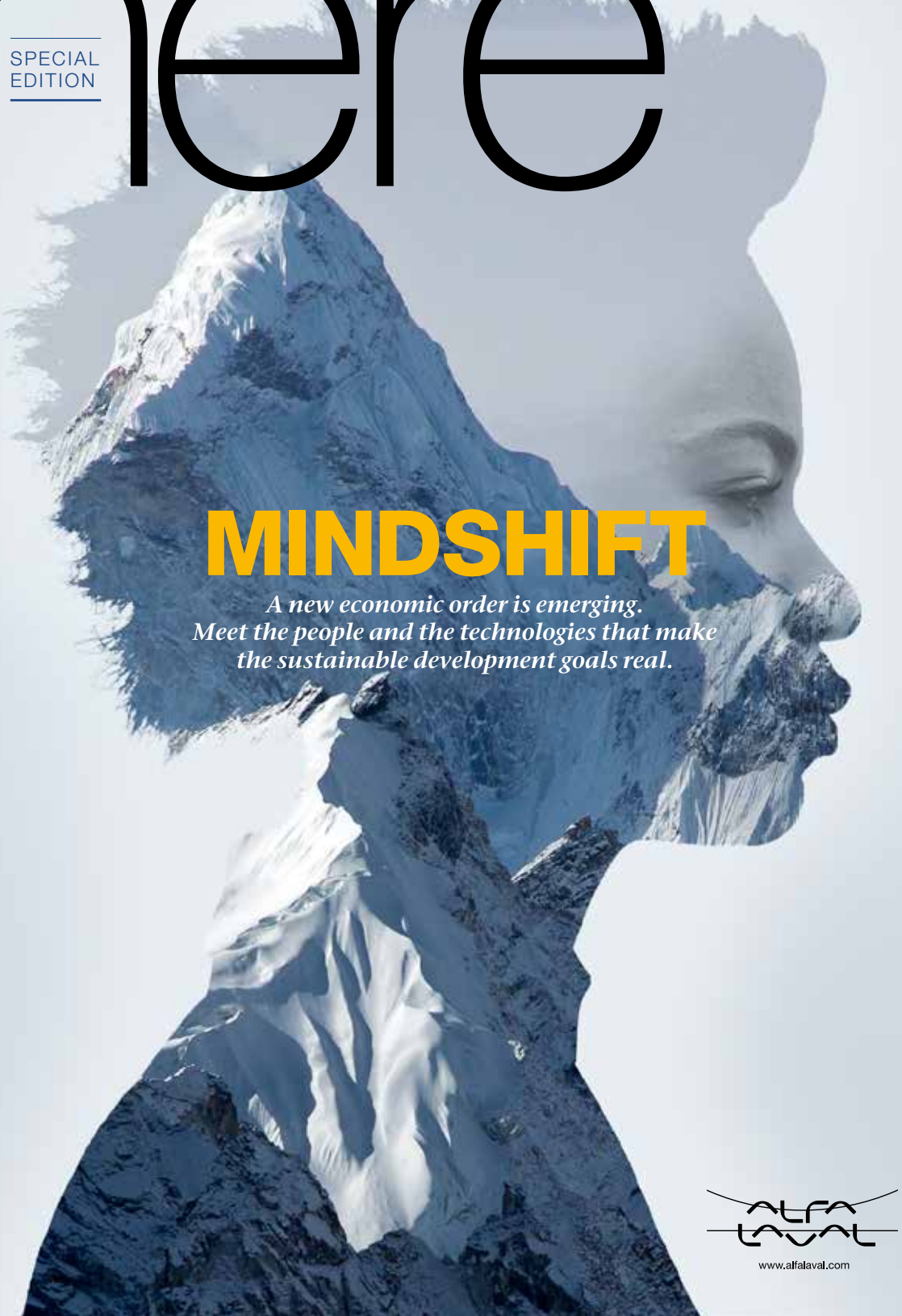
NO. 36
AN INTERNATIONAL MAGAZINE FROM ALFA LAVAL

here

SPECIAL EDITION



MINDSHIFT

A new economic order is emerging.
Meet the people and the technologies that make the sustainable development goals real.

ALFA LAVAL

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The Sustainable Development Goals explained

The 17 Sustainable Development Goals (SDGs) were adopted by world leaders in September 2015 at an historic UN Summit, and officially came into force the following year. Between now and 2030, countries will mobilize efforts to end all forms of poverty, fight inequality and tackle climate change, while ensuring that no one is left behind.

Extreme poverty rates have been cut by more than half since 1990. But one in five people in developing regions still lives on less than USD 1.90 a day. Beyond just the lack of income and resources to ensure a sustainable livelihood, poverty is manifested as hunger and malnutrition, limited access to education and other basic services, social discrimination and exclusion.

If done right, agriculture, forestry and fisheries can provide nutritious food for all and generate decent incomes, while supporting rural development and protecting the environment. Soils, freshwater, oceans, forests and biodiversity are being rapidly degraded, and climate change is putting more pressure on resources. But we will need to feed 2 billion more people by 2050.

Ensuring healthy lives and promoting the well-being of everyone is essential to sustainable development. Significant strides have been made in increasing life expectancy and reducing child and maternal mortality, and progress made on reducing malaria, tuberculosis, polio and the spread of HIV/AIDS. But more effort is needed to eradicate a wide range of diseases and health issues.

Obtaining quality education is the foundation to sustainably improving people's lives. Significant progress has been made towards increasing access to education and increasing enrolment rates in schools, particularly for women and girls. Basic literacy skills have improved tremendously, yet bolder efforts are needed if we are to achieve education goals.

Much progress has been achieved towards gender equality and women's empowerment, but women and girls continue to suffer discrimination and violence around the world. Providing equal access to education, healthcare, work, and representation in political and economic decision-making processes will fuel sustainable economies and benefit humanity at large.

There is sufficient freshwater on the planet for everyone. But due to bad economics or poor infrastructure, millions of people, mostly children, die from diseases associated with inadequate water supply, sanitation and hygiene. Water scarcity, poor quality and inadequate sanitation negatively impact food security, livelihood choices and educational opportunities for poor families.

Energy is central to nearly every major challenge and opportunity the world and humanity face today. Be it for jobs, security, climate change, food production or increasing incomes, access to energy for all is essential. Sustainable energy means opportunity – it transforms lives, economies and the planet.

Roughly half the world's population still lives on about US$2 a day. This slow and uneven progress requires a rethink and retool of economic and social policies aimed at eradicating poverty. Sustainable economic growth will require societies to create the conditions that allow people to have quality jobs that stimulate the economy, while not harming the environment.

Investments in infrastructure – transport, irrigation, energy and information and communication technology – are crucial for sustainable development. Technological progress is a precondition for achieving environmental objectives, such as increased resource and energy efficiency. Without innovation, industrialization will not happen, and without industrialization, development will not happen.

The international community has made great strides towards lifting people out of poverty. But inequality persists and large disparities remain in access to health and education. While income inequality between countries may have been reduced, inequality within countries has risen. Policies should be universal in principle, addressing the needs of the disadvantaged and marginalized.

Cities are hubs for ideas, commerce, culture, science, productivity, and social development. They enable people to advance socially and economically. However, many challenges exist to maintaining cities in a way that creates jobs and prosperity, while not straining land and resources. Urban challenges include congestion, lack of funds for basic services, and declining infrastructure.

This is about promoting resource and energy efficiency, sustainable infrastructure, and providing a better quality of life for all. Its implementation helps to reduce future economic, environmental and social costs, strengthen economic competitiveness and reduce poverty. Sustainable consumption and production aims to “do more and better with less,".

Climate change now affects every country on Earth. It disrupts economies and affects lives, costing people, communities and countries dearly today – and even more tomorrow. Affordable, scalable solutions are now available to enable countries to progress to cleaner, more resilient economies. Change is accelerating with renewable energy and energy reduction efforts.

The world’s oceans – their temperature, chemistry, currents, flora and fauna – drive global systems that make the Earth habitable for humankind. Our drinking water, weather, climate, coastlines, much of our food, and even the oxygen we breathe, are all ultimately provided and regulated by the sea. Careful marine management of is a key feature of a sustainable future.

Forests cover 30 percent of the Earth’s surface and, in addition to providing food security and shelter, they are key to combating climate change, and protecting biodiversity and the homes of the indigenous populations. Deforestation and desertification pose major challenges to sustainable development and have affected the lives and livelihoods of millions of people.

Number 16 of the United Nations Sustainable Development Goals is dedicated to the promotion of peaceful and inclusive societies for sustainable development, the provision of access to justice for all, and building effective, accountable institutions at all levels.

A successful sustainable development agenda requires partnerships between governments, the private sector and civil society. These inclusive partnerships – which must be built upon principles and values, a shared vision, and shared goals that place people and the planet at the centre – are needed at the global, regional, national and local levels.

OUR ROLE IN THE GOALS

Alfa Laval has a unique role to play in helping our customers contribute to the realization of the Sustainable Development Goals. On the pages that follow you can read about installations around the world where our equipment contributes to over half of the SDGs, such as by improving energy efficiency, reducing emissions, cleaning water, minimizing waste and maximizing yield from raw materials.

Sustainability begins at home

WHETHER OUR CUSTOMERS have their operations on the high seas or in sprawling megacities, they all have one thing in common: a need to improve their processes. For some, this means reducing energy or water consumption. For others, minimizing emissions, or eliminating waste. Once these were cost issues, but increasingly the driver is sustainability, as companies wake up to the opportunities created by a more far-sighted and responsible approach to business.

The United Nations Sustainable Development Goals (SDGs) set the vision that humanity needs to work towards, and now it is up to businesses like ours to take us there. In this sustainability special edition of *here* magazine, the focus is on our customers and how they are working to reduce their environmental footprint, with a little help from us. We are very proud that our equipment contributes to more than half of the 17 SDGs.

For those of us who work with compact heat exchangers, energy and resource efficiency have always been goals. The change today is that we convert the saved kWh into reduced CO2 emissions, which increasingly matches the changed priorities of our customers, who recognize how we can help them reach their own targets.

Like most employers, we are seeing that today's talent and tomorrow's leaders are drawn to companies that don't just talk sustainability, but that really make a difference. So to get the best people, it is imperative to take a leading role.

SUSTAINABILITY BEGINS AT home, so at Alfa Laval we are running a sustainability training program for all our employees, while making it an integral part of our own product development. Our efforts, and those of other businesses, build on initiatives underway in the public sector and civil society. And it is these partnerships between different stakeholders, based on shared values and and a shared vision, that are fundamental to achieving truly sustainable development. Much is being done, but far more remains to do. It is now abundantly clear that the companies that will survive and grow are those that create products and services for a more sustainable world.

SUSANNE PAHLÉN ÅKLUNDH
PRESIDENT, ENERGY DIVISION, ALFA LAVAL

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Alfa Laval Corporate AB
PO Box 73
SE-221 00 Lund, Sweden

Publisher: Peter Torstensson

Editor-in-chief: Eva Schiller
e-mail: eva.schiller@alfalaval.com
tel. +46 46 36 71 01

Production: Spoon Publishing AB
Editorial manager: David Wiles
Designer: Ken Niss

Cover: Markus Ljungblom

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You find them in mussels, in fish – and now in humans. How can we tackle microplastics? See p.76.

PHOTO: COLOURBOX

The $12 trillion

NOT SO LONG ago, 'green business' seemed to be more about looking good than doing good. But public concern over climate change and other environmental and social challenges has forced sustainable practices up the corporate agenda. Today, sustainability is a strategic priority for many multinationals.

Driving this shift are initiatives like the United Nations Sustainable Development Goals – 17 targets agreed in 2015 by 193 countries to tackle poverty, inequality and climate change by 2030.

The SDGs are a government-level venture, but one whose success cannot be secured by public authorities alone committed engagement from corporations worldwide is crucial.

"Business is absolutely critical to achieving the SDGs," says Astrid von Schmeling, senior consultant at sustainability specialists Purple Ivy in Stockholm. "Success depends on companies developing scalable products and solutions and embedding the SDGs deeply in their business strategies."

This need not be burdensome. Indeed, some experts suggest that corporations stand to earn vast amounts from embracing the SDGs and transitioning to truly sustainable business models.

The nonprofit Business & Sustainable Development Commission, whose members include top global executives, sees a $12 trillion opportunity for companies that adopt – and tailor their business activities to – the SDGs.

In fact, the $12 trillion bonanza covers just four sectors – energy, cities, food and agriculture, and health and wellbeing. Many more trillions could be earned in other areas.

PETER BAKKER, President and CEO of the Geneva-based World Business Council for Sustainable Development (WBCSD), emphasizes the scale of the opportunity: "Companies that are able to integrate the SDGs into their business strategy will be able to stay ahead of regulatory developments, anticipate future trends and tap into historic new growth markets."

So are global corporations rushing to incorporate the SDGs into their business strategies and get a headstart in this new gold rush? Not quite.

To date, big business has been slow off the mark. However, a January 2018 report by professional services firm PwC suggests uptake is gathering pace. Three out of five businesses now deem the SDGs important enough to include in their corporate reporting, while more than a quarter of companies set quantitative targets for the SDGs in 2017 and linked these to societal impact.

So how should businesses best

"The SDGs are a more radical agenda than most business leaders yet realize."

JOHN ELKINGTON,
GLOBAL SUSTAINABILITY EXPERT

question

approach the challenge? John Elkington, a global sustainability guru and head of the Volans consultancy in the UK, says enterprises must change their strategic mindsets.

"The SDGs are a more radical agenda than most business leaders yet realize," he says. "They imply a shift from incremental to exponential mindsets and ambitions – from our current focus on the negative impacts of economic activity to the deliberate generation of positive impacts."

ELKINGTON SAYS THIS shift means embracing the circular economy and lean practices, as well as understanding business as part of wider social and natural systems.

Companies – and investors – would appear to have much to gain from adopting such an approach.

A 2014 study by Harvard Business School showed that "high-sustainability" companies significantly outperform their counterparts over the long term, both in terms of stock market and accounting performance.

No coincidence, then, that investors are increasingly looking for opportunities to invest in companies that pursue environmentally and socially responsible practices.

"We're seeing an increasing SDG focus among the investment community, the proposed development of SDG benchmarks for leading companies with a view to promoting a race to the top, and the emergence of enhanced guidance on corporate SDG reporting," says the WBCSD's Bakker.

IT SEEMS LIKELY that SDG-oriented businesses could gain a competitive advantage over rivals that don't understand their contribution, enabling them to keep ahead of new policy interventions and revise their strategies more smartly. Those that do may come to be seen as pioneers of a step change in the global economic fabric.

"We're in some form of historic U-bend, where an old economic order is unravelling around us and a new one forming," John Elkington asserts. "These transitions happen maybe once in a human lifetime – and potentially offer the opportunity to radically transform the way capitalism, markets and business operate." ■

Is business engaging with SDGs?

