming cheaper, they are now coming to terms with the fact that they must shift their strategy. It is a process, Rautkivi says, that is made easier by the fact that Americans cannot resist a good business case.

A COMPELLING PROPOSITION

"That is the American mentality and I absolutely love it. That is what makes them different from Europe. They can see that renewables are cheaper and that it is the future. That is why they are rethinking how they do business, and why they exist," says Rautkivi.

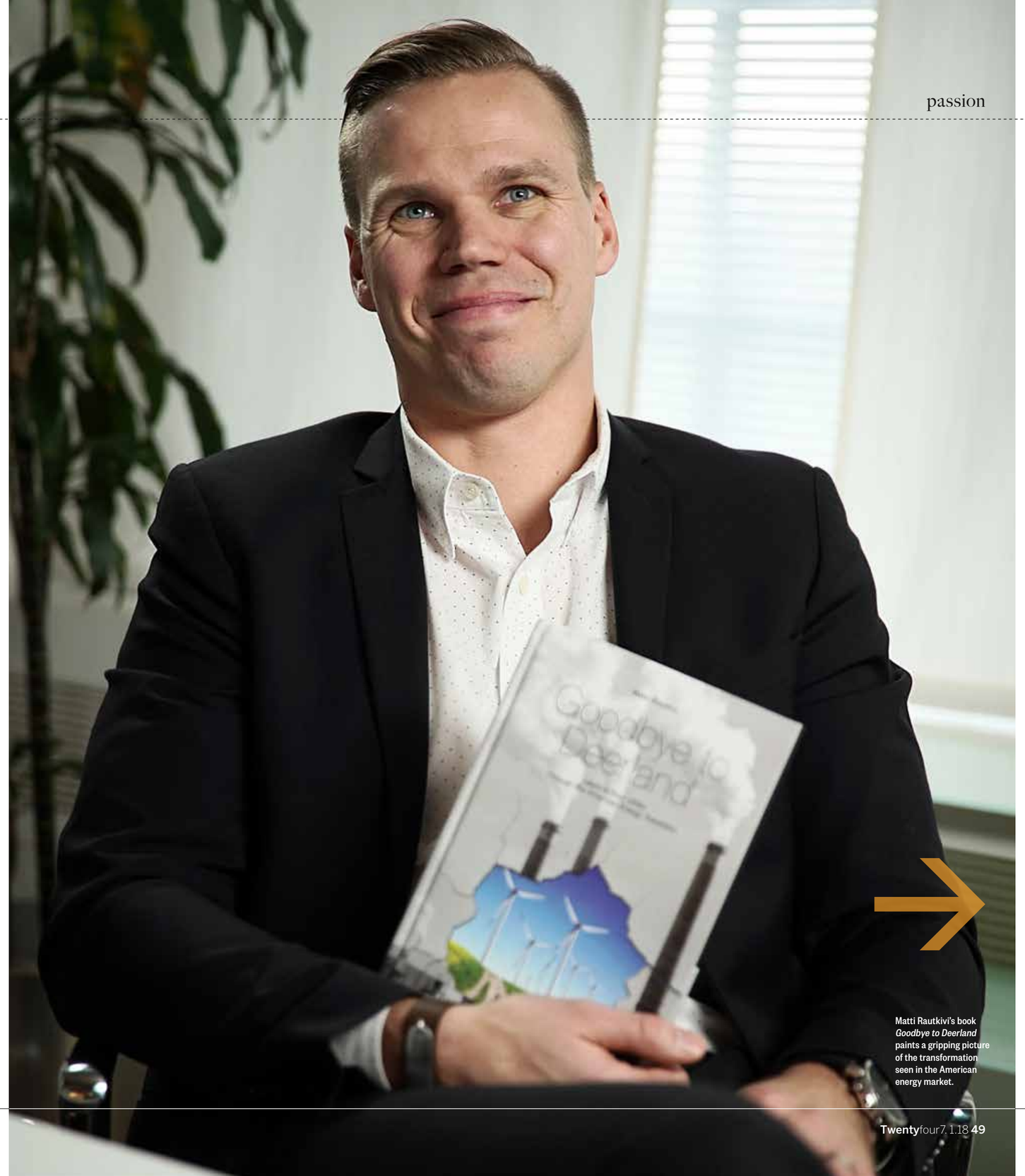
And he should know. Rautkivi has been based in America for several years, travelling with Wärtsilä's originations and stakeholder marketing teams to meet with various utility companies. It is during these interactions that he witnessed, first-hand, the changes in the American energy market and the quandary that utility companies found themselves in.

"It opened my eyes to the bigger picture and how utility companies might be able to cope with a renewable baseload. The character of Bob Sinclair and others in the book came to me fully formed, based on the predicament that various stakeholders found themselves in," recalls Rautkivi. "So, I spoke to my boss and told him that we need to tell this story and that I wanted to write a book on it. And now here we are."

The feedback to *Goodbye to Deerland* has been very positive, especially coming from the utility companies. That is something Rautkivi credits to the fact that the book is simply laying down the facts.

PLANTING AN IDEA

"Take Bob Sinclair, my favourite character. He is a good guy, who is going through this transition. If you have been doing



Matti Rautkivi's book *Goodbye to Deerland* paints a gripping picture of the transformation seen in the American energy market.

passion

RAUTKIVI IS CLEAR THAT HE COULD NOT HAVE WRITTEN THE BOOK WITHOUT THE HELP OF HIS FAMILY AND FRIENDS.

something for the past 30 years, it is really hard to change, and he is trying to find his way" explains Rautkivi.

"So, when you meet the real people who have helped inspire this character and you tell them about Bob's story, it resonates with them. It helps them get past the first stage of acceptance, which is denial. And then they start thinking that there might actually be something to all of this."

While the inspiration for the book came from his experiences at work, Rautkivi is clear that he could not have written it without the help of his family and friends. While the story was fictional in nature, much of the subject matter was technical and drew from Rautkivi's engineering expertise. His wife would help him by reading through the different chapters and offering suggestions on how to simplify the subject so that everyone could understand it.

Rautkivi is hopeful that the book will act as a guide of sorts to stakeholders in the industry, to help them better understand the changes that are occurring.

"You plant the seed, then you water it, nurture it and take care of it. Soon enough, it will sprout and that is what I hope my book will do, in a figurative sense," concludes Rautkivi.

