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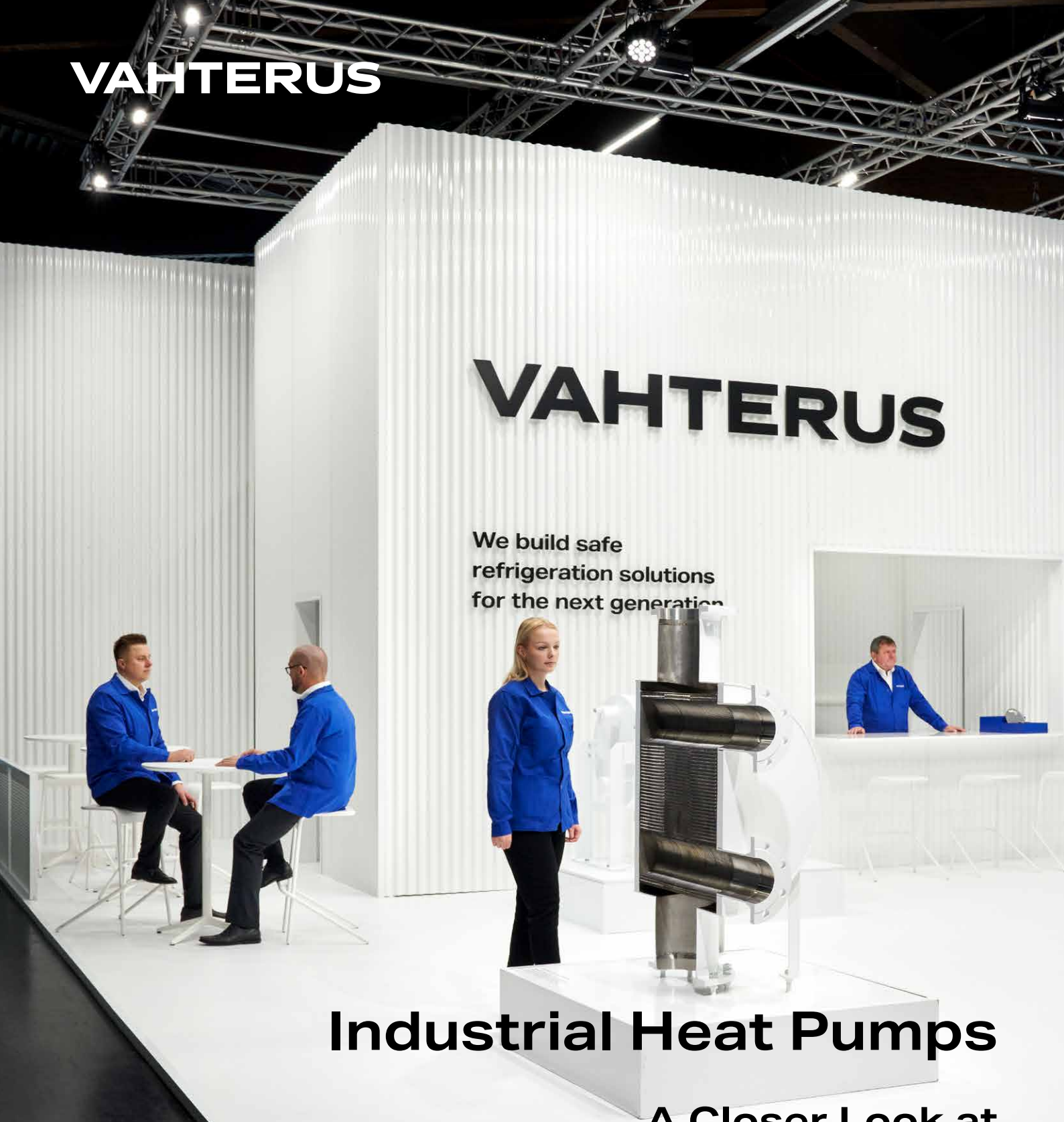

Industrial Heat Pumps

A Closer Look at The High-Demand Solution

The Technology and Talent Behind Vahterus' Signature Welds

HOT&COLD

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ON THE COVER

Front:
Vahterus exhibition stand at Chillventa 2022 in Nuremberg, Germany.