71% of businesses say they are already planning how they will engage with the SDGs

62% of companies mention the SDGs in their reporting

37% of companies have selected priority SDGs

79% of companies that prioritize the SDGs have chosen SDG 13 Climate Action

28% of companies set quantitative targets and link these to societal impact

13% of businesses have identified the tools they need to assess their impact against the SDGs

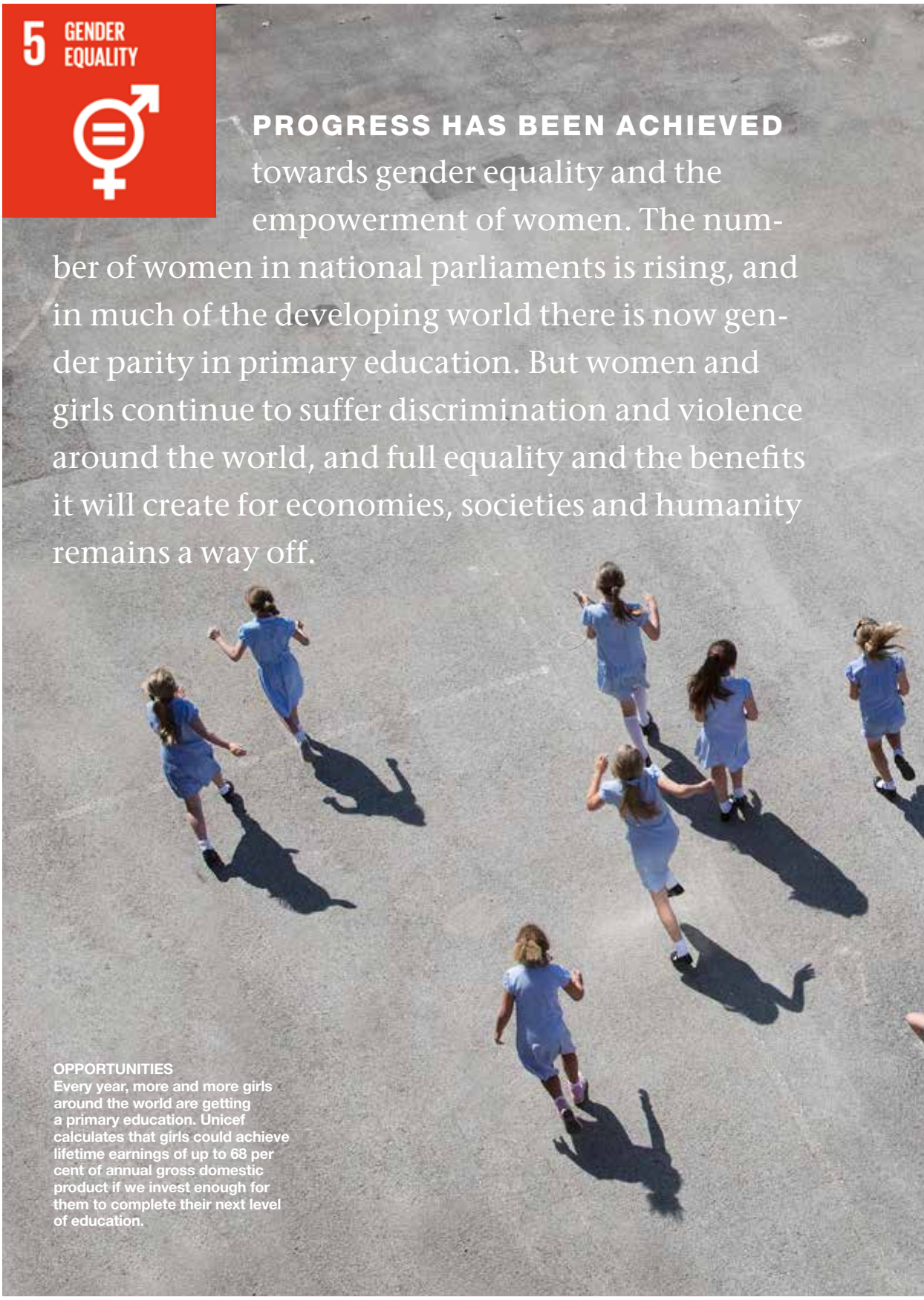
41% of businesses say they will embed SDGs into their strategy within five years

90% of citizens say it's important for business to sign up to the SDGs.

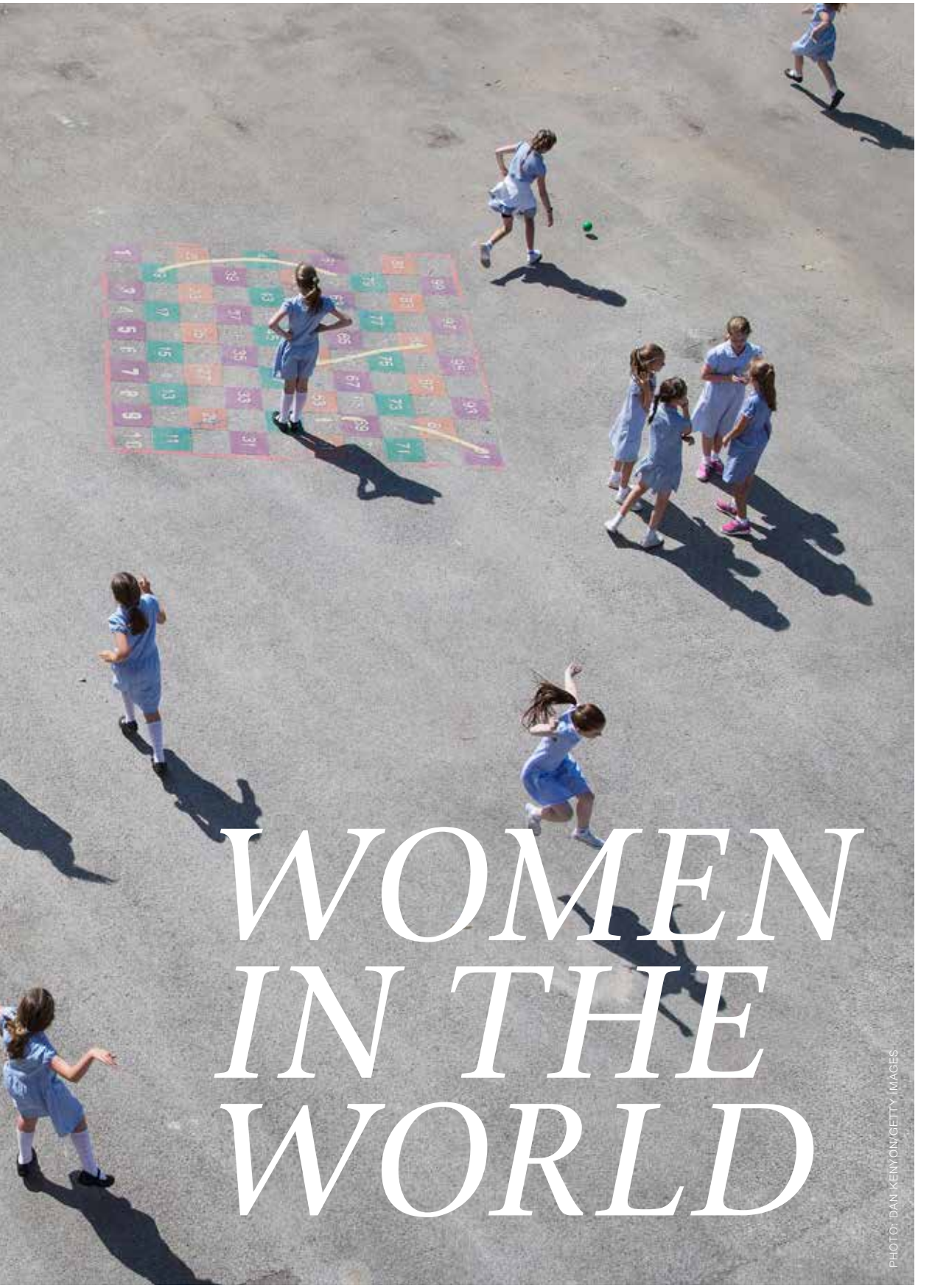
Source: World Economic Forum, PwC SDG Reporting Challenge 2017

5 GENDER EQUALITY

PROGRESS HAS BEEN ACHIEVED towards gender equality and the empowerment of women. The number of women in national parliaments is rising, and in much of the developing world there is now gender parity in primary education. But women and girls continue to suffer discrimination and violence around the world, and full equality and the benefits it will create for economies, societies and humanity remains a way off.



OPPORTUNITIES
Every year, more and more girls around the world are getting a primary education. Unicef calculates that girls could achieve lifetime earnings of up to 68 per cent of annual gross domestic product if we invest enough for them to complete their next level of education.



WOMEN IN THE WORLD

PHOTO: DAN KENYON/GETTY IMAGES

Opportunity knocks

Discrimination against women encompasses all areas of life, from health and nutrition to schooling, employment and politics. Still, there are many good examples that change is possible.

STORY BY CARI SIMMONS & ULF WIMAN
PHOTOGRAPHS BY MARCOS ROMANO & MAURIZIO CAMAGNA

WOMEN ARE ROUTINELY discriminated against in all industries worldwide. Equal pay for equal work and equal career opportunities are still way off in the distance. But, even though the progress is excruciatingly slow and there are backlashes, there are also rays of hope.

In the corporate arena, a growing number of companies are seeing that diversity and equal opportunities – and not only regarding gender – are right from a social and an ethical perspective, but that they also create a dynamic working environment that promote creativity and innovative thinking. And – the bottom line – business growth.

Alfa Laval's vision is to create an inclusive workplace where diversity is essential to achieve company objectives. One proactive company

> **“You need to show direction, take responsibility, and be willing to make sacrifices.”**
>
> **PENNY PENG**, SENIOR MANAGER, PARTS & SERVICES DIVISION, CHINA

initiative deals with attracting, developing and nurturing female managers.

Penny Peng, Senior Manager, Parts & Services Division, China, and Sara Billo, Product Group Quality & Safety Manager, Italy, are two successful Alfa Laval managers that have made the journey. They are inspiring role models, showing that it is possible to be a woman, and a top-level manager in the manufacturing industry.

When Penny graduated from university as an engineering student in 1992, China was opening up to the world. Many international companies came to China and established branches. “Young Chinese, like myself,” Penny says, “were eager to learn the advanced management skills and technologies from these international companies. I joined the Marine department at Alfa Laval soon after my graduation.”

Sara decided to work for Alfa Laval because it is a well-known and solid international company with a good reputation. She wanted to continue to develop her knowledge and competences in the HSE area and be located at an important manufacturing site. “I have a degree in chemical engineering and a master’s degree in Health, Safety & Environment management systems, and when I started at Alfa Laval in 2004, I felt so lucky to have the possibility to work in an area that I really liked.”

LOOKING BACK ON their careers, Penny and Sara agree that an open and feedback-based company culture has been crucial to their success. Support, guidance and coaching from managers as well as mentorship are essential to boost self-confidence and to show direction. Asked about personal success factors, Penny says that, “For me, it’s important to be calm, consistent, never give up, and take training opportunities.”

Sara says: “My specific and deep knowledge in the area of Quality, Health, Safety & Environment, supported by energy, passion and a strong will to improve processes and drive cultural changes.”

Make no mistake, it takes a lot of hard work, and there will always be bumps in the road to success. Sara says that a particularly challenging experience for her was the change from a site to a product

IN BRIEF: **SARA BILLO**

Product Group Quality & Safety Manager, Alonte, Italy. Also responsible for coordinating and standardizing Quality, Health, Safety and Environment (QHSE) processes for sites in other countries. Started at Alfa Laval in 2004, applying her Health, Safety and Environment (HSE) skills at a time when few companies were investing resources in HSE management systems.

IN BRIEF: **PENNY PENG**

Service Divisional Manager, Shanghai, China. Twenty-five years ago, she was the first woman at Alfa Laval China to sell marine equipment to China's shipyards. Not only did Penny introduce new products and technology to the shipyards, but she also crossed a cultural and gender divide.

group dimension, and the responsibility that comes from working with multicultural teams and organizations with different maturity and structures. At the same time, there was a complete reorganization in Alfa Laval.

"My manager helped me understand the underlying reasons and focus on goals with the same energy and commitment," she says. "Having demonstrated that I can accept and lead change has been appreciated. As a result, I have seen my role confirmed and empowered."

FOR PENNY, A BIG challenge was a titanium crisis in China that meant all contract prices with shipyards had to be renegotiated. "Then there was the 2008 financial crisis, when orders were cancelled," she says. "In these situations, it all depended on the team working together, and finding solutions to achieve a win-win situation with our customers."

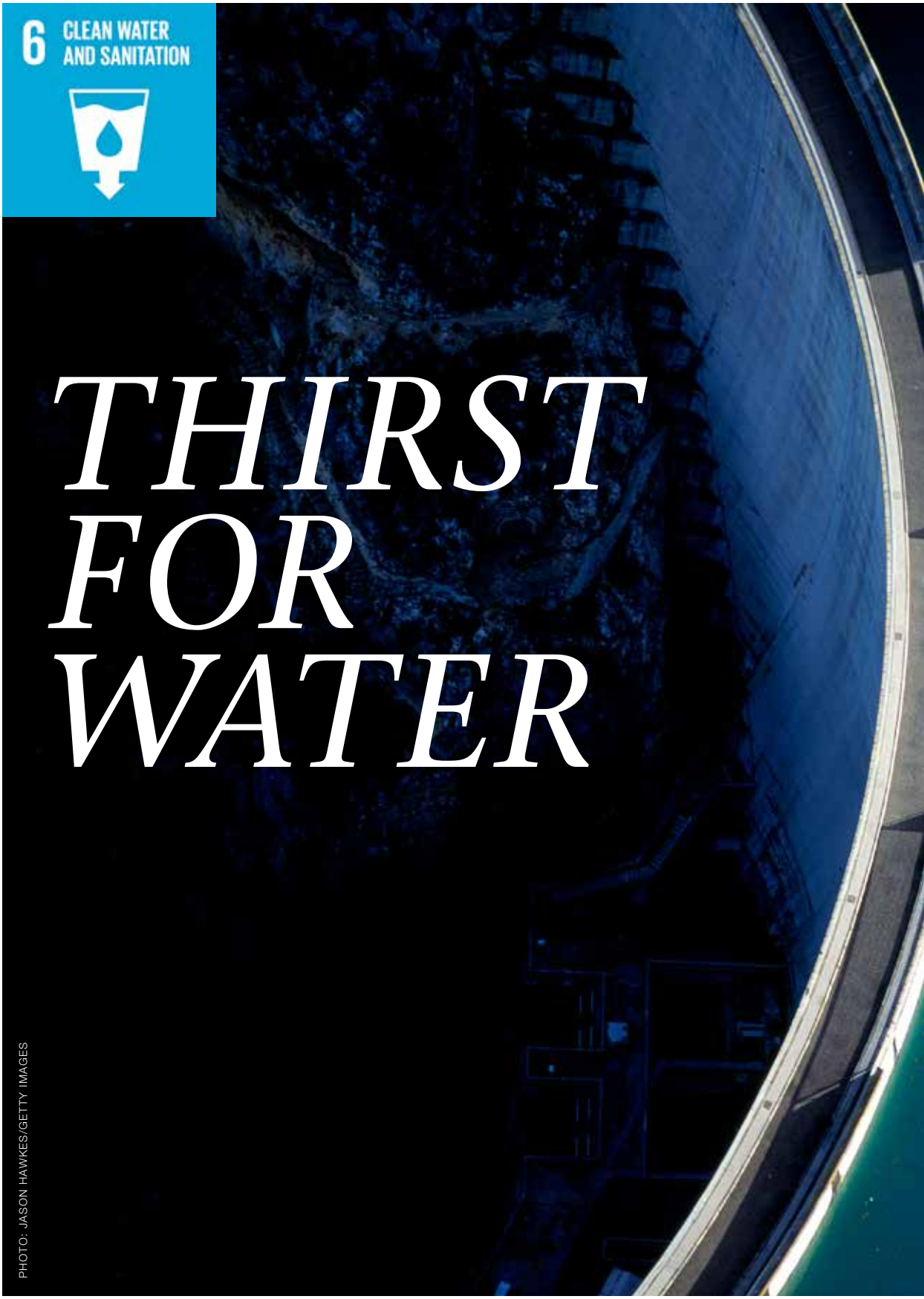
One of Alfa Laval's strategic equal opportunity objectives is to decrease the gap between the proportion female managers and the proportion of female employees. But what does it take to become a leader at Alfa Laval?

"You need to show direction, take responsibility, and be willing to make sacrifices, so that your team members will trust you and be willing to go further with you," answers Penny.

Sara stresses, "the capability to influence and drive change, with strong focus on achieving goals and always having in mind customer satisfaction and people commitment."