RENEWABLE ENERGY

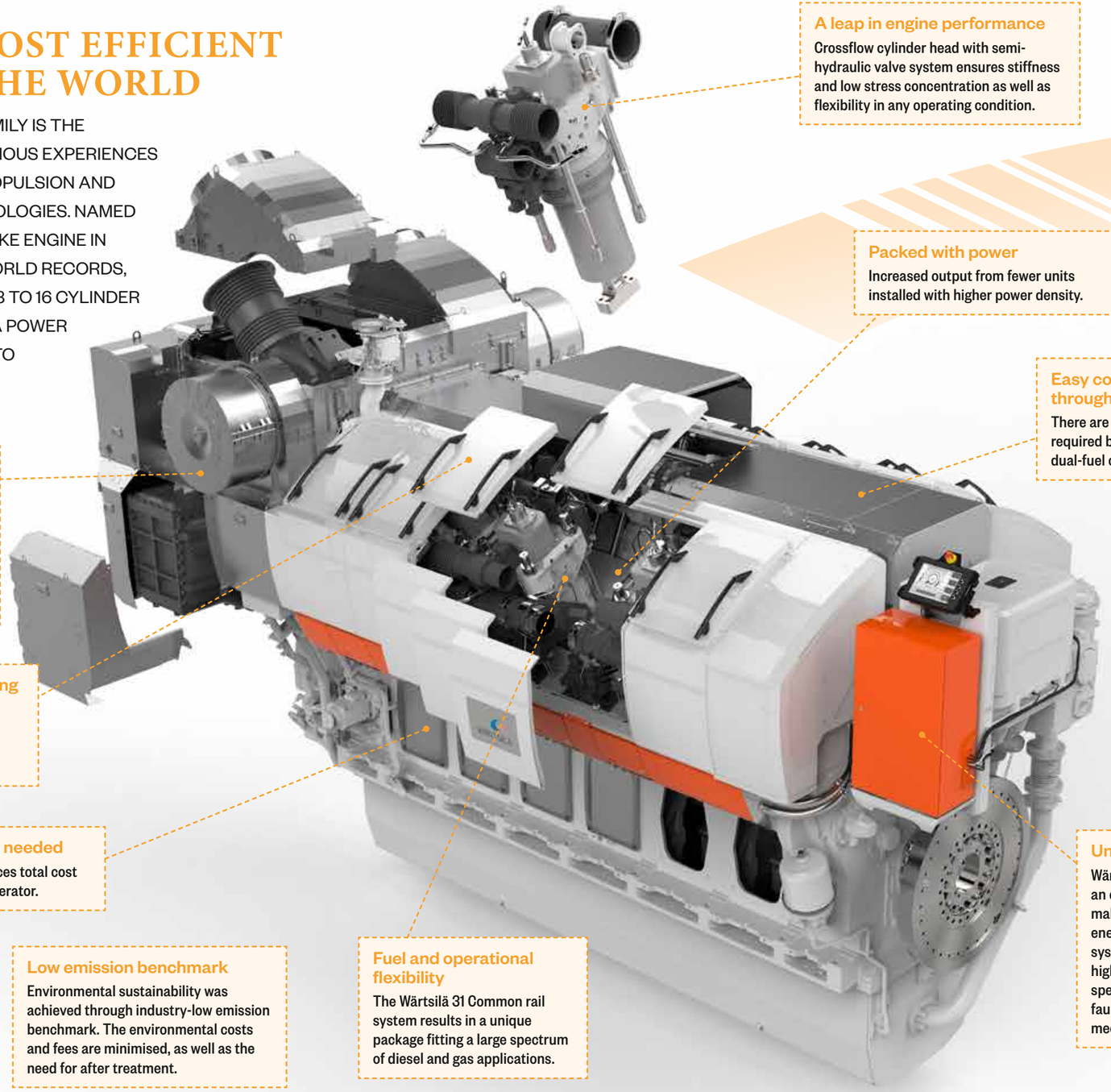
Parallel to the natural gas boom, renewable energy experienced such rapid technological growth and falling production prices that solar and wind are now close to parity with coal. According to Bloomberg New Energy Finance's (BNEF) '2017 Sustainable Energy in America Factbook', in the past five years, 76 GW of renewable generating capacity have come online, nearly double the 39 GW of gas-fired capacity built in the same period. In fact, 2016 set a record for installed renewable capacity as the U.S. added 22 GW of renewable power – half of it in solar, which saw 8.9 GW of utility scale PV installed, more than double the 4.4 GW installed in 2015. Since 2011, 62% of new installations in the U.S. have been renewable projects.

Source: Matti Rautkivi, *Goodbye to Deerland*: Leading Your Utility Through the American Energy Transition, page 25

Renewable energy which was once considered expensive is now considered a near-perfect power system.

MEET THE MOST EFFICIENT ENGINE IN THE WORLD

THE WÄRTSILÄ 31 ENGINE FAMILY IS THE SYNTHESIS OF ALL THE PREVIOUS EXPERIENCES FROM FROM THE MARINE PROPULSION AND POWER GENERATION TECHNOLOGIES. NAMED THE MOST EFFICIENT 4-STROKE ENGINE IN THE WORLD BY GUINNESS WORLD RECORDS, THE ENGINE IS AVAILABLE IN 8 TO 16 CYLINDER CONFIGURATIONS AND HAS A POWER OUTPUT RANGING FROM 4.2 TO 9.8 MW, AT 720 AND 750 RPM.



A leap in engine performance

Crossflow cylinder head with semi-hydraulic valve system ensures stiffness and low stress concentration as well as flexibility in any operating condition.

Packed with power

Increased output from fewer units installed with higher power density.

Easy conversion through smart design

There are minimal changes required between diesel, dual-fuel or pure gas engine.

Future marine technology

The engine is designed with 2-stage turbocharging enabling 50% shaft efficiency and load taking capability. Serviceability and uptime are improved by cartridge concept for compressor and turbine removal and overhaul.

Unprecedented amount of testing

Over 50,000 hours of extensive testing and validation and over 100,000 hours of simulation were carried out during the development.

Less service work needed

Increased uptime reduces total cost of ownership for the operator.

For more information visit: wartsila.com

Low emission benchmark

Environmental sustainability was achieved through industry-low emission benchmark. The environmental costs and fees are minimised, as well as the need for after treatment.

Fuel and operational flexibility

The Wärtsilä 31 Common rail system results in a unique package fitting a large spectrum of diesel and gas applications.

Unique engine management

Wärtsilä Unified Controls, UNIC, is an engine management system that makes engines safe, environmentally energy efficient and flexible. The system is designed to meet the highest levels of reliability, including special measures for redundancy, fault tolerance, and first-class mechanical and electrical design.

THE WÄRTSILÄ 31 CAN BE USED IN...

Icebreakers

Merchant vessels

Fishing vessels

Cruise vessels and ferries

Oil rigs

Energy production

Wärtsilä 31 is available in several configurations for different applications on land and sea. To date, Wärtsilä has sold over 30 engines for icebreaking, cruise, ferry, fishing and power plant engines.

TEXT: MICHAEL LEVITIN **PHOTO:** WÄRTSILÄ

EXPERTISE CENTRES BET ON BIG DATA

Wärtsilä Expertise Centres use the unique combination of big data, analytics and human expertise to bring value to its marine customers. From preventing problems to providing solutions that improve performance, the centres are a force to reckon with. Read on to see what are their other prominent features.

solution

A KEY FUNCTION OF THE EXPERTISE CENTRES IS THE EMERGENCY OPERATIONAL SUPPORT THEY PROVIDE TO THE HUNDREDS OF LNG CUSTOMER VESSELS LOCATED ACROSS THE GLOBE.

Vessels travelling at sea need to achieve optimal operations, by preventing problems rather than solving them as they occur. That is why Wärtsilä's Expertise Centres like the one in Vaasa, Finland, play a critical role in bringing value to marine customers with Wärtsilä's lifecycle solutions. By providing performance guarantees, optimising maintenance and thereby operations, the Expertise Centres help customers avoid and address unforeseen operational and technical events. This will save money, extend the life of their engines and minimise the impacts to the business.

"We support our customers in the most effective way possible, both on the operations side and in maintenance, quality and safety," says **Erik Ristiluoma**, General Manager, Maintenance and Operations Management.

At its Expertise Centres, Wärtsilä facilitates different kinds of service levels to its customers through a collaboration between the company's contract managers, data scientists, maintenance planners and remote supporters. "Especially for LNG customers, we have proactive guidance and advisory services. Wärtsilä is looking through the data we get from the ships. Big data combined with analytics and human expertise results in optimised ship lifecycle efficiency and improved performance."

VALUE FOR CUSTOMERS

In the Expertise Centre in Vaasa, Wärtsilä's technicians can connect online to the engine control room of vessels running on LNG, located anywhere in the middle of the ocean, to ensure its top operational and installation performance. The vessels send data daily to the Wärtsilä Expertise Centre, which analyses the results so technicians can help the ship's chief engineer and crew make the most of their engines, as well as troubleshoot and prevent engine problems from occurring.

"The LNG carriers usually have dual-fuel engines, which are technically more advanced than traditional diesel engines, and we can remotely tune them with the latest solutions provided through the Expertise Centres, taking cyber security solutions into account with our customers," says Ristiluoma. "We optimise the operational experience for the customer, which improves the availability and reliability of the asset. Moreover, being able to predict equipment condition and service needs minimises unscheduled downtime."