Back:
Key Account Manager Maria Kelkka welcoming customers at Vahterus stand in Nuremberg, Germany.

Photography:
Paavo Lehtonen, Ida Pimenoff and Anton Sucksdorff except image on page 35 provided by ATMOsphere.

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After Uncertain Times, Multiple Reasons to Celebrate

The last two years have been filled with uncertainties, due to COVID and the war in Ukraine. Exhibitions and events have been on hold, as has this magazine. But today, you're holding in your hand a new issue of Hot & Cold, which we hope you'll enjoy reading.

Growth continues

Many things have happened during this period at Vahterus. Our business has developed in a positive direction. You've kept us very busy. Our sales in all sectors and regions have achieved unprecedented growth. You'll find our industry insights on pages 26–31.

Significant investments have been made to respond to this growth. In Finland, we built a new manufacturing hall of 3,000 m^2 last year, allowing us to double our platepack manufacturing capacity. It represents the largest extension we've made in our history.

On 12 August 2022, we celebrated 100 years – a postponed Vahterus 30th anniversary and my 70th birthday. Our new production hall provided a memorable location for a celebration with 300 people – our employees together with partners, customers, friends and family near and far. Finally able to get together after years of travel restrictions, we shared a very special moment together.

Last year, we also announced the acquisition of the Finnish metal component manufacturer Rautarakenne S. Lipponen, based in Kalanti, next to Vahterus' existing production facilities. This acquisition added the company's operations and buildings of 1,000 m^2 to our own.

Another important item on the agenda is to develop local manufacturing facilities and assembly to support our key business regions. At the end of 2021, we acquired a US-based pressure-vessel manufacturing company Harliss Specialties to support our supply-chain capabilities in North America and decrease the delivery times in the area. With our manufacturing headquarters in Finland providing the foundation for our business, it's important to have our own US-based facilities to support this region, similar in principal to our APAC manufacturing centre in China. In the acquisition, Harliss became part of the Vahterus Group, operating as Vahterus Manufacturing Inc. Last year, we started to develop the company and the first Vahterus Plate & Shell Heat Exchangers from the US factory were delivered to customers in the region. Not only is this an important step to support our US sales office in Charlotte, North Carolina, but it's also a positive development for our US customers. The growth could be even faster than expected – Vahterus is ready for it.

APAC business development is on the same track, experiencing strong growth. LNG applications have taken a big role in this area. We also had an important marketing and sales success when we delivered Vahterus Plate & Shell Heat Exchangers (PSHE) to a large ice hockey and skating hall for the Olympic Games in Beijing. During the past 20 years, Vahterus has delivered PSHE units for every Winter Olympic Games!

Our R&D team has developed new products and solutions to a range of applications, part of which are introduced in this magazine (see pages 10–13). They continue to innovate, finding new and effective ways to construct plates and shells.

At the same time we're making more and more investments in automation and digitalisation. As part of this development, Vahterus digital team launched a new web-based sizing programme. This opens up new possibilities for better and faster handling of offers and orders.

Vahterus' new 3000 m² production hall provided a memorable location for the company's anniversary celebrations in August 2022. The main speech was given by Jaakko Hirvola, the CEO of Technology Industries of Finland.

While improving the process of our sales team, the data from the new software also allows us to develop deeper supportive applications and products for our customers.

To make this growth possible, we need more people. Today, we have nearly 500 skilled employees globally. I want to say many thanks to my team.

I believe that our strong growth will continue. Last year, we reached 100 – we received 100 million euros of new orders. Thank you, partners! Now we're planning the next 100 million. It will be a very interesting journey. We'll make it, together!