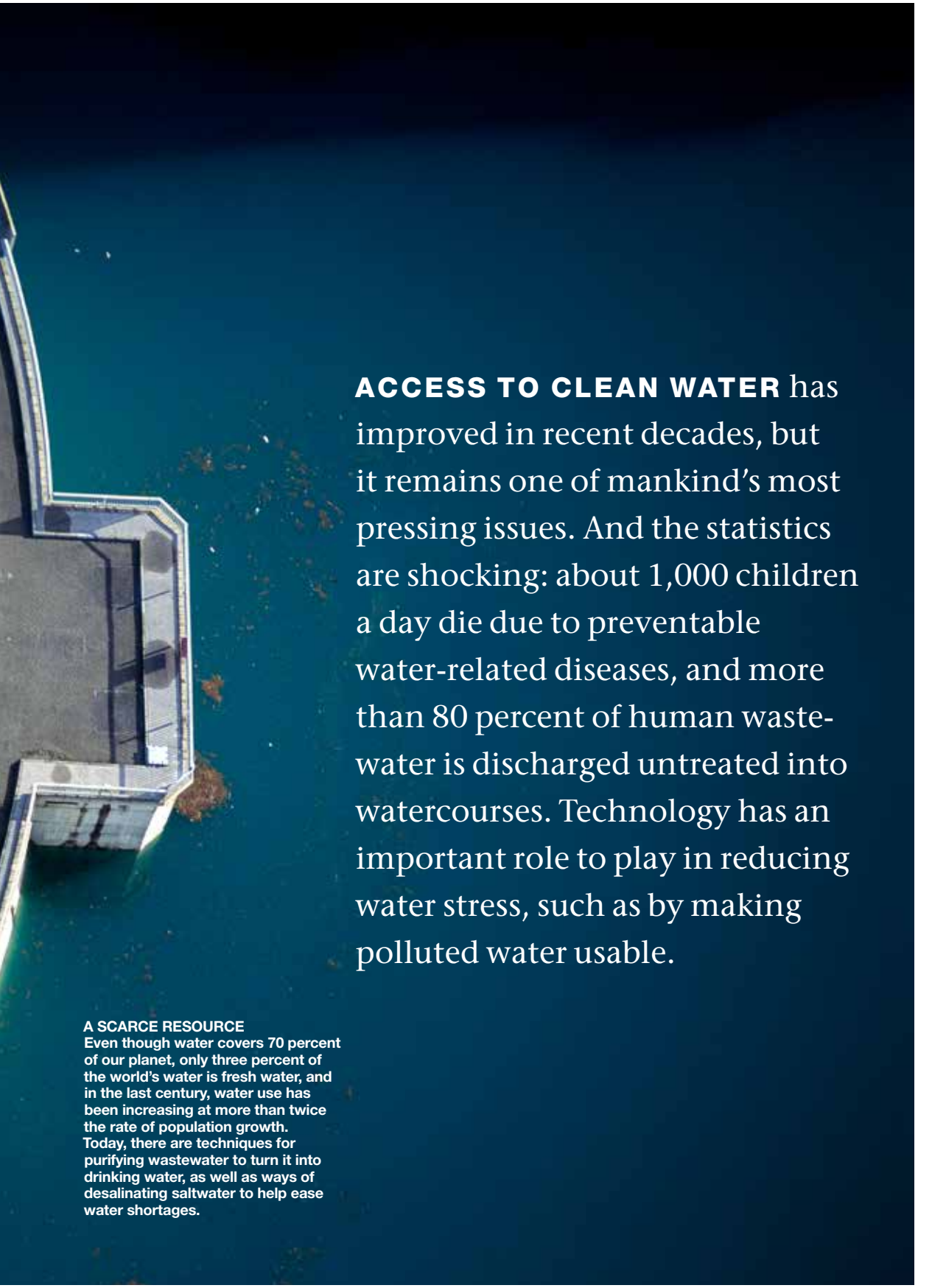
Having come a long way themselves, Sara and Penny have good advice for women who is just starting out in their career, or who want to take the step into management. Sara's recommendation is to always work with high standards, focusing on your strengths and creating a solid network within the organization. "It's also vital to get energy and support from family to stay stable and focused on objectives," she says.

Penny agrees: "Support from family members is very important. Be brave and insistent and do not fear for the future."



THIRST FOR WATER

PHOTO: JASON HAWKES/GETTY IMAGES



ACCESS TO CLEAN WATER has improved in recent decades, but it remains one of mankind's most pressing issues. And the statistics are shocking: about 1,000 children a day die due to preventable water-related diseases, and more than 80 percent of human waste-water is discharged untreated into watercourses. Technology has an important role to play in reducing water stress, such as by making polluted water usable.

A SCARCE RESOURCE
Even though water covers 70 percent of our planet, only three percent of the world's water is fresh water, and in the last century, water use has been increasing at more than twice the rate of population growth. Today, there are techniques for purifying wastewater to turn it into drinking water, as well as ways of desalinating saltwater to help ease water shortages.

WONDERFUL **WASTEWATER**

From Californian wineries to the ski slopes of southern Poland, wastewater is becoming a valuable resource at a time when access to water is increasingly under threat. Richard Orange reports on how membrane bioreactor technology is turning what was previously a "dirty secret" into an innovative global solution.

STORY BY RICHARD ORANGE
PHOTOGRAPHS BY ROBERT BEDNARCZYK & GETTY IMAGES

IT TAKES NEARLY five litres of water to make a single bottle of Californian wine – and that doesn't even include what you use to grow the grapes. So between late 2011 and 2014, when the state suffered its worst drought in over 1,000 years, local governments naturally turned to the winemakers as part of attempts to tackle what many saw as a looming disaster.

At one of the many wineries on the outskirts of Pasa Robles City, all of the water used in crushing, fermenting and bottling is now run through a membrane bioreactor (MBR), with the waste then used to irrigate grass and trees near the plant.

This particular winery has long been a trailblazer, helping put the region on the global wine map at the turn of the millennium when its top wine was ranked sixth best in the world.

But this time the push came from the local Paso Robles City government, which banned local winemakers from sending their wastewater to the municipal wastewater plant, which is not designed to treat water with such a heavy biological load of grape skin and juice.

Almost all of Paso Robles' more than 200 wineries have now MBR systems installed. And according to Nick Gurieff, Global Sales Business Development Manager at Alfa Laval, this has

made the area more resistant to future droughts.

"It's not just for irrigation, it's also an indirect way of recharging the aquifers," he explains. "They can then reuse it to water the crops."

DROUGHT IS ARGUABLY the greatest single threat from climate change. According to a UN report released last year, about 500 million people already live in areas where water consumption exceeds the locally renewable water resources by a factor of two. A recently released World Bank report predicted that close to 150 million people could be forced to leave their homes over the next 30 years as a result of climate change, with drought the most pressing threat.

But even in rich world countries such as the United States, Australia, Spain and Italy, water shortages are a growing problem, leading to growing demand for MBR treatment systems, which have the advantage of taking up little space, compared to other solutions.

"With climate change and changing rainfall patterns, there's a lot of stress on water resources, so the ability to reuse water where you can will be in much greater demand," Gurieff predicts. "Once we put a value on the water, we will see more pressure to invest in MBR. It won't just be a nice thing to have, it will be a requirement. That water will be too valuable to be used just once."

AT A SKI resort in southern Poland, the same Alfa Laval membranes used in California are used to purify the sewage and greywater. Once the solids and other biological matter have been removed, membrane separation purifies the water and it is then used to make artificial snow in the winter, and for irrigating the grassy slopes in the summer. The system has a double benefit: it both prevents the wastewater from being released untreated into local watercourses, as was previously the case, while it reduces stress on local water resources. And being a closed system, with no odour or noise, it does its work unnoticed close to the resort's unsuspecting guests.

There are numerous other examples of similar systems playing a crucial environmental role around the world. Back in the US, MBR-treated wastewater from a private housing estate is sold to the country club next door, where it is used to irrigate the greens on the golf course, recouping some of the treatment cost. "The water has no nutrients in it," Gurieff explains. "If they took it from the nearby creek, which has nitrogen and phosphorus in it, they would get algal blooms in their water features."

Water treated by MBRs is also ideal for use as a coolant in industrial processes, because the filtration removes all the biological matter and salts, cutting the risk of a build-up of limescale or biofilm. In Brisbane, Australia, where Gurieff lives, purified domestic wastewater is used in the cooling towers of the local power station. In India, Galaxy Surfactants, a chemicals producer that already sends water treated by an Alfa Laval MBR system to surrounding villages, now plans to use it in its cooling towers.

> **"With climate change and changing rainfall patterns, there's a lot of stress on water resources."**
>
> **NICK GURIEFF**, GLOBAL SALES BUSINESS DEVELOPMENT MANAGER AT ALFA LAVAL

A forward-thinking ski resort in southen Poland is addressing two challenges with MBR. It is used to clean wastewater, thereby protecting the local environment, while the purified water is used for making snow, reducing demand on local water supplies.

“In the future, there’s a possibility to have a closed cycle system.”

NICK GURIEFF, GLOBAL SALES BUSINESS DEVELOPMENT MANAGER AT ALFA LAVAL

Industrial use bypasses what Gurieff calls the “yuck factor”. Many of his MBR customers are reluctant to publicize their reuse of recycled wastewater, particularly when it is used for public recreation, filling lakes, rivers or town fountains, or for food.

“Everybody has this yuck factor,” he explains. “But we need to overcome it with better education and knowledge of how safe these technologies are. It’s a primeval instinct meeting a technological future.”

WATER COMING OUT of an MBR system, even if it started as human sewage, is cleaner than what you would find in most rivers.

“It’s completely clean of any bacteria and pathogens,” Gurieff stresses. “When people are looking at a golf course or water feature, they want to think it’s nice, natural water, which to be honest, is probably dirtier than what’s coming out of the membrane system.”

If more businesses were brave enough to actively promote their use of recycled water, he believes customers would start to see it as “a step forward into the future rather than a dirty secret”.

Wastewater from MBRs, particularly if further purified with reverse osmosis – the highest level of filtration, which in principle only allows water to pass through – can be used to wash fruit, or even for drinking water, as has been done in Singapore for many years.

“It’s a part of their big strategy of being water independent,” Gurieff says. “They spent a huge amount of money on PR, and they’ve been very smart in not calling it ‘recycled water’. It’s ‘new water’.”

San Diego in California has borrowed this idea with its ‘pure water’ project, which aims to supply 110 million litres of recycled water a day to the city by 2021.

AS PART OF a scheme to build acceptance of the recycled water, the local beer company Stone Brewing last year released a batch of “Full Circle Pale Ale”, made from municipal wastewater. Apparently it was quite tasty.

Gurieff believes that in future MBR plants will be supplemented with reverse osmosis treatment to allow the same water to be used again and again for the same purpose.

“In the future, there’s a possibility to have a closed cycle system,” he says.

Alfa Laval has over the last few years improved the energy efficiency of its modules by about 50 percent, countering the high energy use that has historically been the main disadvantage of MBR.

“All of these places are in pretty sunny areas, so if you could start using solar cells, you could start closing the production loop,” Gurieff says.

He expects housing estates to recycle MBR-treated water for flushing toilets, washing vehicles and watering plants. But the next step for California wineries may be instead to use municipal wastewater on the vines themselves.

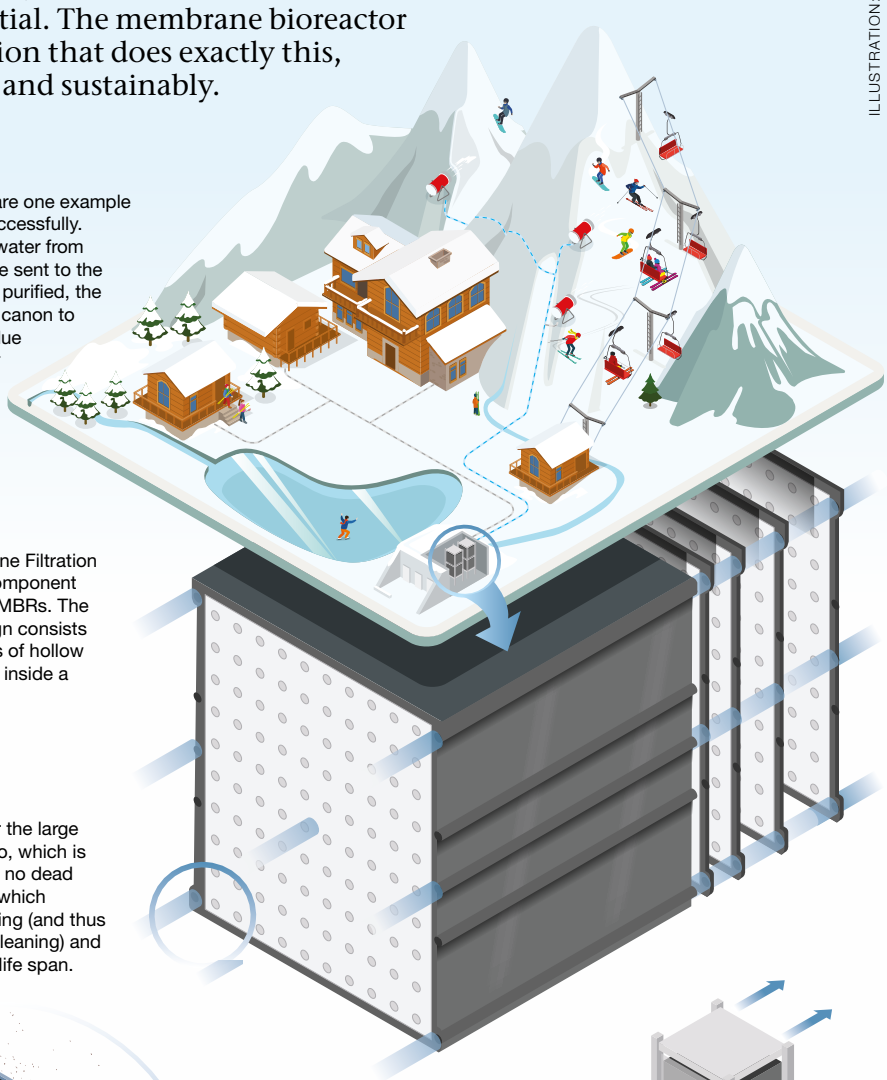
When a long-awaited new municipal treatment plant opens in Paso Robles City in late 2018 or early 2019, the city wants winemakers to use water that was once sewage for irrigation. Matt Thompson, the city’s wastewater resources manager told Wines and Vines magazine that the water would be “perfectly safe” for vineyard use.

“The city does intend to recycle its wastewater,” he said. “It’s not ‘if,’ but ‘when’.” ■

From sewage to snow

Given the current and future water scarcity around the world, the possibility to turn sewage into clean, reusable water has immense potential. The membrane bioreactor (MBR) is a solution that does exactly this, both efficiently and sustainably.

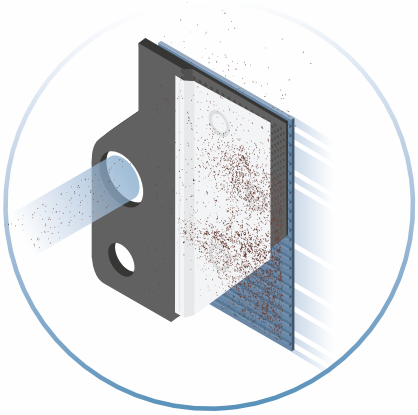
ILLUSTRATION: PETTER LÖNEGÅRD



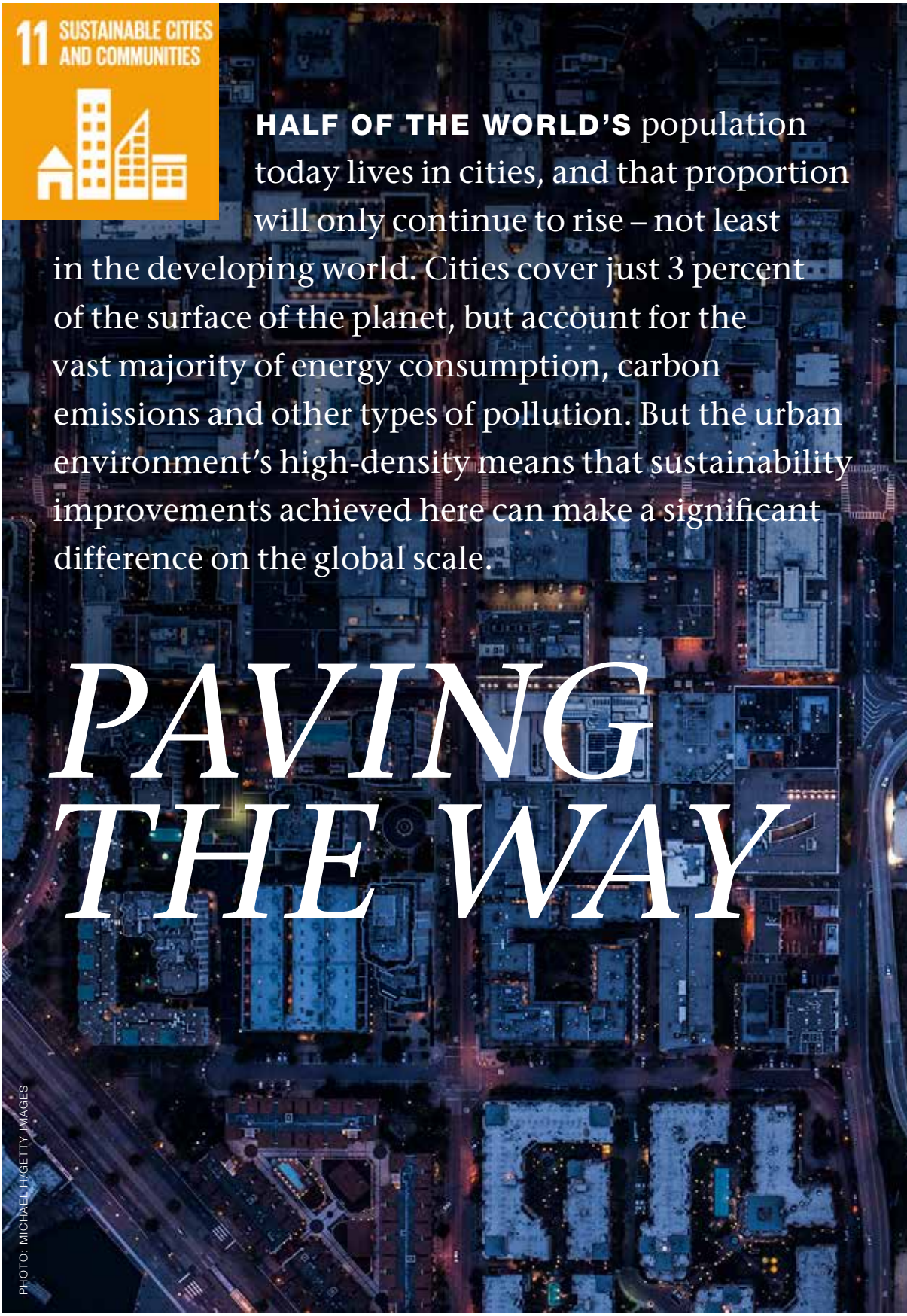
■ Alpine skiing systems are one example where MBRs are used successfully. Sewage and other wastewater from the resort (brown lines) are sent to the MBR for treatment. Once purified, the water is sent to the snow canon to produce artificial snow (blue lines). During the summer months, the water can be used to irrigate the grassy slopes.