A key function of the Expertise Centres is the emergency operational support they provide to the hundreds of LNG customer vessels located across the globe. As long as the ship has a satellite signal, it can receive support.

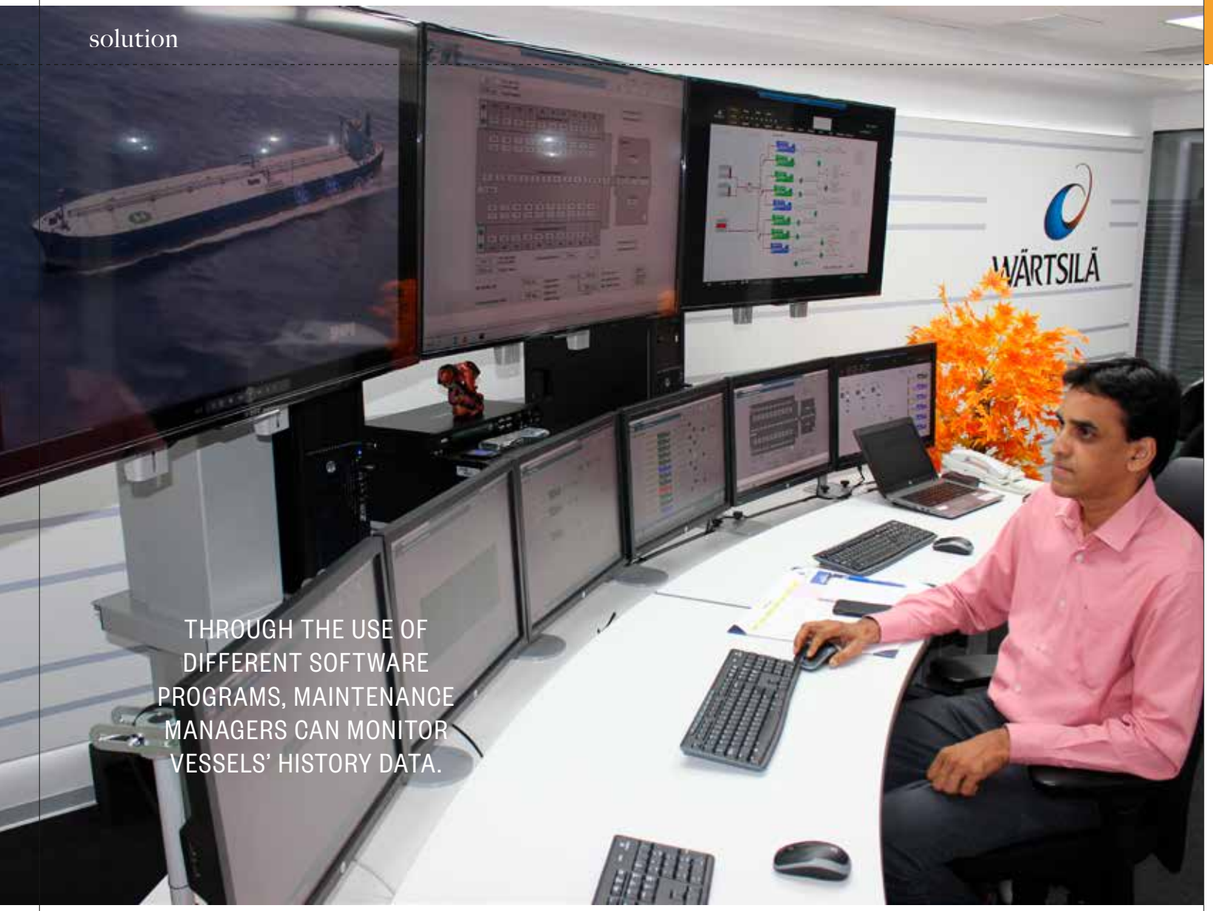
"No matter where the customer is, they will get emergency assistance anytime, anywhere. If something of special competence needs to be done onboard by a high-quality engineer, we have them link to the Expertise Centre. These experts often know the ships and the crews, they're dedicated to their own customers, they know the history of the ship, which makes dealing with the ship smooth," says Ristiluoma.

Furthermore, Dynamic Maintenance Planning (DMP) – which involves frequently monitoring a vessel's equipment, making periodic inspections and preventative changes to ensure it is running at optimal condition – enables Wärtsilä to extend the time between engine overhauls, improving equipment availability, and therefore saving time and money. For example, in the case of LNG customers using advanced dual-fuel or tri-fuel engines, the remote technicians at Vaasa ensure vessels' engines operate on gas as much as possible, since it is the most economic, efficient fuel and can extend the engine overhaul time.

SUPPORT, ALONG WITH EXPERTISE

A feature of Expertise Centres is the support they provide customers through engine performance monitoring, says Wärtsilä's maintenance planner **Dimitra Bostantzoglou**, based in Athens, Greece. "Condition Based Maintenance (CBM) supports owners and users in avoiding engine malfunction, and providing a better interval maintenance and performance of engines, extending major overhauls. At the same time, we are reducing the operational costs for the owners," she says.

Through CBM, Wärtsilä conducts "a daily follow-up of conditions and calculations of ideal operating parameters, based on engine design type, and analyses the quality of the fuel because this has a big impact on the recommended maintenance intervals."



THROUGH THE USE OF DIFFERENT SOFTWARE PROGRAMS, MAINTENANCE MANAGERS CAN MONITOR VESSELS' HISTORY DATA.

Wärtsilä receives data from each engine, which is analysed by the company's experts. This enables real-time optimisation of the equipment while predicting operational and maintenance demands. At the same time, through the use of different software programs, maintenance managers can monitor vessels' history data, including its location, arrival and departure dates, running hours and other information, providing them a big picture of operation and maintenance.

"Each component has a lifetime, so we follow each component and offer services and high quality follow-up maintenance," says Bostantzoglou. "Every month we follow the interval maintenance and we agree with the ship manager on needed measures, since engines are a crucial part of the vessel's reliability."

Ship owners have gained tremendously from Wärtsilä's Expertise Centres. "We have constant support," says **Loukas Kavouras**, Senior Ship Manager, Fleet Management, for Gaslog, which operates LNG carriers out of Piraeus, Greece. "We had some challenges at the beginning with the dual-fuel engines, and we got help through these support centres, where they caught issues early on and identified signs of premature failings, enabling us to avoid any damages."

The relationship is also one of collaboration and mutual benefit. "We've gained substantial technical experience and we feed this knowledge back to Wärtsilä, and vice versa," says Kavouras. "The engines are a crucial part of the vessel. Having these centres and rescheduling the maintenance activities to align with the trading commitments of the vessel is of great assistance. We have a win-win situation and we all benefit from this: we provide feedback, and point out issues and challenges encountered onboard, in order for Wärtsilä to consider further adjustments and improvements to components or maintenance activities."

Ultimately, the role of Expertise Centres is to enhance the lifecycle efficiency of Wärtsilä's customers' assets. "The first target," says Ristiluoma, "is to define the optimal maintenance intervals and, in the end, to ensure the operational and installation performance Wärtsilä is responsible for towards its customers, whose interest, in turn, lies in providing timely services towards their own customers."

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UNPARALLELED LUXURY ON THE HY SEAS!

▶ **TEXT:** ALEXANDER FARNSWORTH **ILLUSTRATION:** WÄRTSILÄ

WHEN YOU MIX a superyacht and a cruise ship, what you get is a ship so exclusive it creates its own market segment.

The majestic X-Expedition.

In boating circles, superyachts and cruise ships are two separate animals. Generally, yachting demands small, representational vessels with luxurious touches and are more stationary compared with cruise ships that sail continuously with thousands aboard. Design-wise, rarely do the twain meet.