Heat pumps

In this issue, we focus on heat recovery and energy saving – in particular heat pumps. Because of the urgent need to solve global warming and the current energy crisis, with very high prices and scarce availability of fossil fuels, totally new technical solutions need to be developed. Heat exchangers are key to all these solutions, where the main requirement is compact, safe and high thermal efficiency.

In this issue, we discuss the differences between heat pumps, exploring what happens when using various refrigerants in heat pumps and their environmental impact (see pages 12–13 and 34–45). Our conclusion is that if we want to prevent global warming and environment pollution, the only acceptable refrigerants are natural ones such as ammonia, CO_2, propane and butane. If we all go in this direction, huge developments will be made, not only in heat pumps, but also chillers. With hundreds of millions of small-sized heat pumps and chiller-freezers in operation, this is an urgent question to be solved – the faster the better.

Global warming brings many interesting challenges for heat-exchanger manufacturing, with a growing market and increasing demand for innovative solutions such as thermal efficiency in chillers, heat pumps and fuel systems. Together with you, our trusted partners, we at Vahterus have worked for over 30 years on natural refrigerant development. We hope that you will continue to push us in that direction in the future. Together, we can discover sustainable solutions to tackle climate change and ensure a safe environment for the next generations.

Together we succeed!

Mauri Kontu
Founder and CEO

A Fordson Major Diesel tractor from 1956. 'This was my father's first tractor and the first diesel tractor in the village of Vahterus. My family restored it and gave it to me as a birthday present', says Mauri Kontu.

'A wonderful surprise was when the Finnish official Navy Band suddenly marched in with over 20 musicians. There was so much emotion in the air, it was difficult for me to handle. A wonderful night to remember!', Kontu says.

Eero Saunamäki and the Guards Brass Septet, an ensemble from the Representative Orchestra of the President of the Republic of Finland.

Vahterus' anniversary celebrations with 300 people – employees together with partners, customers, friends and family near and far. 'Finally able to get together after years of travel restrictions, we shared a very special moment together', writes Kontu. Pictured in the middle are Vahterus' long-term partners John Wijbenga (left) and Brandon Loots.

One of Vahterus' earliest partners and a dear friend of the Kontu family, Tjark de Lange joined the company's anniversary celebrations and Mauri Kontu's birthday party in August 2022. De Lange and his wife Debbie de Lange are pictured in the middle, together with Brandon Loots (on their left) and Marko Rantala (on their right).

Simple Technology, Endless Possibilities

Vahterus Editorial Team

Kapp is an unconventional and decisive engineering agency operating in the field of heat transfer. The company was founded by **Tjark de Lange** in 1997 in Spijkenisse, the Netherlands, and is one of Vahterus' earliest partners. After 25 years in business, de Lange is still at the helm of the company, which has grown into a heat-transfer specialist with 14 passionate employees.

Based in Dordrecht, Kapp relies on a worldwide network of specialised manufacturers and is the exclusive representative of Vahterus Plate & Shell Heat Exchangers in the Benelux. Furthermore, de Lange is the man who built the basis for Vahterus' heat-transfer business in the oil and gas industry. 'It started 25 years ago, when Tjark established Kapp Nederland. Vahterus was very small at that time, and Tjark was a hungry young sales engineer full of Dutch energy', says Vahterus CEO **Mauri Kontu**.

He recalls a special memory from those early days, when Vahterus had received a unique customer order with material requirements and fittings that they couldn't locate. 'Tjark found these missing flanges etc. and brought them in his Golf Wagon to Vahterus through Sweden. And then he waited in Kalanti while we were working on the heat exchanger. At the end of the week, he loaded the unit in his car and drove it to his customer. For Tjark, the customer truly comes first', says Kontu.