■ The Alfa Laval Membrane Filtration Module (MFM) is a key component in treating wastewater in MBRs. The compact, stackable design consists of standardized packages of hollow sheet membranes placed inside a stainless-steel frame.

■ The pressure drop over the large membrane is close to zero, which is ideal for MBRs. There are no dead spots on the membrane, which practically eliminates fouling (and thus costs for downtime and cleaning) and extends the membrane's life span.



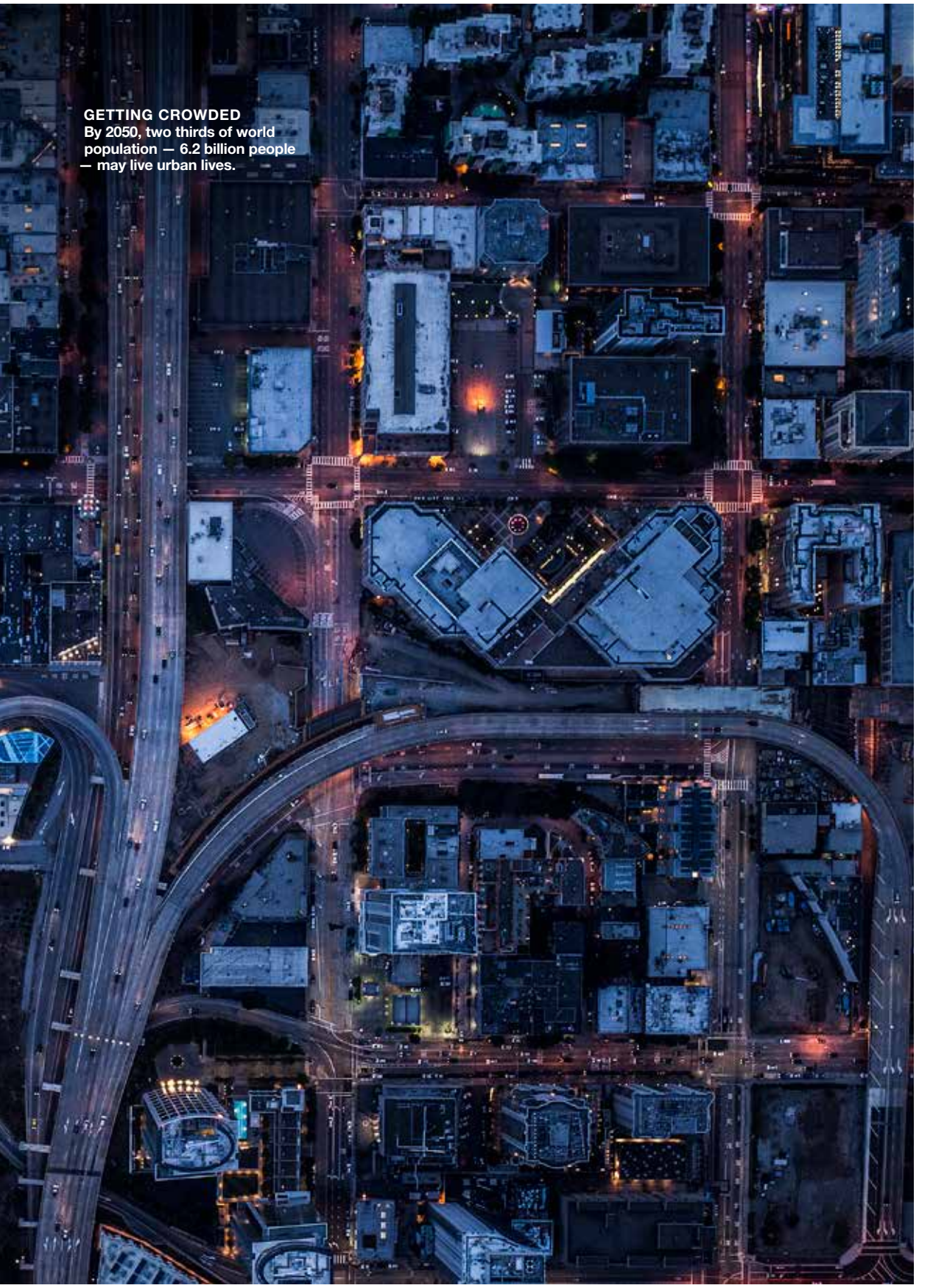
■ The MFM is submerged into the MBR tank, where air bubbles are added to the mixed liquor via an aerator at the bottom of the tank. This creates a cross-flow velocity, which ensures that the liquor circulates effectively. The mixed liquor flows upwards between the membrane sheets (brown arrows). The cleaned effluent passes through the membrane sheets and is collected in channels, exiting through connectors at the top of the unit (blue arrows).



HALF OF THE WORLD'S population today lives in cities, and that proportion will only continue to rise – not least in the developing world. Cities cover just 3 percent of the surface of the planet, but account for the vast majority of energy consumption, carbon emissions and other types of pollution. But the urban environment's high-density means that sustainability improvements achieved here can make a significant difference on the global scale.

PAVING THE WAY

PHOTO: MICHAEL H/GETTY IMAGES



GETTING CROWDED
By 2050, two thirds of world population — 6.2 billion people — may live urban lives.

Clearer skies **in coal country**

Millions of tons of CO_2 and thousands of tons of dangerous dust, sulphur and oxychloride emissions are set to be cut every year thanks to a new power plant in north-east China being fitted with state-of-the-art Alfa Laval technology.

SITUATED DEEP IN CHINA'S coal country, the provincial capital city of Taiyuan has been dubbed 'The City of Haze' due to its high levels of air pollution. Steel and coal-power plants dot the city's outskirts, and residents light coal-fired boilers each winter to ward off the often frigid northern Chinese winter.

But now the city of Taiyuan is trying to clean up its air.

In a major move to reduce air particulates, the power supplier Taiyuan Heating Power Company has partnered with Alfa Laval to make improvements to the Taiyuan Taigu Central Heating Project, one of the world's largest central heating facilities. To improve efficiency of the plant and reduce emissions, 90 large-scale Alfa Laval plate heat exchangers will be installed.

Alfa Laval was chosen as a technology supplier to the project in large part for its heat exchangers' high efficiency, despite the demanding operational environment, with high temperatures and high pressure. The technology must perform well despite narrow temperature differences and maintain a high Number of Transfer Units (NTUs), ensuring high energy efficiency and optimized investment returns.

The installation is just one of a myriad of projects now underway in China to reduce air pollution in the country after decades of coal-fueled economic growth. This year, the city of Taiyuan is replacing coal-burning household heating equipment with electric and natural gas heaters and has acted to control exhaust and dust from cars and trucks.

So, what will the effect of the Taiyuan central heating project be? Alfa Laval's plate heat exchangers are set to reduce carbon dioxide emissions in Taiyuan by about 2.5 million tonnes, cut sulphur dioxide by approximately 4,000 tonnes, oxychloride by 1,000 tonnes and reduce dust emissions by 2,000 tonnes. The reduction in pollutants is aimed at turning Taiyuan into a greener, more liveable city. ■

The polluted skies of Taiyuan, China. The installation of Alfa Laval plate heat exchangers will reduce CO_2 emissions from the city's new power plant by 2.5m tonnes, sulphur dioxide by 4,000 tonnes, and dust emissions by 2,000 tonnes.

PHOTO: ANTON HAZEWINKEL/GETTY IMAGES

FACTS: **CHINA'S FIGHT AGAINST AIR POLLUTION**

Several decades of economic growth have led to high pollution levels in many Chinese cities.

In 2014, the Chinese government declared a war on pollution and has taken tougher action on polluting business.

In 2017, China saw a 23 percent jump in its environmental protection and energy efficiency budget, bringing it to 33.8bn yuan (USD5 billion). More than half of the budget is earmarked for projects to improve air quality.

"We're working on solving the world's energy crisis"

WORKING WITH PLATE heat exchange technology might not sound so inspiring, admits Julien Gennetier. But the technology's impact on reducing global energy use is jaw-dropping.

The question of what he does for a living can be answered in two ways, says Julien Gennetier, President Business Unit Gasketed Plate Heat Exchangers at Alfa Laval. "When I tell people that we sell plate heat exchangers, I don't get so much interest. But if I tell them we're working on solving the world's energy crisis, people sit up and listen."

At the end of the day, they are the one and the same thing.

Take a recent example from Hamburg, Germany, where eight Alfa Laval plate heat exchangers are being installed in a copper plant outside of the city. The waste energy captured through four of the exchangers will reduce the power consumption of the plant, while the other four will generate enough energy to heat 3,500 homes in the region. Julien points to the global impact: "Think about it, that's only a handful of gasketed heat exchangers – and globally we are selling tens of thousands of them per year."

Indeed, the International Energy Agency estimates that, in 2016, the world would have used 12 percent more energy had it not been for energy efficiency improvements. Technologies like plate heat exchangers have contributed to these improvements.

These 12 percent are equivalent to adding another European Union in the global energy market.

Being able to make a global impact is a big part of why Julien loves what he does. "I'm personally a very purpose-driven person." That same sense of excitement applies to much of his team in Alfa Laval's Energy Division. "We are truly passionate about energy efficiency. Our technology is highly efficient, and as we have the ability to understand our customers' processes, we can help them meet their efficiency goals. All of that makes the work really worthwhile."

MUCH OF JULIEN'S time is spent travelling the world to meet Alfa Laval's customers globally.

Recently he was on a trip to China, which has now included specific and far-reaching sustainability targets in the government's current five-year plan.

"I love interacting with people, so I love spending time with customers. Also, you get a reality check. You see that you have to be relevant – not just for sustainability but to meet needs for social and economic development factors, too." ■

3 TIPS FOR CUSTOMERS

1 Map processes to see other opportunities. "A lot can be achieved with existing technology that customers may not be aware of. For example, it is easy to map current processes and identify opportunities to recover waste heat, leading to energy savings and cost reduction."

2 Clean dirty heat exchangers. "Unclean or clogged heat exchangers reduce energy efficiency dramatically. Globally we estimate that the impact of unclean heat exchangers corresponds to 1–2.5 percent of the world's total energy consumption."

3 Carry out performance monitoring. "A performance review can help scan equipment and reconfigure it to perform optimally. Innovations such as non-stick materials can be used to avoid clogging, for example."

PHOTO: FREDDY BILLQVIST

“Our technology is highly efficient, and as we have the ability to understand our customers' processes, we can help them meet their efficiency goals.”

AIMING HIGH

IN 2018, ST PETERSBURG, Russia, became home to the tallest building in Europe: the Lakhta Centre. At 462 metres tall, the new multifunctional complex dominates the skyline of the city, and will form the centre of a new business district.

However, the project's ambitions extend well beyond breaking height records – it has also set bold targets when it comes to the building's environmental impact, both in its construction and continued operation.

One of the most distinguishing features of the Lakhta Centre is its double façade skin, which allows for thermal insulation and natural ventilation. It is estimated this will reduce heating and air conditioning consumption by 50 percent. In addition, conventional heating devices have been replaced by infrared radiators that can reuse heat emitted from other devices, and sensors will automatically adjust temperature and lighting according to the number of people in each room.

Among the other energy-saving components of the Lakhta Centre's construction are 61 Alfa Laval gasketed plate heat exchangers, which will be used for heating, ventilation, hot water and air conditioning. Due to their high heat-transfer efficiency, the heat exchangers will minimize heat loss. They will also reduce the water consumption needed for power transfer and, by extension, reduce the energy consumption for water pumps.

The Lakhta Centre is just the latest of many exceedingly tall skyscrapers where Alfa Laval equipment is used for climate control. Others include the Burj Khalifa in Dubai, the Shanghai Tower (the first and second tallest buildings in the world respectively) and the Bank of America Tower in New York.

The tallest buildings in the world

1 | **Burj Khalifa**
Location: Dubai, United Arab Emirates
Height: 828 metres

2 | **Shanghai Tower**
Location: Shanghai, China
Height: 632 metres

3 | **Abraj Al-Bait Clock Tower**
Location: Mecca, Saudi Arabia
Height: 601 metres

4 | **Ping An Finance Centre**
Location: Shenzhen, China
Height: 599 metres

5 | **Lotte World Tower**
Location: Seoul, South Korea
Height: 554.5 metres

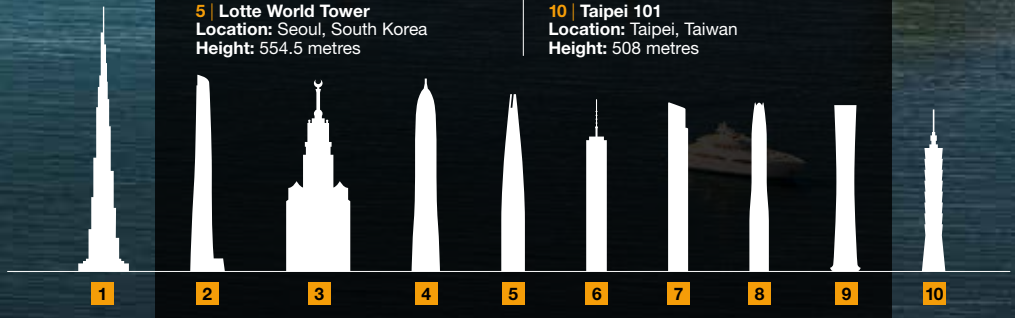
6 | **One World Trade Center**
Location: New York, United States
Height: 541.3 metres

7 | **Guangzhou CTF Finance Centre**
Location: Guangzhou, China
Height: 530 metres

8 | **Tianjin CTF Finance Centre**
Location: Tianjin, China
Height: 530 metres

9 | **China Zun**
Location: Beijing, China
Height: 528 metres

10 | **Taipei 101**
Location: Taipei, Taiwan
Height: 508 metres



FACTS: **LAKHTA CENTRE**

Location: St Petersburg, Russia
Height: 462 metres
Floors: 87
Info: Tallest skyscraper in Europe, 20th tallest skyscraper in the world.

The Lakhta Centre's twisting tower is inspired by a Swedish fortress, which occupied the original site in the early 14th century.

FOOD FOR

THE GLOBAL GROWTH of the middle class is good for individual prosperity, but will be bad for the planet. By 2050, we will be consuming the equivalent of three planets' worth of natural resources. But sustainable consumption and production patterns – doing more with less – can help ensure a better quality of life for all, while reducing resource use, degradation and pollution.

THOUGHT

FOOD FOR EVERYONE?
Global agriculture has grown 2.5–3 times over the last 50 years. This has let food production keep pace with human population growth so that, overall, there are enough calories produced per capita. But hunger and malnutrition affect every aspect of human development.

PHOTO: RICHARD NEWSTEAD/GETTY IMAGES

The sweet smell of citrus success

Bergamot, a citrus grown almost exclusively in Reggio Calabria, Italy, has been a favoured essence of the fragrance industry for centuries because of its quality and versatility. We visit a fourth-generation company that takes a thoroughly modern and sustainable approach to the production of this valuable ingredient in high-end perfumes.

STORY BY CLAUDIA B. FLISI
PHOTOGRAPHS BY MAURIZIO CAMAGNA

FRESHLY SEPARATED bergamot oil is an enigmatic emulsion. Its colour is iridescent green streaked with sunshine, reflecting its origins as a small greenish citrus hybrid between oranges and lemons. The heady fragrance encompasses both these fruits, and adds a subtle suggestion of exotic spices like cinnamon and cloves.

No wonder it was used in the original eau de cologne. An Italian named Johann Maria Farina, who had settled in the German city of Cologne, created the first scent under the name of his adopted city in 1709. Homesick for the smells of his native land, he had written to his brother the previous year: *"I have discovered a scent that reminds me of a spring morning in Italy, of mountain narcissus, orange blossom just after the rain. It gives me great refreshment, strengthens my senses and imagination."*

TODAY, 90 PERCENT of the world supply of bergamot comes from Reggio Calabria, the region at the very "toe" of southwest Italy, and the fruit is still favoured by the "noses" of the fragrance industry: it is found in both traditional and modern perfumes because of its freshness, multi-faceted aroma, and its ability to blend well with other

scents. It is also used in many other aromatized products such as cosmetics and detergents – but you may be most familiar with it as an essential ingredient in Earl Grey tea.