This is about to change.

In May 2017, superyacht designer and architect **Stefano Pastrovich**, his Monaco design studio and Wärtsilä launched a new type of vessel, the X-Expedition, to cater to a growing segment of the ocean-going yachting/cruising business.

Key to the X-Expedition's groundbreaking market position is the prototype design that blends the best details of cruise ships and superyachts, reducing price and purchase time, while keeping the exclusive character of the onboard experience with customised arrangements. Powered by the innovative Wärtsilä HY, a fully integrated hybrid power module, X-Expedition paves the way for unprecedented luxury guaranteeing optimised performance, efficiency and flexibility with minimum environmental impact. The X-Expedition can sail anywhere, anytime.

Giulio Tirelli, Director, Marine Engineering, Wärtsilä Marine Solutions, puts this ground-breaking new concept into focus.

"Wärtsilä HY was developed as a product that can be customised for specific requirements of different ship types. Thanks to hardware and software optimisation, Wärtsilä HY can perfectly meet the needs of this new niche segment of the cruising industry, opening up a lot of potential for growth," he says.

Tirelli clenches the concept further: "Imagine having a sunset dinner at the captain's table without noise, vibration or smoke belching out of the smokestacks. This is possible with Wärtsilä HY!"

In three sizes – 60, 108 and 200 metres with up to 250 passengers – the Pastrovich/Wärtsilä X-Expedition small capacity luxury cruise vessel is made for a new generation of well-heeled travellers who seek not just privacy, dependability and comfort but the adrenaline of exotic adventures.

STANDARD DESIGN WITH EXCLUSIVE CHARACTER

X-Expedition is designed on a standard cruise ship platform. It is efficient and reliable to build and can be optimised. To differentiate their brands, cruise operators can customise the characteristics – exterior colours or interior arrangements – without losing the integrity of the standard ship.

In other words, X-Expedition combines the best of a cruise ship with the amenities and flexibility of a superyacht.

Thanks to its modular design and construction, X-Expedition is like a big puzzle where everything fits perfectly. This concept was developed to avoid waste of space and materials, achieving a perfect integration between exclusive design and optimised building costs.

The number of total cabins change according to their configurations, allowing operators to select preferred operational requirements.

Pastrovich carefully chooses details onboard the X-Expedition to grant passengers an unforgettable experience.

"We wanted to design a new home at sea for our travellers," explains Pastrovich, head of the Pastrovich Studio. "With this class of vessel, everything is designed with the passenger in mind: the cabins are the right comfortable size, the restaurants are placed to avoid seasickness, the number of restaurants is increased to reduce the number of tables for more privacy. The result? Passengers travelling with X-Expedition can enjoy pure comfort and privacy aboard a superyacht whilst sailing on a cruise ship."

> "X-EXPEDITION SHIPS WILL MAKE CRUISING GREENER AND MORE COMFORTABLE THAN EVER BEFORE."

HYBRID POWER: GREEN COMFORT FOR MAXIMUM FLEXIBILITY

Wärtsilä HY is a unique hybrid product that combines engines, an energy storage system and power electronics into a single smart product. The different elements of the power module are optimised to work together through a new-generation energy management system (EMS), specifically designed for this application. The EMS controls the power flow between the different power sources, but it also adds performance optimisation features with respect to vessel performance monitoring, emissions, trim and route. Wärtsilä HY achieves unrivalled efficiency of operations and delivers guaranteed performance.

"X-Expedition ships will make cruising greener and more comfortable than ever before," continues Tirelli. "The EMS co-ordinates the engines and energy storage system to guarantee that engines are used at their highest efficiency load points during the entire navigation, reducing fuel consumption and emissions in compliance with the latest environmental regulations."

In green mode, by switching to electrical storage power, emissions are reduced to zero for shorter cruise journeys, or at anchor. This also makes the stay onboard extremely comfortable as noise and vibrations are almost eliminated.

Wärtsilä HY also features a new patent pending automation procedure that enhances the synergy between the energy storage system and the engines to guarantee smokeless operations at all load points and in all operating modes.

For added flexibility, Wärtsilä HY ensures cold system start-ups and instant load-taking capacity, with rapid response to step-load changes making power boosts instantly available. The higher level of redundancy given by the combination of engines and batteries also provides an extra safety insurance to the vessel.

All these features give the X-Expedition an unparalleled smooth ride.

"...so that passengers can dream sweet dreams while sailing in extreme locations," says Tirelli. "And maybe book another cruise extravaganza during that dinner chat at the captain's table."

MEET THE MIRACLE: WST-24R THRUSTER

▶ **TEXT:** RICHARD ORANGE **ILLUSTRATION:** WÄRTSILÄ

WÄRTSILÄ'S NEW WST-24R retractable steerable thruster beats its predecessor on a lot of levels: it comes at a lower cost, it is more powerful, efficient and reliable, it is easier to install, and requires less maintenance. And there's more. Read on.

When **Vincent Klous** started thinking about how to renew Wärtsilä's retractable steerable thruster family to make it more hydrodynamically efficient, by adding the eight-degree tilted propeller gearbox, he quickly realised it would mean more than simply changing the angle of the propeller shaft.

Tilting the pod, shaft line, propeller, and nozzle by eight degrees implied also a longer retraction length. This meant the thruster unit, if left unchanged, would take up more space on board the vessels such as shuttle tankers, offshore support vessels, and construction vessels, for which the thruster was intended.

This set Klous' product development team in Drunen, the Netherlands, on a comprehensive redesign. Over a period of 18 months, they replaced the hydraulic retraction and steering mechanism with a ground-breaking electric one, which is currently being patented.

"We had to basically develop a completely new thruster, and change all the inboard parts as well," Klous says. "So this whole system is as compact as possible to minimise the envelope space in the vessel."

The new WST-24R thruster was launched at the Marintec China conference in December, last year. According to **Michel van Veluw**, head of Thrusters & Propulsion Control Systems, it is an improvement on its predecessor, the LMT-FS1510, across the board.

"We have improved on every area: performance, maintenance and operational costs, and also safety for our customers and yards," he says.

BEATING CONVENTION

In comparison to a conventional 90-degree thruster with a five-degree tilted nozzle, the eight-degree tilt, which Wärtsilä first introduced in the WST drilling series, significantly reduces the amount of thrust lost when the stream from the propeller hits the underside of the vessel's hull. Experience and research show that eight degrees is the optimal angle to veer the jet (sufficiently) downwards to clear the hull without notably reducing forward thrust.

The tilt also cuts thruster–to-thruster interaction by deflecting the jet sufficiently to reduce 'forbidden zones', where thrusters cannot operate without blowing into the stream from other thrusters.

This means, together with the larger propeller and improved hydrodynamic design of the pod and nozzle, the WST-24 generates more than 10% extra unit thrust compared with the LMT-FS1510 and translates into 23% more efficiency during dynamic positioning operations.

The resulting extra efficiency improves dynamic positioning performance of the vessel, reduces fuel consumption and lowers operating costs.

Throughout the redesign process, Klous kept in close contact with ship owners and yards to incorporate their needs into the design, resulting in a thruster that is easier to install, maintain and repair.