Over the years, by using his knowledge and experience every day, de Lange has refined his commitment to finding and delivering the best solution for each specific case into an exceptionally deep understanding of heat transfer. Although Kapp's services and product scope have expanded considerably since the beginning, it still considers itself a niche company in the industry and takes pride in its in-depth, focused expertise.

The size and structure of the company allows for flexible services and quick action when it's needed. This applies to specific customer commissions, as well as more generally in the business. Heat transfer happens in many different sectors, but the supply and demand fluctuate constantly. While giving rise to uncertainty, this has also been an opportunity for a creative and agile company like Kapp. If business in one sector is slow, they can use their products and services in another sector. 'We decided to embrace this challenge and make it our strength', de Lange says.

And a real strength it has been. During the 25 years of working together, nearly 2,000 Vahterus Plate & Shell Heat Exchangers have been delivered to Kapp. The partnership has been fuelled by the collaborative mindset of the Kapp team, and the abundance of new ideas that they've brought to Vahterus.

'Technologies are constantly changing', de Lange explains. 'The technology of a heat exchanger is just as mature and basic as that of a windscreen wiper. However, this has never stopped us from inventing and refining innovative state-of-the-art approaches. The application of the heat exchanger is the crux of the matter.'

For de Lange, the challenge lies in continuing to improve a process that has been in existence for over 100 years. Kapp's eagerness to develop or construct new solutions for its customers using Vahterus technology has brought success and growth to both companies.

'Tjark and his team want to challenge us and we always want to rise to that challenge by finding the best solutions for them. This is exactly the feature we respect the most when building a strong partnership', Kontu concludes.

The Separating Gas Cooler is specially developed to cool the gas, partially condense it and finally separate the condensed liquid from the gas. It can be applied to many types of processes requiring these functions in one compact solution.

New Product for Gas Cooling and Condensate Separating

Utilising fully welded heat-transfer technology and Vahterus' separating components, the Vahterus PSHE Separating Gas Cooler combines heat transfer and gas separation functions in one compact solution.

Valtteri Haavisto, Customer Service Director at Vahterus

Vahterus sales and R&D have been working to develop a new heat-exchanger solution for gas-cooling duties. Our new product, an addition to the existing Plate & Shell family, is called Vahterus PSHE Separating Gas Cooler.

Gas-cooling duties often include the partial condensing of water from the product gas. This is the case in hydrogen plants, where water needs to be removed, and eventually dry hydrogen is supplied. The Separating Gas Cooler is specially developed to cool the gas, partially condense it and finally separate the condensed liquid from the gas. It can be applied to many types of processes requiring these functions in one compact solution. Vahterus heat exchangers have been used for years in all kinds of gas heating and cooling processes, many of them also having partial phase-changing duties.

The first part of the Separating Gas Cooler is the heat-transfer area. The effective heat-transfer abilities of the Plate & Shell Heat Exchanger offer significantly better heat transfer and approach temperatures when compared to traditional tube-type heat exchangers. The wide range of optimisation of the plate size, the flow gap and the small amount of passes needed also allows Vahterus to offer good heat transfer, without compromising the pressure drop over the heat-transfer surface.

The second part of Separating Gas Cooler is designed to separate the condensed liquid from the cooled gas before it exits the unit. This is achieved with Vahterus' separating components that have been used for over 10 years in many liquid-separation duties in various industries. This construction has also been tested widely in Vahterus' labs.

The last section of the unit offers the possibility to maintain the condensate liquid level inside the Gas Separating Cooler rather than in a separate receiver.

The materials and design conditions used in the Vahterus Gas Separating Cooler are similar to those in the standard Plate & Shell Heat Exchangers. Like all Vahterus products, the Gas Separating Cooler also offers customer safety and a service-free future, since the fully welded plate construction does not have a gasket that would require service or create a possible leakage risk to the surrounding environment.

There Are Differences Between Heat Pumps

Heat pumps offer energy efficient cooling and heating, but their environmental impact is more complex. The sustainability of a heat pump cannot be defined without taking into account the refrigerant used in it.