The fortunes of family company Capua 1880 have been intertwined with bergamot and other citrus fruits of Reggio Calabria (oranges, lemons, mandarins) since 1880, when a Calabrese couple, Caterina and Domenico Capua, began supplying bergamot oil to perfume makers in Paris, Grasse, and elsewhere. The Capuas extracted the oil from the fruit using the old-fashioned pressing techniques of the time, but their marketing was modern for its day, gaining international clients from the outset.

TODAY, A FOURTH generation Capua, Gianfranco, runs the company, with his twin sons Giandomenico and Rocco already preparing for fifth-generation leadership. Much else has changed; extraction is done with high-tech Alfa Laval centrifugal separators, and marketing is entirely global (the company has no domestic clients). The product focus is also quite different: fragrances for perfumes, cosmetics, and household detergents represent only half of Capua's current turnover, which has experienced double-digit growth for the last half decade. The other 50 percent of business is comprised of flavourings for the food and beverage sector.

The growth in use for fragrances can be attributed to the quality, stability, and versatility of Capua oils, and the company's ability to supply them at a price acceptable to the buyer. The growth in use for flavouring is riding global demand for a "return to nature". The natural fruit oils produced by Capua 1880 for the food sector are sold to companies that make flavour essences for food companies, and products like these that deliver more natural flavour and aroma are preferred by many consumers.

The company's strategy for future growth consists of three pillars, according to its president. The first is innovation. "R&D is continuous to help us develop new product processing," explains Gianfranco Capua. His company is always studying new techniques for extracting, filtering, and treating essential oils.

The second is new product creation. Citrus fruits don't change, but Capua is always looking for new ways to fragment the fruit oils to create something different. "Our clients are hungry for new ideas," notes Giandomenico Capua, one of Gianfranco's sons. "We may suggest ten new fragrance or flavour combinations and they want to hear about all of them. They may reject nine, but one will be accepted." The majority of Capua's oils for fragrances are custom-made for its clients according to the standards they specify.

THE THIRD PILLAR is market expansion. The "return to nature" trend has resonance not only in developed markets like Europe and North America but also in newer markets such as India and China, and even in Central and South America, who are leaders in the production of citrus fruits. Growth is prompting the company to consider a new purpose-built plant in the next few years, and Alfa Laval technology will be a factor in the layout of that facility. ■

> **"R&D is continuous to help us develop new product processing."**
>
> **GIANFRANCO CAPUA**, CAPUA 1880

Gianfranco Capua is the fourth-generation head of Capua 1880. The photo behind him is a reminder of family tradition.

Less energy, higher end-product quality

When Giandomenico Capua took over responsibility for citrus processing at Capua 1880 in 2013, he faced the problems of business growth and ageing equipment. He looked to new technologies in citrus oil separation equipment for solutions.

Over the course of the next five years, he evaluated separation equipment by Alfa Laval and others. The Alfa Laval CR 250 ranked at the top of his list for its performance, quality results, and yield increase.

On-site testing began in May 2017 and the results confirmed Capua's expectations.

- The Alfa Laval CR 250 can handle 4,000-5,000 litres of emulsion an hour – more than double the old capacity of 1,200-1,600 litres an hour.
- The separator uses 30 percent less energy than competitors' equipment for the same results.
- Its bottom-fed, fully hermetic design is gentler on shear-sensitive particles and eliminates oxygen pickup, leading to better quality aromas in the final product.
- The design meets the EU's highest regulatory standards for health and safety.
- The fact that the operator can optimize the process during production means reduced need for downtime for mechanical changes.

Sustainable citrus

Sustainable practices are ingrained in Capua 1880's corporate culture. Since the company's raw materials are 100 percent citrus fruits from local farmers, and all its finished products (essential oils) are sold abroad to environmentally aware multinational corporations, it is totally committed to sustainable goals. And it has been officially recognized as such: in January 2018, Capua 1880 was certified by the Union for Ethical Bio-Trade (UEBT) as a sustainable organisation.

In the first phase of this certification, Capua documented the sustainable practices of 450 of its citrus suppliers. The information gathered from this research was passed on to the UEBT for a subsequent phase of certification.

According to company head Gianfranco Capua, his agricultural suppliers should be motivated to follow sustainability guidelines – otherwise it is up to Capua to motivate them. By doing so, he says, "the quality of their produce improves, their yield increases, their efficiency improves, their savings increase, and they make more money".

Natural selections

Besides bergamot, some of the other raw materials found in high-end perfume can include:

- Woods are important in providing the base notes to a perfume. Birch, cedar, juniper, pine and sandalwood are among those commonly used.
- Ambergris, which is produced in the intestines of sperm whales. Occasionally found washed up on beaches, ambergris can be worth more than USD 10,000 per kilo.
- Musk is a potent, reddish-brown substance secreted by male musk deer. Today it has mainly been replaced by synthetic musk.
- Other natural ingredients used in perfume include flowers, grasses, spices, fruit, roots, resins, balsams, leaves, gums and bark. Alcohol, petrochemicals, coal, and coal tars are also used.

Citrus fruits are washed after arrival at Capua 1880, under watchful and experienced human eyes.

With the bottom-fed, hermetic design of Alfa Laval separators and the process optimized by Ioannis Koulioumpas, Capua 1880 produces higher quality perfume essences.

PHOTO: PETER KROON

“Generally, we talk a lot about waste: waste energy, waste product and waste water. But yield is a perspective that gets lost."

"It can be important to break with tradition"

WHAT ARE THE environmental benefits for brewers if they chase higher yields instead of just improved efficiency? John Kyle Dorton is using new ways to think about sustainability to "green" one of the world's oldest industries.

John Kyle Dorton was fresh out of college the first time he changed the brewing industry. Employed by a small manufacturer of pasteurizers in Denmark, he helped reengineer and simplify the heating system of the beer tunnel pasteurizer – one of the most energy-intensive parts in the brewing packaging process. The result was a more streamlined and energy-efficient system that soon became an industry standard.

"Since I was new to the industry, how things worked wasn't as ingrained," he says. "The experience taught me that it can be important to break with tradition."

NOW, AS VICE President of Brewery Systems at Alfa Laval, Dorton continues to reassess traditional ways of looking at things. Take the question of sustainability. The shift in mindset that he advocates is to talk a bit less about efficiency, and more about yield.

"Generally, we talk a lot about waste: waste energy, waste product and waste water, but yield is a perspective that gets lost," he says. "Looking at yield, the question the customer asks is not, 'how can I reduce the material needed to produce something', it's 'how can I make more with what I have?'"

It's an approach his team took when developing new technologies to improve fermentation and to get more beer out of wort, a liquid mixture of grains and hops used in the brewing process. Not only have these new systems allowed brewers to achieve higher production yields, but the spent material is also drier and more concentrated, increasing its value as a high-quality feed that can be sold to local farmers. "It's been a game-changer for the industry," says John Kyle.

EXPANDING THE FOCUS beyond efficiency towards overall productivity is also a philosophy Dorton believes in when it comes to management (a subject in which he has a PhD). When he took over responsibility for the brewery sector at Alfa Laval, Dorton first took a lot of time to source and co-develop brewery expertise within the company – and the effort is now paying off.

"We see that as customers scale back their engineering teams, they are starting to use us as a repository of process knowhow," says Dorton. "That's good, because that's when we can really make a difference. Combining our customers' needs for product development with our expertise in process solutions allows customers to team up with us in a trust-building exploration of the unknown. It is a win-win." ■

3 TIPS FOR BREWERS

1 Plan for scarcity. "There are many places in the world where there isn't enough water, and others where water and energy prices are rising rapidly. You might have access to water today but that may not be the situation tomorrow. So, you need to plan with that scenario in mind."

2 Take a broader view of the problem. "When we get a customer request about a production problem, we first look at what is going on upstream and downstream from the pain point. Taking a broader view of the problem can often help solve the issue, rather than just the symptom."

3 Think productivity, not just efficiency. "As a customer you should ask yourself, 'How can I make more with what I have now? How can we improve yields? How can we put a value on waste?'"

Eureka moments in winemaking

A unique combination of decanters and enzymes allows large-scale winemakers to reduce their energy and water use, and the amount of waste they produce, while producing clearer wines. *Here* headed to Verona, Italy, to get the story behind this latest innovation in winemaking.

STORY BY CLAUDIA B. FLISI
PHOTOGRAPHS BY MAURIZIO CAMAGNA

GIANCARLO VASON'S eureka moment came in 1980. At that point he had been working at his family's company near Verona, Italy, for two decades. The Vason Group, founded in the 1950s, develops specialized products such as stabilizers and preservatives for the wine and beverage industry.

Vason's customers lamented to him the problems they faced trying to clarify (i.e. filter) their wines. They had been using decanters and centrifuge systems to separate the juice from the grape must for white and sparkling wines, and the results were unsatisfactory. The chemical composition of must is so complex that a centrifugal system couldn't handle it effectively in continuous processing.

"Back then, winemakers were using old model decanters from the 1950s, and they wanted a better way," explains Vason. He thought of applying the principle of flotation – a separation process based on chemistry rather than the mechanical/centrifugal principles being used. At that point, the process had been used in mining and then water

> **“Our innovation was to transfer our technique of breaking down the must with enzymes into an integrated system with Alfa Laval’s new decanters.”**
>
> **ALESSANDRO ANGILELLA,** GENERAL MANAGER OF JU.CLA.S

purification systems, but it eventually proved effective when adapted for musts. The market response was enthusiastic, and in 1989 Vason created a subsidiary, JU.CLA.S. (Juice Clarification System), to grow this business.

A SECOND EUREKA moment came in 2011 when Alessandro Angilella, general manager of JU.CLA.S, visited an Alfa Laval facility in South Africa*, where he was casually shown some experimental decanters. “It was purely by chance,” recalls Angilella. “They asked: ‘Would you like to see our decanter project? It isn’t perfected yet but we are working on it.’”

Angilella realized that Alfa Laval’s prototypes, combined with his company’s know-how regarding flocculants, could be a winning combination for the wine industry. “Our innovation was to transfer our wine technique of breaking down the must with enzymes into an integrated system with Alfa Laval’s new decanters,” he explains.

He put Alfa Laval in touch with a professor he knew at the University of Verona, Roberto Ferrarini, and wine experts from both companies. One of the latter, Giacomo Costagli, process industry manager for olive oil and wine at Alfa Laval, piloted the project for the next three years.

THE RESULT WAS Alfa Laval’s Foodec, designed specifically for use in situations where hygiene must be impeccable and gentle treatment is essential. Prof. Ferrarini, who died in 2014, was recognized for his research by the Italian Oenological Association. Alfa Laval received a patent for its extraction and simultaneous must clarification process by decanter technology in 2015.

The decanter separates grape liquid from the must in one powerful continuous process. The sediment formed by the must is continuously removed by the screw conveyor, rotating at a different speed from the bowl. The result is not only cleaner must but greater control over the degree of cleaning desired. This is all quite different from the traditional press method (which is discontinuous by definition: press grapes, clean, reload).

In 2017, JU.CLA.S. and Alfa Laval formalized a commercial agreement to commercialize Foodec decanters and Vason flocculants. The system was installed in three highly-regarded wineries in different Italian regions: Duca di Salaparuta S.p.A. in Sicily, Broni in Lombardy, and Mezzacorona in Trento. “These have all worked very well, so we can say that the system is recognized in the wine world,” notes Vason.

While Alfa Laval and JU.CLA.S. can sell their respective products separately outside of Italy, they believe that the integrated system will be attractive because it puts more control into the hands of the winemaker.

And control is something the wine industry covets. Vason maintains that the current trend is from corrective to expressive winemaking... and “eureka” is the epitome of expressiveness. ■

***For the full story** of the first attempts to use the technique in South Africa, see *Here* 32.

Giancarlo Vason saw demand among winemakers for better clarification of their product, and recognized the potential of flotation as a solution.

The winery of Valentina Cubi, found in the hills of Valpolicella, near the northern Italian city of Verona, combines tradition with technology. Valentina Cubi is the wife of Giancarlo Vason, whose company, the Vason Group, provides the wine industry with specialized products.


JUCLAS

The diamond of drinks

Just as diamonds are classified by the "four Cs" (colour, cut, clarity, carats), wine may likewise be classified by its colour, clarity, consistency, and alcoholic content.

- **Colour** depends in part on the grapes – the process determines consistency and content (the two are related).
- **Clarity** (the removal of pectins, yeast, tannins) is achieved by filtration and stabilization processes chosen by the winemaker.
- **Alcoholic content** varies from about 5-20%, and can depend on the style of wine, quality and the climate in which the grapes grew.
- The industry uses a colour and haze spectrophometer to measure wine **clarity**; the result is a designated Nephelometric Turbidity Unit (NTU). While a lower NTU is desirable in most cases, sometimes an oenologist prefers unfiltered or lightly filtered wines. In the case of high-end reds, some sediment at the bottom of the bottle is expected. White wines display better colour and consistency with low NTUs.

A solution with many benefits

The wine industry has embraced the combination of Foodec decanters and Vason enzymes not only because of performance and cost savings, but also because of their notable sustainability benefits, observes Alfa Laval's Giacomo Costagli. He was process industry manager for wine and olive oil during the development of this technology. Among the benefits are:

1 **Higher yield.** The system produces greater yield of the most desirable must, called flower must (mosto fiore in Italian). "Our system yields 65% flower must," reports Giancarlo Vason, president of the Vason Group. "Other systems yield only 50%."

2 **Less waste.** The system drastically reduces the tank bottom quantity from clarification settings, with reduction of residual waste for their filtration.

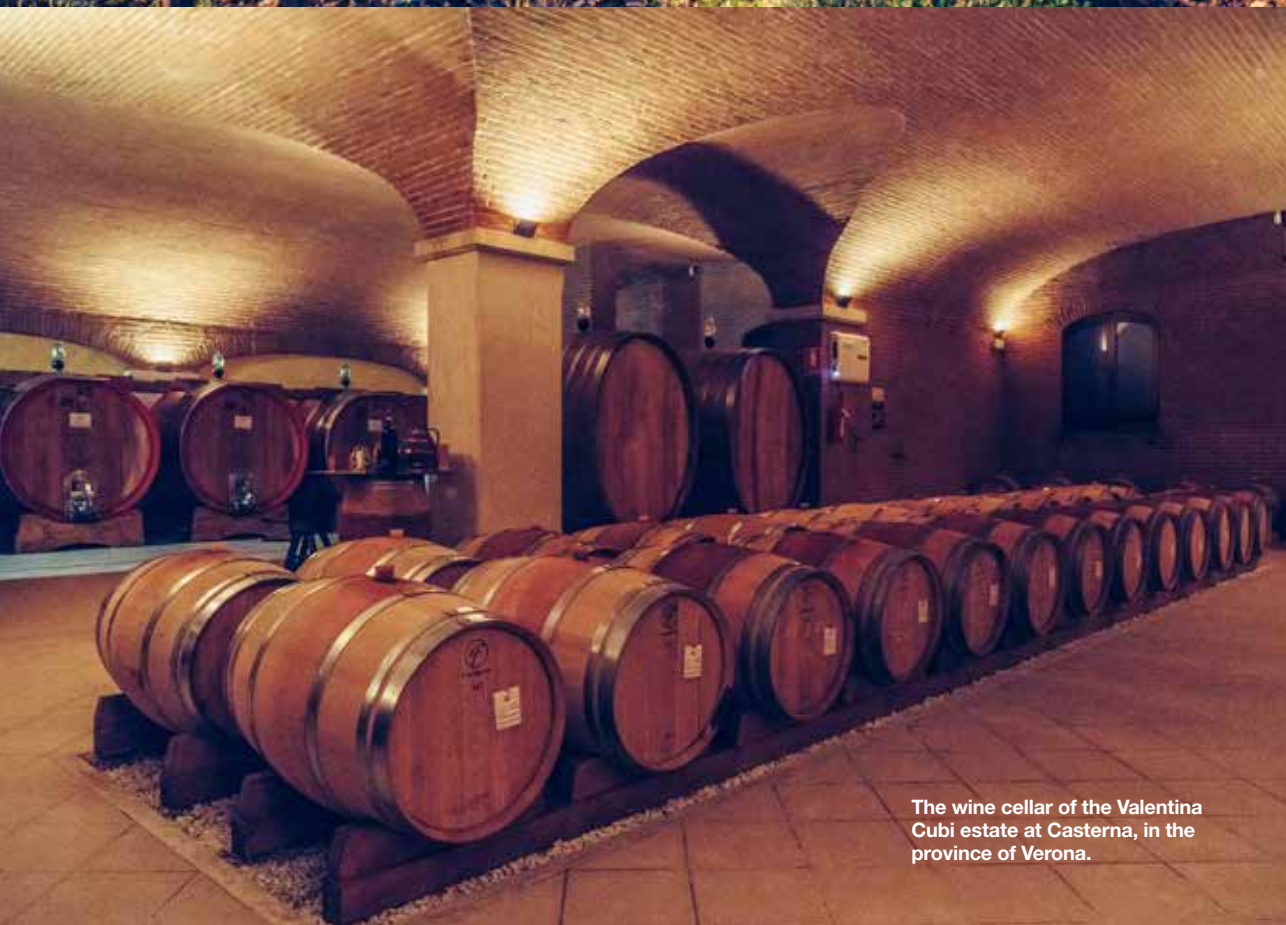
3 **Lower energy for refrigeration.** This is because less cooling is required than in traditional press systems. The grapes don't have to be cooled ahead of time with Foodec as they do with presses.