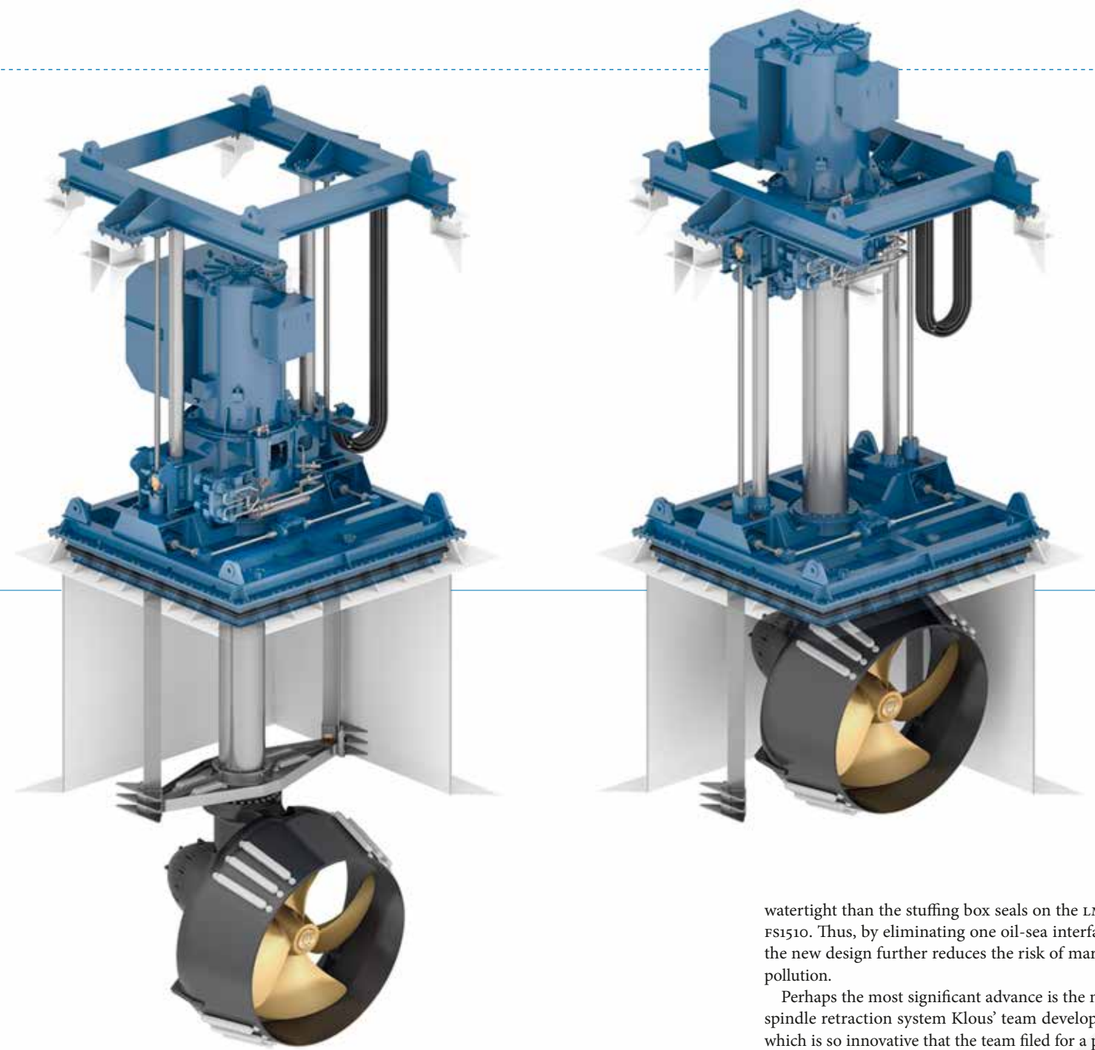
"We can fully assemble and pre-align this thruster in the factory, so it will be a lot like plug-and-play when delivered to the yard," van Veluw explains.

The thruster comes in a single delivery, and alignment is checked by a 3D laser during installation.

The retraction and steering mechanism, together with their combined sealing package, are also designed to be repaired and serviced on board without the need to go to dry dock. An inflatable seal keeps the water out when repairs are underway.

The composite bearing holding the propeller and gearbox, meanwhile, is designed to be serviced by divers in water, again avoiding expensive dock visits.

"WE HAVE IMPROVED ON EVERY AREA: PERFORMANCE, MAINTENANCE AND OPERATIONAL COSTS, AND ALSO SAFETY FOR OUR CUSTOMERS AND YARDS."



The unit's lean design is also expected to result in greater reliability and less need for maintenance.

"We designed it also with a cost reduction in mind, so we reduced a lot of components and combined functionalities. Therefore, we believe it's also more reliable and also more maintenance friendly," Klous explains.

One of the prime ways the designers saved space was by replacing the two hydraulic systems used for retracting and steering the LMT-FS1510 with electrical systems.

Eliminating the hydraulic system means less risk of fluid leakage, which pollutes the environment and leads to a slippery, unsafe environment for crew. The design, then, saves further space by using a single electric drive controlling the two engines responsible for retracting and steering the pod.

"When you are retracting you don't need to steer, and when you are steering you don't need to retract. That saves both space and money," Klous says.

INNOVATION, ALL THE WAY!

The team worked with a major seal manufacturer to combine the two separate sealing packages used on the LMT-FS1510's retraction and steering mechanisms into one single seal.

The new rotary seal, which has been made also suitable for linear motions, is considerably more watertight than the stuffing box seals on the LMT-FS1510. Thus, by eliminating one oil-sea interface, the new design further reduces the risk of marine pollution.

Perhaps the most significant advance is the new spindle retraction system Klous' team developed, which is so innovative that the team filed for a patent last year.

The new system reduces the required diameter of spindles to lift the same load from 330mm to 80mm by keeping them loaded permanently under tension. This prevents buckling and makes the retraction system self-locking, removing the need for external locking hooks.

"We are doing that with a couple of spring sets," Klous says of the system. "It's capable of lifting the same load with a much lighter system, so that's also a major positive."

The long list of new design ideas in the thruster, together with the increased ease of repair and installation, has already brought attention from ship owners and yards. At the moment, the first potential customer is on the brink of signing an exclusivity agreement.

FUTURE-PROOFING ENERGY STORAGE

TEXT: ZIKO RAY **ILLUSTRATION:** WÄRTSILÄ

RISING ENERGY AND POWER consumption is fast becoming a global 'talk of the town'. In this scenario, we dive into the Energy Storage Systems (ESS) market to explore the nitty-gritty of this segment and find out if (and how) we can future-proof energy storage.

The demand for energy is at an all-time high. Immense population growth and rising standards of living in developing countries are key drivers of growth in energy demand. This has led to Energy Storage Systems (ESS) playing a pivotal role in addressing the growing power demands.

A report titled "Grid-connected energy storage market tracker H1 2017", by IHS Markit, states that the global ESS market size was USD 1.5 billion in 2016 and is forecast to rise to USD 7 billion by 2025.

But it's not all cakewalk for the industry.

"While the ESS market is growing rapidly, a significant barrier to growth is financing risk. ESS assets are built to last 10 years or longer; however, long-term performance data for grid-scale ESS does not exist. The US Department of Energy (DOE)'s Energy Storage Database shows that the median operating lifetime of grid-scale battery energy storage systems is four years and nine months," says **David Miller**, Director of Business Development, Greensmith Energy – a Wärtsilä Company.

"Major equipment vendors release new energy storage products every 12 to 18 months, meaning that past performance may not be indicative of future results. In addition, many markets for ESS face uncertainties that make revenue forecasting a difficult task," adds Miller.

BATTLING REVENUE UNCERTAINTY

ESS solutions generally come with a usable lifetime of 10 or more years depending on the ESS technology and usage profile. But many of the crucial electricity market services that ESS offers are garnered with short-term contracts.

ESS projects often drive revenue from auxiliary services and capacity markets, which do not offer long-term contracts in the majority of cases. The procurement mechanism, as well as market value for these market services, transforms in unknown ways during the life of the ESS solution.

ENCOURAGING RENEWABLE ENERGY PRODUCTION

Energy Storage Systems also complement the renewable sources of energy like solar and wind which are witnessing a significant traction in terms of deployment owing to rising pollution levels particularly in developing economies like India and China.