4 **Minimal water consumption.** Because the system is designed to save on both supply and disposal costs, water savings can total 90% or more.

5 **Flexibility.** The continuous process means more control for the winemaker, better quality grape must, and more limpid juices.

6 **Lower maintenance costs.** Foodec units are robust. The bowl, conveyor, inlet tube, outlets, cover, etc., in direct contact with the juice are made of AISI 316L and/or duplex stainless steel. The discharge ports, conveyor flights, and feed zone are protected with special abrasion-resistant materials. Savings in maintenance costs can reach up to 56%.

Giancarlo Vason, left, and Alessandro Angilella, general manager of Vason subsidiary JU.CLA.S, inspect the vineyards of Valentina Cubi in winter. The organic-certified vineyard covers some 13 hectares.



The wine cellar of the Valentina Cubi estate at Casterna, in the province of Verona.

CLIMATE CHANGE IS already a reality on every continent, in the form of changing weather patterns, rising sea levels and extreme weather events. The cost of inaction will be extremely high, but behavioural and technological changes, if rapidly implemented, could still keep temperature increases within acceptable levels.

EARTH'S HOTTEST TOPIC

DRIER CLIMATE
Large wildfires in the United States burn more than twice the area they did in 1970, and the average wildfire season is 78 days longer.

PHOTO: RICHARD DU TOIT/GETTY IMAGES

THE HEAT IS ON

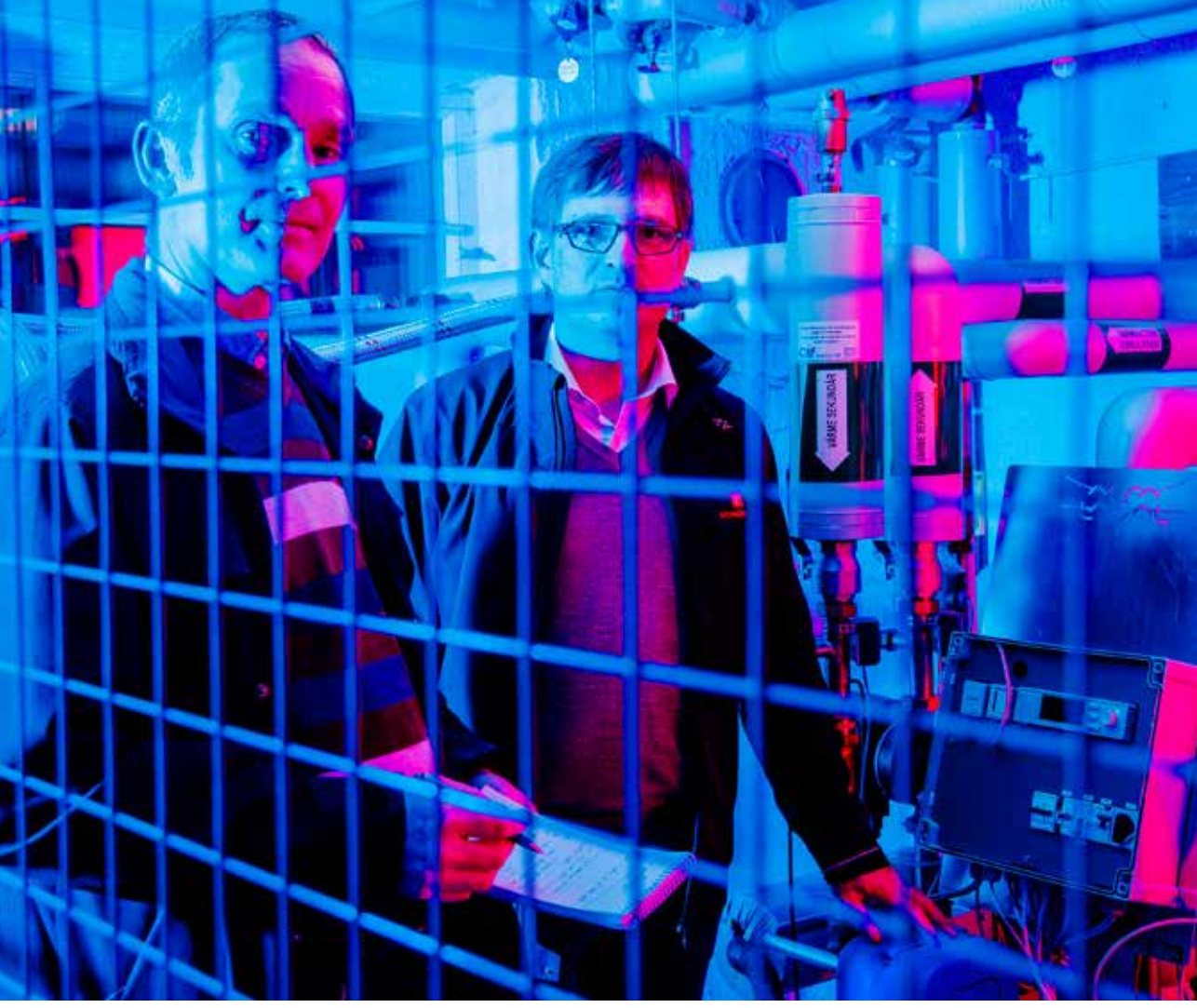
A unique combination of tried-and-tested hardware and cutting-edge software – in the form of a self-learning algorithm – is revolutionizing district heating in Sweden. Described as the district heating equivalent of a self-driving car, this solution has the potential to help significantly reduce carbon emissions in the energy-intensive domestic heating sector.

STORY BY RICHARD ORANGE
PHOTOGRAPHS BY MARTIN MAGNTORN

LAST OCTOBER WAS so wet in Ronneby, a medieval town in southern Sweden, that the autumn market – where locals stock up on apples, pumpkins and honey – had to be cancelled. In previous years, this much rain would have had the phones ringing all day at the publicly owned housing company Ronnebyhus.

"Because of the humidity, you get a feeling that it's cold, even though the thermometer says it isn't," explains Kristian Olsér, Ronnebyhus' operations chief. "We get a lot of calls from people saying 'it's freezing', and that they want the heat on."

But this year, the calls didn't come. Olsér had instructed IT company NODA, which installed its Smart Heat Building software in 50 of his buildings in November 2016, to boost indoor temperatures by a single degree for 30 days. The system,



Alfa Laval's Mats Persson, left, and Kristian Olsér, Ronnebyhus' operations chief, in the basement of an apartment block. The total energy savings have been nearly 50 percent.

managed by a self-learning algorithm, then automatically calibrated the Alfa Laval IQHeat controllers in the buildings to meet the new goal, keeping residents warm and dry. Olsér likens it to a self-driving car.

Ronnebyhus' apartment buildings are heated by a district heating network supplied by Miljöteknik, a municipal-owned utility. Roughly half of all houses and apartments in Sweden are now heated by such networks. The heat supplied by district heating networks in Sweden increased by 49 percent between 1990 and 2015, with most networks shifting to carbon-neutral biofuels.

But Ronnebyhus' experience shows that even district heating networks have room to improve. Olsér takes us to the basement of one of his buildings, where an Alfa Laval Midi Compact – with one heat exchanger for hot water and another for heating – sits alongside residents' bicycles.

Instead of one large heat exchanger for five large apartment buildings, each building now has its own. Olsér estimates that installing the new Alfa Laval system in 2013 cut his apartment blocks' energy use by 25 percent. Hydraulic balancing reduced energy use by a further 10-12 percent, and installing the NODA software cut an additional 7-8 percent. "You can reduce energy use by almost half," he says.

Patrick Isacson, NODA's chief executive, claims NODA can do better still. The average energy saving across the 2,000 buildings where the software is now installed was last year 11.6 percent, he says. "The system gets a little bit better each year. It will take three years to have it perfect. It's self-learning," he says.

The NODA system takes in data from all the buildings connected to it, and creates a detailed digital model of each one – learning about its physical construction, how it reacts to rain, wind or cold, to when it's empty or full of people, or at different times of the day – and then compares it to similar buildings.

The Ronnebyhus contract marked the first time NODA's software has been connected to another company's hardware – Alfa Laval's, in this case. "We have this very innovative but still traditional automation company in Alfa Laval that catches all this data that we need, and then we have this software as an add-on, so we can very easily integrate it with quite a small investment," says Isacson.

RONNEBYHUS MARKED the first time NODA had done a project with a housing company – Ronnebyhus – and a utility – Miljöteknik – at the same time. Miljöteknik has already installed Smart Heat Grid – NODA's system for district heating operators.

"The cool thing here comes when we combine a lot of buildings into a cluster and then use them as virtual capacity storage for a utility," Isacson explains.

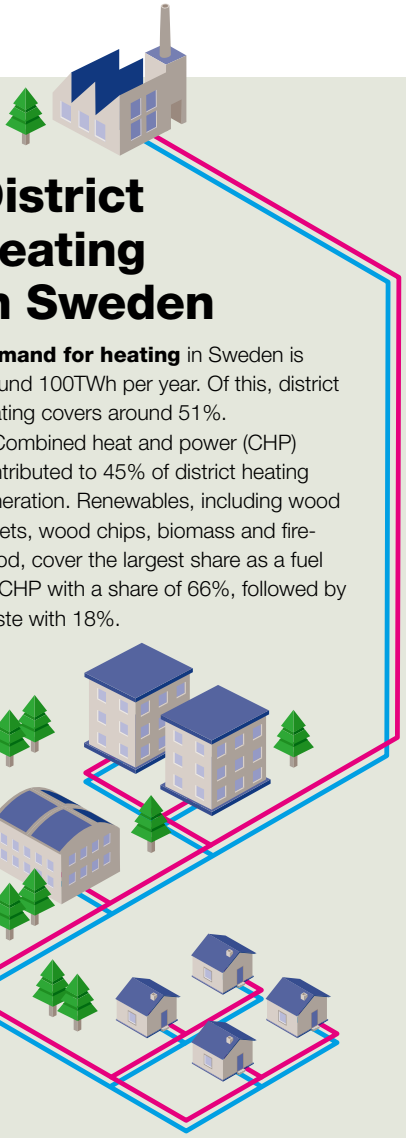
The baseload heat generated by Miljöteknik – around 95 percent – comes from burning wood pellets, which are close to carbon neutral. But when demand peaks during a sudden cold snap, or on a Monday morning, it has to use expensive and environmentally unfriendly oil-fuelled peak-load burners. NODA's idea is to use the heat inertia in Ronnebyhus's buildings instead, viewing them as "virtual heat storage".

When Miljöteknik started operating Smart Heat Grid in January 2018, NODA began to automatically cut off or reduce the heating in some or all of Ronnebyhus's 50 connected buildings to meet demand peaks, taking direct control of the IQheat controllers.

Patrick Isacson

It's already saving Miljöteknik money. When the utility connected Ronneby's airport to its district heating network in 2017, it decided to rely on the heat storage in Ronnebyhus' apartments. This, together with the large energy saving and return temperature decrease, made it possible to extend the network without having to build an extra peak-load boiler.

They probably don't know it, but the residents of the 40 apartment buildings with NODA installed have an algorithm to thank for protecting them from last year's autumn chill. Starting 2018, the self-learning system will also offer them lower energy bills and reduced carbon emissions. ■



District heating in Sweden

Demand for heating in Sweden is around 100TWh per year. Of this, district heating covers around 51%.

Combined heat and power (CHP) contributed to 45% of district heating generation. Renewables, including wood pellets, wood chips, biomass and firewood, cover the largest share as a fuel for CHP with a share of 66%, followed by waste with 18%.

Source: Euroheat.org

Refine & reduce

What difference could replacing a single heat exchanger make to the CO_2 emissions of an oil refinery? A big one. In fact, it's had the same effect as taking 30,000 cars off the road, and meant a cost saving of more than USD 2 million per year. We visited the west coast of Sweden to find out more.

STORY BY LINA TÖRNQUIST
PHOTOGRAPHS BY JONAS TOBIN

IT IS A FROSTY MORNING in Sweden's western archipelago, a picture-postcard region where white and rust-red houses perch on bedrock worn smooth by wind and pounding waves. Fishing boats cut their way across the large fjord as a flock of seabirds circles overhead. Nestled in this idyllic landscape is one of Europe's most modern and energy-efficient refineries – the Preem facility outside Lysekil.

Preem is Sweden's largest fuel company and it has made sustainability central to its operations. It produces the first diesel in the world that has met the criteria of environmental sustainability certification – it's made of 50 percent tall oil, a byproduct of the Swedish forest. The company also delivers extra energy from its two Swedish refineries – the other is in Gothenburg, just down the coast – to the surrounding area as heat, providing the energy equivalent of heating 36,000

homes. Its long-term ambition is to become entirely climate neutral. “Ultimately, we want to be part of the solution, not part of the problem,” says Gunnar Olsson, the company’s Technical Director.

THE LYSEKIL REFINERY’S location by the sea is a source of inspiration for that work, says Olsson. “Being out here, so close to the coast, brings everything into sharper relief. We work and live side-by-side with nature.”

Refining oil is a hugely energy-intensive process, so one area where the refinery has been focusing its efforts to reduce its environmental footprint is energy consumption. In 2012, Preem conducted a wide-ranging energy audit, when the refinery’s entire operations were analyzed for possible energy savings. The company's management decided to replace four of its traditional shell-and-tube heat exchangers at the Lysekil refinery with an Alfa Laval Compabloc welded plate heat exchanger in the atmospheric distillation process. This is one of the refinery’s most critical and energy-intensive processes, where crude oil is separated into different fractions.

Preem's Technical Director Gunnar Ohlsson: "We work and live side by side with nature."

The energy intensity of the refining process makes energy the single biggest expense for a refinery like that at Lysekil. But it also creates opportunities for sizeable reductions in both emissions and costs.

And the result? The single Compabloc exchanger delivers 22.6MW of energy recovery – 7MW more than the previous installation. "The investment lowered our energy use substantially, and it's brought down CO_2, sulphur and nitrogen oxide emissions," says Olsson. In all, Preem estimates that 14,600 tonnes of CO_2 emissions have been cut annually.

THE ENERGY INTENSITY of refining oil makes energy the largest cost at the facility. The Alfa Laval Compabloc exchanger results in significantly higher energy efficiency, since the temperature difference between two fluids (what is called the temperature approach) in the exchanger can be low as 3-5°C for the Compabloc exchanger to work. This allows the exchanger to recover more heat than the shell-and-tube heat exchangers traditionally used by refineries, while using significantly less plot space.

In purely economic terms, the resulting energy efficiency improvements of the new Alfa Laval exchanger are worth about USD 2.2 million per year at the Lysekil refinery alone.

As the next step in its improvements to the facility, Preem is building an entirely new vacuum distillation unit – the part of the refinery process where the heavy oil residue remaining at the bottom of the atmospheric distillation is further refined. And Preem has extended its investment in Alfa Laval's Compabloc technology and is installing these welded plate heat exchangers extensively throughout the process.

"It was a pretty straightforward decision," says Olsson. "They are much more energy efficient and compact, and the technology works even with a temperature approach of just a few degrees."

IN THE REFINERY process, there are often major problems with residue deposits on the surface of the heat exchangers, which reduces heat transfer efficiency and increases the hydraulic resistance – a factor that can lead to reduced capacity. But Alfa Laval Compabloc exchangers in these applications have fewer problems with fouling, which leads to greater overall efficiency and sustainability gains. Fouling is something that Ibrahim Tahric, Mechanical Engineer at Preem, has experienced first-hand.

"There is definitely less fouling on the Compablocs compared to the shell-and-tube exchangers we use otherwise, so they require less maintenance," he says.

Due to the risks involved in the handling of fuel and other refinery products at high temperatures and pressures, the refinery business is known for being extremely conservative when it comes to introducing new technologies. Still, Eva Andersson, Refinery Industry Manager at Alfa Laval, sees a trend among refineries that they start with testing one Compabloc exchanger in the distillation process and then make a larger investment once they have seen the results.