"Generally, we see energy storage deployment following the deployment of renewable resources like wind and solar. The reason is that energy storage is used to solve some of the grid issues that wind and solar create. These issues include grid frequency stability as well as temporal mismatch between energy production and energy consumption," Miller explains.

He also states that both China and India now consume more than 10% of their energy from renewable resources, and the percentage of renewables in both countries is growing quickly.

EVOLUTION OF HYBRID SYSTEMS

The ESS segment is also witnessing the evolution of hybrid systems that combine solar with ESS storage systems and also other generation resources.

"With solar + ESS projects, many islands and remote grids are looking at solar PV and energy storage to help offset high fuel charges. Solar + ESS can deliver evening energy at lower rates than diesel generation. ESS is also being deployed to increase performance from existing generation assets," says Miller.

20 MW/80 MWh ESS in California with planned augmentation and flexible warranty.

"We have already seen successful integration of an engine and storage project in Finland and with AEP (American Electric Power), a hydro and storage project in Virginia. Both of these projects demonstrate how energy storage can optimise all generation assets," Miller adds.

HOW CAN WE FUTURE-PROOF ENERGY STORAGE?

To develop future-proof energy storage systems, storage developers should harness technology and project engineering tailored specifically for flexibility. Future-proofing also demands commercial agreements as well as analytical expertise to enhance the operational value of energy storage.

"ESS projects can be future-proofed by 1) installing a flexible controls architecture, 2) planning the right way for battery capacity augmentation, and 3) tracking ongoing operation with a flexible warranty. We see flexibility as the number one factor. Battery storage can be scaled in a building-block fashion, but you can save a lot of money in future expansions if you design for expansion capacity initially," points out Miller.

According to Miller, while battery designs are changing rapidly, engineering design to ensure future flexibility is tricky.

MAXIMISING REVENUE

That said, future-proofing a system is the most important measure to maximise revenue. This is valuable for an ESS operator, for whom the rate of return, which includes revenue and cost, is the most crucial aspect.

"The way to maximise the rate of return is to future-proof a system by building flexibility into the design. We have systems where our customers do not have long-term contracts with their off-takers. By future-proofing an energy storage investment, we enable our customers to maximise their rate of return, regardless of underlying market conditions," adds Miller.

While the factors associated with revenue generation vary from region to region by a great margin, ensuring maximum scalability for a streamlined revenue generation is a strategy backed by a large segment in the industry.

FINDING THE MOST APPROPRIATE LNG-TO-POWER SOLUTION IN MYANMAR

TEXT: NICOLAS LEONG, JOHN REINLUND **PHOTO:** iSTOCK **ILLUSTRATION:** WÄRTSILÄ

ONE OF THE growing economies of South-East Asia, Myanmar, is looking to increase its installed generation capacity to fulfil its economic and industrial growth. Betting on cleaner alternative fuel sources, such as LNG, is the way forward for the country. But what are the possible LNG terminal solutions and where can they be built in Myanmar? We dive into the details.

Myeik is a city located in the extreme south of Myanmar.

The recent lifting of international sanctions due to economic and political reforms in Myanmar, along with its strategic location as a land bridge between South and South-East Asia, has brought the country into the spotlight of international investors.

Myanmar's energy consumption is among the lowest in the world. The consumption per capita is 160 kWh per annum – 20 times less than the world average – and electricity access in the country is extremely limited, with the national average being around 34%.

But things are changing fast. The nation's electricity consumption is growing. The peak load demand reached 4,000 megawatts (MW) in 2016, growing on average 14% per annum in the past five years. As per the Myanmar Energy Master Plan published by the Asian Development Bank, the demand forecast is expected to grow to close to 14,500 MW in 2030. This provides immense potential to improve the country's power scenario.

Myanmar has not yet developed its own fossil fuel resources and is dependent on imports. Due to the current domestic gas shortage till 2020, alternative liquid fuel sources should be considered in the short- and middle-term future for power generation in order not to slow down the economic and industrial development of Myanmar.

Heavy fuel oil (HFO), with high-efficiency internal combustion engine technology, is considered a suitable interim fuel in Myanmar until pipeline gas or liquefied natural gas (LNG) is available, especially when the country needs urgent access to power. Since not all locations will be able to connect to a gas pipeline, LNG-to-Power will definitely be one of the solutions in the future Myanmar.

LNG LOGISTICS CHAIN

The key in making LNG affordable for the end users and still leave some profit for all the stakeholders making the value chain possible is to design an optimal logistics chain, which includes liquefaction of the natural gas; loading the LNG carrier for sea transport; unloading the LNG carrier to the receiving terminal via a jetty and unloading systems; and regasification or other means of further redistribution of LNG with trucks or barges.

Optimising the logistics chain depends on several parameters such as the size of the ship(s), shipping route(s), size and location of receiving terminal(s), utilisation of boil-off gas (BOG) in the process and finally the customer's gas dependence and gas availability and reliability requirements.

Wärtsilä has developed a tool to optimise the logistics chain with all the interdependent variables. The tool can also be used for sensitivity analysis on the final landed LNG price and how it is affected by the various parameters in the logistics chain, and to calculate the cost of delivering LNG from one supplier to three potential receiving consumers.

LNG-TO-POWER WILL BE ONE OF THE SOLUTIONS IN THE FUTURE MYANMAR.

For the full article, please see wartsila.com/twentyfour7/in-detail

MAY THE BEST OPTION WIN

To explain how this will work, let's use a fictive case based on delivery from the Singapore LNG terminal to sites in Myanmar.

This example illustrates the practicalities around planning the optimal logistics chain and choosing the LNG receiving terminal and power plant solutions in order to convert LNG-to-Power in the most cost-efficient and optimal way.

There are both onshore and offshore solutions available for the LNG receiving terminals today. For large onshore terminals, flat-bottom concrete tanks are the most commonly used. For the small sizes, pressurized steel tanks are becoming popular.

For large-scale terminals there are possibilities to employ an offshore solution with an FSRU (floating storage and regasification unit) or an FSU (floating storage unit) with a re-gas unit mounted on the jetty. In locations where an onshore location is not suitable and the gas amounts are too small to make an FSU or FSRU feasible, Wärtsilä's LNG floating storage and regasification barge (FSRB) can be the best alternative.

POWER PLANT SOLUTIONS

The running profile of the existing plants is changing from baseload operation to a more flexible and peaking operation. This is an important change to consider when designing new LNG infrastructure.

In order to reduce the risk and to ensure successful projects, the team or consortium setting out to develop the project should ideally include experts from all the segments starting from the molecule providers, shipping, permitting and local community knowledge, engineering, procurement and construction (EPC) and operations and maintenance. Wärtsilä's LNG solutions team can co-ordinate the work of such a diverse team as well as provide the complete EPC and operations & maintenance of LNG terminals

To explore the LNG-to-Power solutions, we use a few sites in Myanmar as examples.

• **Nga Yoke Kaung**: located near the city of Pathein (350,000 inhabitants) with basic industry, universities and some tourism.

• **Yangon**: Major city with a population of six million. It is the country's center for industry, trade, tourism, etc. Chronic power shortages currently limit the factories' operating hours.

• **Dawei**: with approximately 150,000 inhabitants, is the proposed site for a Special Economic Zone (SEZ) with a deep sea port.

We estimate the cost price of gas for two alternative project configurations and examine the effects of our preferences.

While examining the sites and planning the logistics chain, we encounter a challenge. The size of carrier that would be needed to make a milk run of all the sites cannot according to our (fictive) site description reach the Yangon site due to draught limitations. The solution is to create a hub terminal in Dawei and distribute the LNG from there in a smaller vessel to the other sites.

For Alternative 1, where we prefer low CAPEX, we need to keep the terminals as small as possible. We calculate that we can make do with an intermediate terminal with 22,500 m³ capacity that would be serviced by a 15,600 m³ LNGC going back and forth to Singapore.

For Alternative 2, where we prefer low OPEX, we focus on finding a less expensive way of delivering LNG. Hypothetically, we could look for a ship owner that can offer a larger LNG carrier. This would of course come at a higher day rate than the 15,600 m³ LNGC in alternative 1, but this time we manage to sign a flexible agreement that allows us to charter the vessel only for the time period when we need it.

With a 45,000 m³ LNGC, we can extend the time between filling the tank in Dawei from 8.5 days to 25 days. The logistics for the Dawei – Yangon – Nga Yoke Kaung milk run remain unchanged.

In this example the low OPEX solution gave the lowest gas price in all three locations. We will use these gas prices to calculate the cost of electricity.

COST OF ELECTRICITY

The cost of fuel, which is the biggest cost contributor, especially in baseload power plants, is then calculated based on the power plant efficiency and the gas price at power plant.

The average power output is the actual electricity available for sale after the high-voltage transformer at the point of connection to the purchaser's electrical grid. As these plants run at a variable load, depending on their power purchase agreement and actual demand from the grid, this is then converted into an annual average load.

THE RECIPE FOR SUCCESS

This study shows that the cost of produced electricity can be kept at a reasonable level by careful selection of the site. A good site should have existing structures that can be utilised – e.g., harbour facilities, deep enough water for LNG carrier access, an existing industrial area making development and construction easier, good land access and a location with good soil bearing capacity.

All of this will help reduce the initial infrastructure investment. After selecting the site, it is important to choose the most optimal solution based on the conditions at the site.

For Nga Yoke Kuang, we managed to reduce the cost price of gas by 0.60 USD/mmBtu, which might have a decisive impact on the financial feasibility of the entire project. Also for the other sites, we managed to reduce the costs despite the effects of significantly higher CAPEX of the terminal.

This case study shows that judging a project's feasibility simply by looking at CAPEX can be extremely misleading. One can make significant improvements by designing a logistical chain with a good fit with regard to distances, gas consumption and the sizes of available ships. Such optimisation should also examine the effects of even the slightest reduction of charter rates or LNG prices on the final cost price of gas.

The fuel cost dominates the tariff in the plants with a high power factor, while the fixed costs are almost negligible. In a power plant with a low power factor (for example, peaking plants or renewable energy followers), the CAPEX and fixed costs, of course, play a bigger role.

ONE CAN MAKE IMPROVEMENTS BY DESIGNING A LOGISTICAL CHAIN WITH REGARD TO DISTANCES, GAS CONSUMPTION AND THE SIZES OF AVAILABLE SHIPS.

TEXT: LOTTA HEIKKERI PHOTO: MINNA JALOVAARA

Powering the next generation

It was "Energy Week" in a school near Tampere, Finland. All through the week, the students from pre-schoolers to sixth graders dived into topics of power generation and renewable energy.

"We have been exploring different energy sources and trying to understand where our energy comes from," said **Niina Ketomäki**, a teacher at the school.

The method, phenomenon-based learning, is an essential part of the Finnish education system, which has often been hailed as one of the best in the world. The school invited **Matti Rautkivi**, Director of Sales and Marketing, Wärtsilä Energy Solutions, and few of his colleagues to talk to the kids about the future of energy and how engines help to generate power when the sun doesn't shine or the wind doesn't blow.

To make the interaction fun, Wärtsilians carried a scale model of Wärtsilä engine made out of Legos and also a bunch of Lego kits for kids to learn by doing. After a brief chat, the students, divided into groups, were asked to assemble an engine using Legos. While doing so, they kept posing questions to Rautkivi about the different features of the actual product.

"What does this part do?"

"How many pistons are there in the engine?"

"What about horsepower?"

Rautkivi, born and educated in Finland, was more than delighted to answer the questions.

"The best part of the schooling system in Finland is that you have the freedom to ask and apply what you learn," he said.

In a few hours, the classroom was home to a bunch colourful engines made out of Legos.

*Sign off

Read the full story and watch the video: wartsila.com/twentyfour7

TEXT: LOTTA HEIKKERI **PHOTO:** MARJA VÄÄNÄNEN

[AT YOUR SERVICE]

Safe and sound

CYBER-ATTACKS ON VESSEL OPERATORS or power grids can cripple infrastructure, cause huge losses and endanger people's well-being. **Mark Milford**, Vice President, Cyber Security at Wärtsilä, tells us what he thinks are the biggest vulnerabilities in the business and how he, along with his team, is making sure cyber security becomes a vital part of Wärtsilä's service.

1 WHAT DOES CYBER SECURITY MEAN FOR WÄRTSILÄ?
Because everything is now connected, security becomes more prevalent. Wärtsilä is becoming a smart technology company, and we're moving towards providing smart solutions for a sustainable ecosystem. Everything we do in our Energy and Marine Solutions requires that we have a safe and secure methodology in place. Cyber security is a risk management process that secures both our own and our customers' revenue streams by protecting key assets in the connected chain.

2 WHAT ARE THE BIGGEST VULNERABILITIES IN THE MARINE AND ENERGY ECOSYSTEMS?
Every aspect of the system has a security feature. On a vessel, everything from navigation all the way down to the automation of the engine has an electrical component that is connected to others. If you have a connected power solution and one part fails, it's likely that others could fail too. To be able to prioritise the security of each element and look at the system holistically is therefore very important.

3 FOR YOU, THE MOST FASCINATING THING ABOUT CYBER SECURITY IS THE PEOPLE. WHY?
It may sound like a strange or a surprising thing to say, but cyber security is not about technological solutions but about the people. If the security fails within an IT system, it's not usually the system that is failing but the person who is using it. It all comes down to the basics. If you have good personal cyber hygiene, you can do a lot to mitigate threats.

"CYBER SECURITY IS NOT ABOUT TECHNOLOGICAL SOLUTIONS BUT ABOUT THE PEOPLE."

[SIGN OFF]

[CLASSIC]

In step with style

The famous star patches on the inner sides not only identify the brand, they have a practical function – they were originally added as ankle protection.

Chucks have made appearances in over 500 films, including *Rocky* and *Grease*. **David Tennant** wore three different-coloured pairs in his role in the British TV show *Doctor Who*.

The design has remained essentially the same since the introduction of the classic black and white model, with its white rubber toe guard, in 1949. Before World War II, the toe guards were black.

In the 1990s, Converse tried to remove inconsistencies in the rubber tape that lines the base of the shoe. Hardcore aficionados rebelled, prompting the company to go back to making the imperfect version.

The ventilation eyelets were added in 1932.

An average of 270,000 pairs were sold per day in 2015, according to *The New York Times*. That works out to about three per second, or 100,000,000 per year.

ORIGIN

Nothing has ever hopped the fence between sportswear and pop fashion quite like **Chuck Taylor All-Stars**. Massachusetts rubber boot company Converse first put them out in 1917 as 'Non-Skids,' but it was basketballer and brand evangelist Taylor who deserves credit for making All-Stars the NBA must-haves of the 1960s. 'Chucks' have since dominated the art and music scene, their iconic status cemented by everyone from The Ramones to Ed Sheeran.

TECHS & SPECS

Production
1917 – present

Manufacturer
Converse

Materials
Stitched cotton canvas, rubber

[CULTURE WATCH]

[SCIENCE]

A new scanning technique can finally reveal the writing hidden inside mummy cases. The decorated boxes into which Egyptian elites were placed before entombment were fashioned from bits of waste papyrus previously used for mundane purposes like shopping lists or tax returns. University College London researchers are now scanning the 2,000-year-old papyrus with various kinds of light that makes the ink glow, providing a non-destructive way to study everyday life in ancient Egypt.