"Both the business case and the environmental benefits for the Alfa Laval Compabloc exchangers are so strong," says Andersson. "When I list the advantages, people often don't believe that all of it could be true, but then they try it out and they discover that it holds up. It's encouraging that responsible players like Preem are leading the way." ■

FACTS: **ALFA LAVAL COMPABLOC**

The design of the Alfa Laval Compabloc makes it possible to operate at high temperatures with a wide range of aggressive media and under high pressure (up to more than 400°C and 42 bar).

The heat exchanger results in three to five times higher energy efficiency (per heat transfer surface area) than a shell-and-tube heat exchanger, and can handle temperature approaches (the temperature difference between fluids) as low as 3-5°C, which allows for maximum heat transfer. It also results in significantly less fouling, which means it can operate three times as long between maintenance/cleaning as competing solutions.

The Alfa Laval Compabloc's compactness means it is extremely flexible and can be used in a huge variety of applications.

Ibrahim Tahric has observed first-hand the benefits of Alfa Laval Compabloc, such as less fouling, which makes maintenance easier.

Stories from previous editions of ***here***.
Visit **alfalaval.com/media/here-magazine**.

Bright ideas

Solar power is becoming an increasingly important energy source. While it might be "free", one challenge is that availability of electricity doesn't necessarily match demand. Concentrated solar power (CSP) is an important technology for converting sunlight energy into electricity. Connecting CSP units to a thermal storage system that uses molten salt makes it possible to generate electricity even when the sky is overcast or after sunset. This method brings a 50-percent increase in operation capacity.

Alfa Laval has developed a Packinox heat exchanger specifically for CSP thermal storage systems, which transfers heat between the salt and the system's hot oil circuit.

EDITION: **Here 29**

GOALS: 7 8 12 13

New solar capacity around the world grew by 50 percent in 2016. CSP technology makes solar even more attractive.

PHOTO: COLOURBOX

Seeds of hope

On Norway's Svalbard islands lies one of the world's largest seed collections. Among the millions of seeds stored there are African and Asian food staples such as maize, rice and sorghum, and European and American varieties of eggplant, lettuce and potatoes. The frozen treasure is a bank of last resort, to provide backup should natural catastrophe, environmental damage or war deplete the Earth's crop diversity.

This so-called Doomsday Vault required a fail-proof cooling solution, which was a challenge given its location in the middle of a mountain. The solution relies on four Alfa Laval air coolers to maintain an even temperature of -18 degrees Celsius.

EDITION: **Here 24**

GOALS: 2 9 15

Crates of seeds are sent to the Svalbard facility – 1,300km from the North Pole – from around the world for safe storage in the cold and dry rock vaults.

PHOTO: GETTY IMAGES

PHOTO: TOKE HAGE

The Triple-E's wide, U-shaped hull and more bulbous bow mean it can carry even more containers.

Bigger is better

At 400 metres long and 59 metres wide, and with room to carry 18,000 containers, the Maersk Triple-E is one of the world's largest container ships. It is also one of the greenest. The Triple-E emits 3g per tonne of goods per kilometre, well below the average container ship emissions of 10 to 20g. It also features a number of Alfa Laval technologies to further boost its green credentials: a waste heat recovery system that cuts fuel use by up to 10 percent; Alfa Laval PureBallast to prevent the spread of invasive species; and energy-saving Alfa Laval AQUA freshwater generators.

EDITION: **Here 32**

GOALS: 7 9 14

Cheers to that

With increasing environmental legislation and its associated costs, the global brewing industry is looking to reduce product losses and waste streams. For example, every 1,000 tonnes of beer produced may create up to 170 tonnes of spent grain waste.

Today, many breweries aim for zero waste in their production process. Using the right equipment, they can, for example, recover a substantial amount of beer in the main wort and beer lines. Recovered by-products can be transformed into potentially valuable products.

Alfa Laval offers a broad portfolio of equipment, including separators, filtration modules, decanters and jet heads, which help breweries reach their sustainability goals.

PHOTO: CARLSBERG

EDITION: **Here 30**

GOALS: 9 12

Net benefits

Alaskan fishing company Westward Seafoods, which operates in the icy, pristine waters of the Bering Sea, turned to Alfa Laval in its efforts to minimize its eco-footprint. The company wanted more efficient processing of "stick water", a liquid mix of water and suspended fish oil and residues left over from seafood processing. Fish oil has multiple uses, from fishmeal additive to diesel oil alternative. The Alfa Laval skimmer is a centrifuge with a special configuration and an ancillary system. It helped Westward Seafoods reduce the oil content in its stick water, in doing so reducing waste, cutting energy costs and meeting environmental regulations.

EDITION: **Here 35**

GOALS: 6 12 14

PHOTO: GETTY IMAGES

Removing more of the fish oil from its stick water has multiple environmental and economic benefits for Westward Seafoods.

Saving Venice

One of the world's most iconic cities is under threat from rising seawater. With climate change fueling the sense of urgency, engineers are constructing the world's most advanced flood barrier on the floor of the Venice lagoon.

When flooding conditions occur, 78 mobile gates are pumped with compressed cooled air from Alfa Laval heat exchangers. This air forces out the seawater that normally fills the gates – keeping them submerged – and they rise to become barriers against the rising water. Cooling is crucial because the gates are made of a rigid composite material that cannot tolerate air at too high a temperature.

EDITION: **Here 35**

GOALS: 9 12 13

The threat to Venice from rising seawater is constantly increasing.
PHOTO: MAURIZIO CAMAGNA

PHOTO: SIMON CASSON

At Sundrop Farms, steam generated by solar power evaporates seawater into pure water vapour.

The greener greenhouse

On a sunbaked patch of land in South Australia, Sundrop Farms has built a massive greenhouse complex with a technological solution and commercial scale that has never been attempted before. The aim is to prove you can sustainably farm high-value crops – in this case, truss tomatoes – in the desert using sunshine and seawater. A state-of-the-art integrated solar energy system heats the greenhouses, produces electricity and generates energy to run a desalination unit from Alfa Laval – the largest unit of its kind ever made – which produces freshwater to irrigate the crops. The aim is to grow 15,000 tonnes of tomatoes per year.

EDITION: **Here 34**

GOALS: 6 7 9 12

PHOTO: GETTY IMAGES

More data requires more servers, which in turn demands more cooling technology, such as Low Speed Ventilation.

Cooling the Internet

As humanity produces and stores increasingly large amounts of data online, the demand for safe and reliable servers and data centres grows exponentially. The problem is, data centre equipment consumes huge amounts of energy, not least the cooling units, which are crucial to keep the servers from overheating.

Overcoming many of the drawbacks of traditional server room cooling, Alfa Laval and partner Boersma have come up with Low Speed Ventilation (LSV), which reduces energy consumption by up to 35-40 percent. Easy implementation of free cooling, for example from outdoor air or water, adds to the environmental and cost benefits.

EDITION: **Here 34**

GOALS: 7 9 12

Pump action

A hidden environmental threat is lurking off the coast of Norway. Second World War shipwrecks of British, German and Norwegian origin are slowly rusting away, creating the risk that their toxic fuel oil could leak out and seriously pollute the marine environment. So how do you remove the oil – and with it the threat – when the water is so deep that it is beyond the reach of divers? The Alfa Laval Framo Remote Offloading of Sunken Vessels (ROLS) system – an unmanned remotely operated vehicle – is maneuvered down to these shipwrecks, where it then drills through the hull of the vessel and safely empties the tanks of the hazardous fuel.

EDITION: **Here 34**

GOALS: 6 14

PHOTO: GETTY IMAGES

PHOTO: ALASTAIR MILLER

The waste from water treatment plants can be turned into a valuable resource.

Value from waste

Each day, the world's cities release huge quantities of contaminated water into waterways. This sewage can potentially cause disease, threaten food supplies and create "dead zones" in the ocean. But it can also be put to good use.

Using Alfa Laval decanters, the world's largest water reclamation plant has doubled its capacity to process wastewater sludge into a biosolid that is ideal for agriculture, reintroducing nutrients into the soil.

Meanwhile, Europe's largest water treatment plant has relied on Alfa Laval spiral heat exchangers for more than 30 years in the tough digestion process. The heat exchangers enable methane to be recycled as an energy source, which then covers roughly 60 percent of the site's electricity needs.

EDITION: **Here 27 & 31**

GOALS: 3 6 7 12

14 LIFE BELOW WATER

OCEANS COVER THREE quarters of the Earth's surface, and contain some 200,000 identified species (not to mention potentially millions more we haven't found yet). Billions of people depend on their biodiversity for their livelihood, but human activities are leading to pollution, depleted fisheries and loss of coastal habitats. A wide range of technologies are available to protect this important global resource.

TRAVELLERS
More than 8 million tons of plastic are dumped in our oceans every year, turning up in every corner of our planet.

PHOTO: PATRICIO ROBLES GIL/SIERRA MADRE/MINDEN PICTUREST/GETTY IMAGES

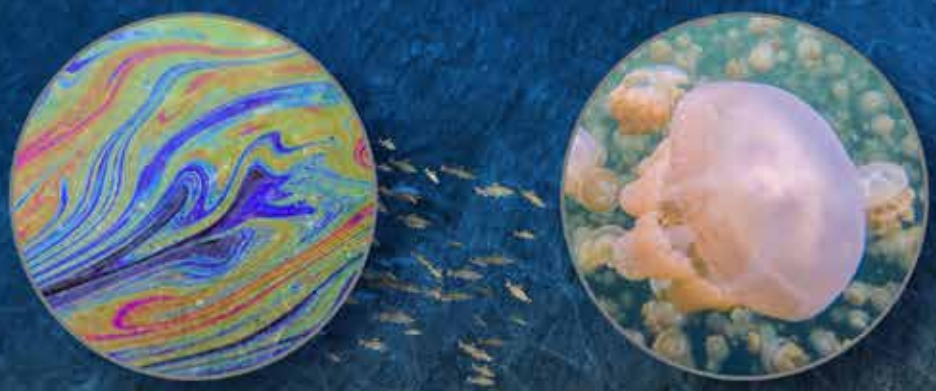

A DROP
IN THE
OCEAN

SULPHUR OXIDE EMISSIONS

The heavy fuel oil burned by most ships is a major source of sulphur oxides (SOx), which contribute to acid rain, irritate the eyes and affect the respiratory system. Alfa Laval PureSOx cleans the emissions from marine exhaust gases by scrubbing with seawater or freshwater.

SEA CHANGES

The world's oceans and their marine life face many challenges from diverse sources of pollution. Alfa Laval has a number of technologies for use on land, at sea and beneath the waves that play an important role in protecting the marine environment.



BILGE WATER

Ships' engines and auxiliary machinery produce a liquid waste consisting of water, oily fluids, lubricants, cleaning fluids, detergents and other chemicals. This highly noxious slurry collects in a vessel's bilge and, once discharged, becomes one of the major ocean pollutants. Alfa Laval PureBilge is the most effective system available today for cleaning bilge water.

BALLAST WATER

Water carried in ships' ballast tanks can contain viruses, bacteria and larger organisms such as jellyfish and molluscs. When discharged into new habitats, these non-native species become a massive threat to marine biodiversity, and can lay waste to entire ecosystems. Alfa Laval PureBallast uses UV light to kill microorganisms or stop them from reproducing.

ILLUSTRATION: DAN HAMBE

NITROGEN OXIDE EMISSIONS

Nitrogen oxides (NOx) from marine exhaust gases cause respiratory diseases and can aggravate existing heart disease. Alfa Laval Pure NOx water treatment cleans the circulating scrubber water to protect the EGR system and cleans the excess water.

MICROPLASTICS

Small fragments of plastic from synthetic textiles, personal-care products and other sources are a large and rapidly growing marine problem. Found in fish and shellfish the world over, these microplastics have now entered our food chain. Alfa Laval membrane bioreactors installed in wastewater treatment plants stop these fragments being released into the sea.

WRECK OIL

Oil in the tanks of the countless sunken ships that dot the world's seafloor poses a significant marine hazard, as it can leak out as the vessels' structure corrodes over time in the salty water. Alfa Laval's Framo Remote Offloading of Sunken vessels (ROLS) system can be manoeuvred down to the wreck, where it drills through the structure and safely pumps out the oil.

Exhaustive efforts on marine emissions

Seaborne trade has seen an extraordinary expansion over the last decades. This has increased the shipping industry's negative impact on the environment. But there are solutions.

STORY BY ULF WIMAN
PHOTOGRAPH BY GETTY IMAGES

DESPITE MODERN HIGH-TECH alternatives on land and in the air, seaborne trade remains the most efficient mode of transporting goods. In fact, it has seen a phenomenal growth. Between 1986 and 2016, seaborne trade almost tripled, and now accounts for some 90 percent of global freight movements.

Ships are a more energy efficient means of moving goods than trucks or aeroplanes, but the combustion of heavy fuel oils does produces hazardous SOx, including the gas sulphur dioxide (SO_2), as well as soot and ash – so-called particle matter (PM).

The negative environmental impact of SOx includes damage to vegetation, and to sensitive ecosystems through acid rain. It is also hazardous to humans and animals, potentially irritating skin, eyes, mouth and the respiratory system. In high concentrations, SOx can seriously affect lung function.

DRIVEN BY INDUSTRY INITIATIVES and legislation, the shipping industry is turning to more sustainable alternatives. The International

“This has far-reaching consequences for many shipping companies worldwide and is one of the most urgent topics in their boardrooms today.”

RENE DIKS, MANAGING DIRECTOR INERT GAS & EXHAUST GAS CLEANING SYSTEMS AT ALFA LAVAL

Maritime Organization (IMO) is the UN agency responsible for controlling safety and security of shipping and for regulation to prevent marine pollution, and it also governs vessel emissions, including SOx. IMO continuously revises the regulation, and as of January 2020, the global sulphur cap will be reduced from the current 3.5 percent to 0.5 percent. There is also stricter regulation in so-called Emission Control Areas (ECAs), with a 0.1 percent sulphur limit.

“This has far-reaching consequences for many shipping companies worldwide and is one of the most urgent topics in their boardrooms today,” says Rene Diks, Managing Director Inert Gas & Exhaust Gas Cleaning Systems at Alfa Laval. “The decisions made will impact their competitive position and landscape.”

The heavy fuel oil (HFO) traditionally used in shipping by far exceeds the stipulated SOx limits. To comply with the stricter regulations, ship owners basically have three choices:

- Switch to liquid natural gas (LNG)
- Switch to low-sulphur fuel
- Install an exhaust gas scrubber

With LNG, infrastructure is still very much under development, so the most feasible alternatives today are switching to low-sulphur fuel (diesel-type distillates), or continuing using HFO, but install SOx scrubbers. All options come with their respective pros and cons, and each has its advocates.

Exhaust gas scrubbers are a proven technology in industrial applications. “But this doesn’t make their use in marine applications easy and straightforward,” Diks says. “The impact of marine legislation, class demands, corrosion impact and onboard vibrations are very different than in land-based applications. It requires a different approach, and to be successful you need solid marine knowledge.”

WITH SOX SCRUBBERS, such as Alfa Laval PureSOx, ship owners can continue to use cheap high-sulphur HFO – as long as the emission levels comply with regulations. To scrub the exhaust gas, Alfa Laval PureSOx uses seawater in an open loop or freshwater in a closed loop for more sensitive environments.

It reliably removes more than 98 percent of the SOx content, and up to 80 percent of the PM content.

DID YOU KNOW?

Alfa Laval’s PureSOx Connect service simplifies compliance reporting on sulphur emissions. Rather than analysing scrubber compliance data themselves, operators can use the Alfa Laval Touch Control system to access user-friendly, graph-based reports – which can be handed over to authorities directly.
https://www.alfalaval.com/microsites/puresox/

An obnoxious problem

The term nitrogen oxides (NOx) refers to a group of highly reactive gases that are major air pollutants, where especially NO_2 is of great concern.

NO_2 can be formed naturally, but most of it comes from the burning of fossil fuels, such as in combustion engines and industrial processes. The negative effects of NOx are much the same as those of sulphur oxides (SOx), potentially harming the respiratory systems in humans and mammals, for example through photochemical smog. They are also hazardous to the environment, where acid rain harms forests and lakes, and other ecosystems.

Much can be done to manage the levels of NOx, including legislation and turning to alternative fuels. One proven technology for vessels to reduce NOx levels is Alfa Laval PureNOx Prime, a compact water treatment system for use in Exhaust Gas Recirculation (EGR) circuits, where it cleans both the circulation water and the bleed-off water for overboard discharge.

Taking aim at **marine invaders**

According to the International Maritime Organization (IMO), the spread of invasive species is now recognized as "one of the greatest threats to the ecological and economic well-being of the planet". But legislation is getting stricter and there are sustainable solutions to the problem.

IT HAS BEEN ESTIMATED that invasive species – such as jellyfish, crab and mussels – are the second-largest cause of species extinctions in the US, where the problem costs around USD 120bn each year in control methods and loss of environmental resources through irreversible damage to biodiversity.