[LITERATURE]

In the world's developed economies, investment in intangibles like design, branding, software and R&D has now surpassed investment in tangible assets. *Capitalism without Capital: The Rise of the Intangible Economy* explores the far-reaching ramifications of this quiet revolution. Authors **Jonathan Haskel** and **Stian Westlake** warn that managers, investors and policymakers need to understand its power to drive social and economic disruption.

[TECHNOLOGY]

We could soon be lighting our homes using nothing more than houseplants, thanks to a group of MIT engineers working in the field of plant nanobiotics. The researchers treated a watercress with specialized nanoparticles, resulting in a faint glow that lasted four hours. Much more development will be needed to achieve desk-lamp intensity, but the days of the light bulb may very well be numbered.

[SIGN OFF]

TEXT: DAVID J. CORD **PHOTO:** TIINU WUOLIO & 123RF

[AMBITION]

Challenges and opportunities with energy's future

We should focus not only on the quantity but the quality of energy, says Laura Cozzi from the International Energy Agency.

Laura Cozzi, director of the International Energy Agency, says the world is changing quite rapidly.

"Italy is out of the World Cup," says **Laura Cozzi**, director of the International Energy Agency. "So the lesson is: don't take anything for granted."

We may think we know what is happening in the world energy markets, but the reality can catch us by surprise. Some of the foremost energy experts gathered in Helsinki, Finland, late last year at the Nordic Energy Forum to debate the current status and future of energy. The International Energy Agency (IEA) released its World Energy Outlook 2017, and Cozzi was on hand to explain its findings.

FOUR MAJOR UPHEAVALS

Cozzi detailed four major upheavals occurring in energy, several of which may take people by surprise.

"First, the United States will become the undisputed leader in oil and gas," Cozzi says. "In 10 years' time they will be responsible for 80% of new production. In fact, the US will become an oil exporter in net terms."

While America becomes a net exporter of oil and gas, renewables will make a drastic leap in cost efficiency.

"Secondly, solar photovoltaics will become the cheapest source of electricity," Cozzi continues. "This will happen in India and China within 10 years."

The third major upheaval is electricity, the demand of which is growing twice as fast as total energy growth, thanks in part to digitalisation.

"Finally, we have a cleaner energy mix in China," says Cozzi.

"When China changes, everything changes. In the recent party congress **Xi Jinping** has pledged an energy revolution and fight against pollution."

CHANGING SUPPLY AND DEMAND FOR ENERGY

The IEA predicts some good news on the horizon, such as cheaper energy, but also more challenges like cybersecurity threats and how to integrate renewables into our current grids. Cozzi says the world is changing quite rapidly.

"For example, India – not China – will dominate demand growth," she says. "Also, Africa will be innovative in the energy sector, such as new business models which use small solar applications and efficient appliances. These types of solutions are being rolled out very quickly across the continent."

The demand for energy is increasing, but it is being met by a different type of supply.

"Don't only think of the quantity of energy; also think of the quality," Cozzi explains. "About 80% of the growth will come from low-carbon sources, such as natural gas, nuclear and renewables. The demand for coal is collapsing, and by 2030 energy production from renewables will surpass coal in China. Solar is the new coal."

Another key point regarding China is how the economy is changing, Cozzi says. China is moving from heavy manufacturing to services and light manufacturing, which requires less energy per unit of output. The domestic economy will drive growth, making China much less dependent upon heavy manufacturing exports.

DIFFICULT BUT REACHABLE GOALS

The IEA sees also significant challenges for the coming years. As we are now, we will not meet the Paris agreement goals. Also, we are still falling behind on universal access to energy. Finally, air quality, particularly in cities, is still a challenge.

"We can still meet our goals if we focus on several things," Cozzi says. "For instance, we need to use more natural gas, as long as we improve emissions and leakages. We also need more solar power, and we need to have three times as many electric vehicles – 875 million – than we envisage in our most likely scenario."

These seem to be ambitious goals. As at so many times in the past, one might be tempted to despair of reaching them.

"I'm driven more by numbers than emotions, and there are good reasons to be optimistic," Cozzi says. "The growth of renewables and EVs were a pleasant surprise. I think we are moving in the right direction."

"I'M DRIVEN MORE BY NUMBERS THAN EMOTIONS, AND THERE ARE GOOD REASONS TO BE OPTIMISTIC."

[TRAVELLERS' GEAR]

Any USB power bank can be a travel lifesaver, but the credit card-sized **TravelCard charger** wins the prize for portability. Weighing in at 57g, the 1,500 mAh gadget comes with built-in cables and delivers enough juice to charge your iPhone or Android to 35–45%.

The ultimate cure for mangled umbrella syndrome, the compact **Repel Easy Touch** uses nine reinforced fiberglass ribs to stand up to gale-force gusts. It also features Teflon coating, one-touch opening and closing, and a lifetime guarantee.

Taking loads of gadgets on the road? The **Cable Stable DLX** is a great way to prevent your suitcase from turning into the familiar snake pit of wires, connectors and whatnot. The nylon organizer offers 15 flexible stowage spaces as well as pockets galore.

[LITTLE ENGINEER]

Power with a new spin

'SUSTAINABILITY' DOESN'T EXACTLY ROLL off the tongue for most kids. Likewise, the marvel of free, renewable energy may be lost on someone who assumes that electricity flows magically from the wall socket. At some age, however, youngsters will begin wondering what's really powering their PlayStations and why adults are so concerned about it.

Educational toy specialists Thames and Kosmos have come up with a fun, hands-on way to broach the clean energy subject: Wind Power 2.0, a kit that lets Little Engineers build a wind turbine and harness the power it produces. The windmill can light an LED or charge a battery to run various model vehicles snapped together from the kit – a glider, jet car, sail car, race car, tractor and tricycle.

The set comes with nearly everything needed to piece together the vehicles and two different designs of an approximately one-metre-tall windmill. The exception is the AA rechargeable battery, which you have to supply. Outdoor use will also require some extra ballast.

While you probably won't be blown away, ahem, by the charging speed, the kit more than makes up for this limitation with the amount of tinkering that can be done with it, including experiments that involve adjusting gear ratios and blade pitches to see which yields the best efficiency. The 40-page colour instruction manual doubles as a science book, explaining the history and principles behind wind power.

Users looking for a more advanced blade design, albeit with fewer gear and vehicle choices, can opt for the newer Wind Power V3. Both are recommended for ages 8 and up.

Let's unleash an open innovation approach!

WHEN IT COMES TO CHALLENGES AND CHANGE, the world is full of both – and Wärtsilä is no exception. We are at a significant moment as an organisation because we are faced with a choice. We can shape our purpose and become active drivers of the transformation of our businesses, our organisation, our customers' organisations, our industries, and even society. I believe this moment of choice is not about *whether* we want to do this, but about *how* we want to do it.

So I'd like you to savour this moment of choice – and think about the '*how*' aspect – for you.

When thinking about this *how*, try thinking about it from a new approach – an open innovation approach. This means people with the same challenge coming together and contributing to the solution, with their personal perspectives and experience, in a way that overcomes silos and creates synergies between what makes us great now and what will make us better in future.

Which part do you represent? How will you contribute? What will be your story? In this how, innovation is no longer about 'thinking outside the box', but about 'bringing the boxes together'.

Imagine what if those boxes were not only our own, but also ideas coming from our customers, our industry partners, the external ecosystem of parties that share the passion to solve the same challenges? What if Wärtsilä was the catalyst that brings all of these parties together, to challenge, to accelerate, to boost capability and build sustainable businesses – at the pace of the digital world? How can you be a catalyst? Who do you know that will make a difference? How will you collaborate?

Clearly, none of this can be done well if you are doing this alone. However, it's not just about jumping in, it's about navigating *your* way. I'd like to invite you to savour *your* moment in all of this, about how *you* will be involved.

Pick up *your* own innovation box and let's bring those boxes together!

Alid Dettke
Vice President
Wärtsilä Digital Innovation