One way that invasive species spread is through the ballast water discharge of ships. And this is an escalating problem – there has been a huge increase in seaborne trade over recent decades, and today roughly 80 percent of international freight is now carried by ships.

The IMO estimates that 10 billion tonnes of ballast water are transported each year, enough to fill 4 million Olympic-sized swimming pools. Around the clock, year-round, some 7,000 species are being transferred in ballast water from one location to another.

Aiming to get a grip on this worrying situation, the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) entered into force on 8 September 2017.

From that date, all new ships must meet the stricter D2 standard, which specifies the maximum amount of viable organisms that are allowed to be discharged. Existing ships must meet the D1

PHOTO: GETTY IMAGES

standard, which requires them to exchange ballast water in open seas, where few organisms survive. After 8 September 2024, all ships must meet the D2 standard.

TO DO THIS, VESSELS NEED to install a ballast water management system. "There are different technologies available in the market for installation onboard vessels to treat ballast water," says Anders Lindmark, Head of PureBallast, Alfa Laval. "We have decided to focus on biological UV technology for a chemical-free solution."

Launched in 2006, Alfa Laval PureBallast was the first commercially available treatment solution. Now in its market-leading third generation, it has been approved by IMO and the US Coast Guard (USCG), and more than 2,400 systems have been sold worldwide.

The system works in any waters and is available in five UV-reactor sizes, which makes it very flexible. The components, such as filter and reactor, are installed in the ballast water piping.

"Our focus has been to provide a reliable, high-performance solution that is energy-efficient, but also easy to install," Lindmark says. "We also have a well-developed service offering that provides customer support throughout the chain from advice to parts and service." ■

"My values are part of my day-to-day work"

FOR MORE THAN 100 years, invasive organisms carried in ships' ballast water have caused massive damage to marine ecosystems around the world. Kristina Effler and her team are working to stop their spread.

Finding solutions to global environmental problems is something that gets Kristina Effler out of bed in the morning.

"Sustainability is something I've always cared about," she says. "When I studied mechanical engineering at university, I majored in energy because I believe that, as the world's population grows, energy will be one of humanity's biggest challenges."

Before starting at Alfa Laval, Effler considered going into international development work, but instead she has forged a career in sustainability through her work at Alfa Laval.

PRIOR TO TAKING on her current role, Kristina built up Alfa Laval's PureNOx business from scratch. That business area is also focused on sustainable solutions – specifically harmful emissions from ships' exhaust gas. Now, working as Manager Business Development & Marketing for Alfa Laval PureBallast, Effler and her team are helping to solve a one-hundred-year-old environmental issue.

Since the 1880s, ships have filled their hulls with seawater to increase stability. "Already around 1907, it was possible to see the problems caused by invasive species of microorganisms carried by ships to distant harbours," says Effler.

Every year, 3 to 5bn tonnes of water is carried in ships' ballast tanks, and that water contains countless organisms, including jellyfish and mussels, as well as microorganisms. "We know these are causing billions and billions of dollars in damage and doing untold damage to the environment," she says.

"Our solution doesn't make use of chemicals and uses little energy – instead it makes use of UV light to kill microorganisms or stop them from reproducing."

TREATING BALLAST WATER will help to reduce the numbers of invasive organisms in the world's oceans, while allowing native species to adapt and recover. Since more than 35,000 new and existing vessels need to install technology to clean their ballast water between now and 2024, the work combines doing good for the environment with a huge business opportunity.

"I'm very proud to be working with a dedicated team trying to solve this environmental challenge, and with customers that want to be at the forefront when it comes to sustainability," says Effler.

Having the chance to make a positive impact on the world is a big part of what makes her excited to work at Alfa Laval: "I have strong core beliefs – ethics and values that I live by – and my values need to be part of my day-to-day work," she concludes. ■

3 BALLAST TREATMENT TIPS

1 Check your power supply. "Power supply can be very limited on ships. Choosing technical solutions with low energy usage is important in order to keep fuel costs low."

2 Examine the total cost of ownership. "Buying the cheapest solution is often not the most cost effective in the long run. Despite tight profit margins in the marine industry, it makes sense to look at the total cost of ownership."

3 Select a supplier with a long presence in the marine industry. "A reliable supplier also holds the knowledge and the ability to support the owner through the whole lifetime of the vessel."

PHOTO: OSKAR OMNE

"I'm very proud to be working with a dedicated team to solve this environmental challenge – and with customers that want to be at the forefront when it comes to sustainability."

PHOTO: KRYSTIAN TAMBUR

The invisible menace

While images of massive floating islands of plastic waste have recently started to catch the public's attention, an equally serious threat to the environment and human health is emerging on an altogether smaller scale: microplastics. In a Danish research project, membrane bioreactors have proven to be an effective technology in removing from wastewater this invisible menace, whose disastrous impact on the marine environment is only now becoming apparent.

STORY BY *RICHARD ORANGE*

THERE MIGHT BE as many as 50 trillion (50,000,000,000,000) particles of microplastic currently awash in the world's oceans. These plastic fragments of pollution from consumer products and industry, each smaller than 5mm in diameter, have been found in 16 out of 17 brands of sea salt, four out of five samples of drinking water, and 80 percent of British mussels. A Danish study conducted in Roskilde Fjord found, on average, one plastic particle in every mussel, and one to four particles in each fish.

"The problem with microplastics is that they don't disappear in the environment," says Claudia Sick, biologist and project manager at the Danish NGO Plastic Change. "Plastic takes an extremely long time to degrade completely – many hundreds of years or more – and during this long period, these particles of different sizes risk causing harm to a variety of organisms."

Most of us rarely encounter the larger pieces of plastic pollution that are the most visible components of ocean junkyards such as the Great Pacific Garbage Patch, a spinning concentration of plastic bigger than Texas discovered in 1985.

But we all regularly swallow pieces of microplastic. And although the human health effects are unknown, there is mounting evidence they are harming animal life, particularly in the seas.

"These small particles physically block or reduce the functionality of vital organs; in a mussel, microplastic particles can stick to their feeding filtration organs, and in fish, to the gills or inside their digestive systems," says Sick. This can prevent organisms catching or digesting food, inducing stress, and even prevent them from breathing properly.

On an expedition to Bermuda, Sick's NGO observed a turtle with more than 2,000 pieces of microplastic inside it. "It died of this because the microplastic had quite simply blocked its intestines," says Sick. A study from the University of Queensland estimates that more than half the world's sea turtles have ingested plastic.

SOME MICROPLASTICS, such as polyvinylchloride (PVC) can be toxic in themselves, while others contain harmful chemicals as plasticizers or flame retardants. There are also fears that microplastics might act as carriers for microbes or micropollutants such as DDT and BPA, following observations by Japanese researchers that these substances adhere to microplastic particles.

According to Emmanuel Joncquez, a membrane bioeactor process specialist at Alfa Laval, research into this global issue is only just getting underway, even if the problem is increasingly recognized. The UN Environment Programme this year launched its Clean Seas project, encouraging countries to take measures such as banning the use of microplastics in cosmetics.

"The problem could be even worse than we think, because microplastics are very difficult to find and measure," says Joncquez. Few ocean trawls have tried to pick up particles below 0.3mm in diameter, and between this diameter and 0.005mm there is still no scientifically accepted way of quantifying them. "When you filter down to this size, the standard analysis systems struggle to tell if it's a plastic or another material," says Joncquez.

Microplastics are divided between "primary materials" — microplastics used, for example, as exfoliants in care products and cosmetics, or for air-blasting off paint and rust — and "secondary

PHOTO: WWW.5GYRES.ORG

Microplastics have been found in the digestive tracts of sea creatures ranging in size from plankton to marine mammals. As such they have also entered the human food chain.

materials". These are fragments created by the disintegration of larger pieces of plastic, such as fibres from textiles, car tyres, and packaging. But there is still some uncertainty over where microplastics come from and how they get into the environment.

ALFA LAVAL HAS WORKED with Plastic Change, Aarhus University, Roskilde University and EnviDan to measure the quantities of microplastics released into Denmark's Roskilde Fjord from the Bjergmarken wastewater treatment plant.

Alfa Laval financed, installed, managed and operated a membrane bioreactor (MBR) pilot plant capable of filtering down to 0.2µm (micrometers) — one thousandth of the diameter of the nets or filters used in standard plastic trawls. The plant helped the research by concentrating the suspended solids in the retained water by 50 times, so that they could be studied.

"The concentration of plastics in Danish wastewater is luckily not so high today that you can just sample a low volume of water in order to get an adequate and representative sample, so you need to filter a large volume of water," Sick explains. "This is where Alfa Laval's MBR was of great help, since it could create a concentrate of the plastic from a large volume of wastewater."

"What I found most interesting so far is that about 1% to 5% of the microplastic going through the wastewater treatment plant is ending up in the treated wastewater, and 80% ends up in the sludge, with the rest caught elsewhere and, to some extent, incinerated. But despite this removal-efficiency, the concentration of microplastic near the plant's outflow in the fjord was higher than anywhere else in the fjord, with plastic fibres predominating."

More than 50% of Danish sludge is used as a fertilizer in agriculture, so the plastic caught in the sludge by the plant, which contained a lot of black rubber fragments, possibly from tyres, is returned to farmland, where Sick fears it might change the behaviour and health of key earth organisms, before possibly being washed into rivers, fjords and the sea.

Claudia Sick believes spreading the sludge on fields remains the best environmental solution due to its vital nutritional value, but stresses the urgent need for solutions to remove microplastics.

For Alfa Laval, the study supports previous studies showing that the MBR process is an efficient way of removing microplastics. No microplastic particles have yet been found in the wastewater treated by the pilot plant, with analysis so far done down to 50µm.

"It confirms that MBR retains more microplastics than conventional technologies," Joncquez says. "So if future legislation requires further removal of microplastics, then MBR is a proven technique."

Membrane bioreactor technology is today still more costly and energy intensive than sedimentation tanks, which limits its use to where there are space constraints, specific output requirements, or where land is expensive.

According to Joncquez, Nordic municipalities are starting to think about MBR as a solution to the microplastics problem. "We've been asked by several consultants and municipal water authorities: 'What about microplastics? And how much would they cost to treat?'. People know that there might be a regulation on plastic coming, and they are starting to look for solutions."

But Joncquez thinks it will take a few years for scientists to develop an effective, standardized way to measure the amount of microplastics in water. Only then does he expect moves towards water treatment regulation.

GOVERNMENTS ARE ALREADY taking action at the supply end, however, with the UK and Sweden promising bans on the sale of cosmetics containing microbeads by the start of 2018, following similar moves in the US, Canada and the Netherlands. Companies are also phasing out the beads – although a 2016 ranking by Greenpeace accused some big names of having loopholes in their microbead policies.

But Joncquez believes there's a long way to go. "Avoiding more plastic going into the sea is really important, and it should happen," he says. "But, as with climate change regulation, it might take 50 years."

With humans releasing between 4 million and 14 million tonnes of plastic into the ocean every year, by then there will be a lot more to clean up. But with a UN resolution in December 2017 calling on all members to "prioritize policies" that "avoid marine litter and microplastics entering the marine environment", the tide is starting to turn. ■

Plastic pollution in numbers

51 TRILLION

microplastic particles may be currently awash in the oceans, according to a study by the University of California. However, such is the current uncertainty, the number could also be as 'little' as 15 trillion.

4,360

tonnes of microplastic beads were used in the EU, Norway and Switzerland in 2012.

8.3 billion

tonnes of plastic have been produced in the world since the 1950s. This is roughly equal to the estimated total weight of all plants, animals and bacteria in the worlds' oceans.

5mm

is the maximum size for a plastic particle to be classed as 'microplastic'.

200 million

tonnes of plastic are produced globally each year.

8 million

tonnes of plastic are washed into the ocean each year. That is the equivalent of nearly 120 billion plastic milk jugs. Stack them up and they would reach about halfway to Mars.

5µm

is the minimum size for microplastic fragments. This is about the length of a typical human spermatozoon's head.

100,000

microbeads are washed down drain in a single shower with some shower gels.

The 7 main sources of microplastics

35% **Synthetic Textiles.** When clothing made of synthetic textiles is washed in washing machines, they shed fragments of fibre, which are then flushed away in the sewage system.

These fibres are typically made of polyester, polyethylene, acrylic or elastane.

28% **Synthetic rubber** from car tyres. A large fraction of the microplastics found in the sea appear to have their origin in car tyres made from styrene butadiene rubber, which is worn off tyres and then washed into waterways by rain.

24% **City dust.** This is a generic group, including fragments created by the abrasion of synthetic soles, cooking utensils, artificial turf, abrasives used to blast off coatings, and other urban activities.

7% **Road markings.** Thermoplastic coatings used for roadmarkings are worn away by cars and then washed into the water system.

3.7% **Marine coatings.** Several types of plastics are used for marine coatings including mostly polyurethane and epoxy coatings. Microplastics are released as they are worn away.

2% **Personal care products.** Many shower gels and other personal care products contain plastic beads as exfoliants.

0.3% **Plastic pellets.** Plastic pellets of between 2mm and 5mm in diameter are the main raw material used to manufacture objects out of plastic.

There is growing evidence that some pellets are spilled into the environment during transport, storage, manufacturing and recycling of plastic goods.

PHOTO: COLOURBOX

"My aim is that this job won't exist one day"

CATARINA PAULSON'S WORK with sustainability is spurred on by the experience of spending her childhood in two very different worlds. As Head of Sustainability at Alfa Laval, she monitors and reports on efforts to integrate sustainability into all aspects of the business.

Having more than one perspective is often useful. For Paulson, it pushed her towards the work she does today: "I grew up in Mexico City," she says. "During term-time, I trained basketball next to the most polluted road in the world. Then I would spend summers in Sweden, exploring nature and swimming in clean water."

The difference in perspective had an impact. "It made me see that there are alternatives and it left me determined to make a difference. It also taught me to value nature and its resources."

Today, Paulson takes a dual approach to her work. "We need to reduce our own environmental and social impact and to mitigate risks, while at the same time exploring business opportunities," she says.

A positive aspect of working with sustainability at Alfa Laval, says Paulson, is that business opportunities align closely with sustainability goals. "In an analysis of the UN

Sustainable Development Goals, we identified several areas where our products help to achieve global targets, from cutting carbon dioxide emissions to reducing water stress," she says.

Paulson started working with sustainability just as the field was taking shape. Though many companies had worked with environmental issues before, it was first when the UN Global Compact was introduced in 2000 that companies started to take a broader perspective on sustainability.

"Back then, a lot of the work was communication-based – lifting up best practices etc. But today, sustainability work is strategic; it's about minimizing risks and maximizing possibilities," she says. "Sustainability is about protecting resources – human, financial and natural – by, for example, improving energy efficiency, water treatment and improved yield, and Alfa Laval has been doing this actively for decades. Beyond minimizing the pressure on limited resources, our products and services also reduce financial costs for our customers."

PAULSON SAYS THAT Alfa Laval also practises what it preaches when it comes to sustainability. For example, solar panels will be installed on the roof of one of its new factories in China, while in Sweden, the company uses its own heat exchangers to convert waste heat from a manufacturing plant into heating, with the excess going into the district heating system.

Paulson's ultimate goal is that sustainability becomes a natural part of organizations. "I like to think that my aim is that the role of sustainability manager won't exist one day, because sustainability will be fully integrated into everything we do," she says. ■

3 TIPS

1 Quantity and quality. "Measure your current use of water, energy or emissions and the impacts these have on your bottom line, both in the short and long term."

2 Be selective. "Focus on the areas where your structure has the most significant environmental impact."

3 Get the supply chain on board. "Involve your stakeholders (suppliers, customers, employees, peers, owners etc). This helps you prioritize and will also help you to find the best solutions."

“Alfa Laval sets itself apart because there is such a tight correlation between sales and sustainability.”

PHOTO: FREDDY BILLQVIST

Northern lights recycled

50,000,000,000 watts.
That's how much power is needed to keep all the homes of the Nordic region running. And it's the same amount of energy that industries around the world are saving every year thanks to Alfa Laval heat exchangers. Now that's what we call alternative energy use.

The fact is that huge amounts of energy are still being lost in industrial processes – including in the form of waste heat. Thanks to our high-tech heat exchangers, the energy efficiency of these processes can be increased by 10 to 50 percent, which amounts to a reduced global power requirement of 50 gigawatts. As a bonus, CO2 emissions are also being reduced by around 150 million tonnes each year – the same amount as 30 million cars release into the atmosphere annually. It's simply about using watts with wisdom.

Pure Performance.
Energy. Environment. Marine. Engineering. Food. Chemicals. Take almost any industry, and Alfa Laval is helping it refine and develop its products – over and over again. With our expertise, systems and service, we are helping industry in more than 100 countries. Our driving force is always the same: creating a cleaner environment and a better, more comfortable and hopefully brighter life for people.

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