Valtteri Haavisto, Customer Service Director at Vahterus

Renewable and low-emission energy are topics that have dominated the debate on energy production in recent years. Rapid change has brought a vast number of new solutions onto the market, and has necessitated and driven technological development.

Heat pumps are part of the new energy solutions. Households are changing their heating systems to heat pumps, and the same trend can be seen on an industrial scale. Energy companies have increasingly been adding heat pumps to their products. The efficiency of industrial heat pumps enables the effective utilisation of waste heat from several sources and brings it to a higher temperature. New heat pumps have also made it possible to use air or seawater as a source of heat, which was previously thought to be impossible. However, the refrigerants used in heat pumps are a topic that is often excluded from these studies.

The compressor in a heat pump takes the pressure of vaporised gas to a higher level, enabling heat transfer between the refrigerant and user of the heat. The same refrigerants are used in the housing, food and transport industries in countless applications, and their total volume is millions of tonnes. Refrigerant leaks from systems are also huge.

The troubled history of refrigerants is as follows: **1834** A refrigeration system based on compressed gas is invented. Ammonia or water is used as the refrigerant. **1930–1950** The first synthetic CFC refrigerants (R12) are developed. 1960–1987: New synthetic HCFC refrigerants (R22) are developed.1970: It is discovered that CFC and HCFC refrigerants cause ozone depletion. 1987: A global agreement, the Montreal Protocol on CFC and HCFC is introduced to reduce the use and production of refrigerants that cause ozone depletion. 1987–2015: New synthetic HCF refrigerants are developed and used (R23, R32, R134a, R404a, R507a). 2015: The EU decides to reduce the use of HCF refrigerants gradually. 2015: The era of natural and HFO refrigerants begins.

The purpose of the decisions made by the EU in 2015 was to find refrigerants with the lowest GWP values possible. Natural refrigerants are usually considered to include ammonia (0), carbon dioxide (1) and hydrocarbons such as propane (3), butane (4) and ethane (6). Synthetic HFO refrigerants include, for example, R-1234yf (1), R-1233zd (4), R-1134ze (1) and R-1366mzz (2). The figures in brackets are the GWP (Global Warming Potential) values of the substances.

However, when refrigerants are examined, it is not sufficient to take only the GWP value into consideration. When selecting refrigerants, the emissions generated during their production and the long-term decomposition of refrigerants leaking from systems should also be taken into account. In addition, the user should consider whether the refrigerant will be available throughout the useful life of the equipment and how its price will change over the years.

A heat pump with a natural refrigerant is the safest option for the future, writes Valtteri Haavisto.

In terms of the environment, the most important aspect is the decomposition of refrigerants and their breakdown products leaking into the environment. According to studies, trifluoroacetic acid (TFA), which is one of the breakdown products of fluorinated refrigerants (HFO), has been found, to an increasing extent, in rain and drinking water.

According to a statement issued by the German Environment Agency (UBA) in May 2022, using low-GWP natural refrigerants in heat pump and refrigeration systems is the best way to reduce TFA in our environment and thereby prevent this harmful substance from affecting people and animals through the soil. The EU has already started to analyse whether some of the HFOs should be listed as PFAS (forever chemicals), which are extremely harmful. It is hoped that these observations will accelerate the transition towards natural refrigerants, and that this change can be implemented among manufacturers and users more rapidly than previous changes. This would ensure that the energy-saving principle of heat pumps is not built on technical solutions that will burden the environment with new emissions.

I hope that those purchasing heat pumps will look far into the future and make decisions that will withstand critical examination for decades to come.

https://www.umweltbundesamt.de/en/press/pressinformation/trifluoroacetic-acid-from-fluorinated-refrigerants

Generating steam with heat pumps

In industry, heat is needed mostly in the form of steam (water vapour). Many of the new high-temperature heat pumps have been developed for that purpose and are set to replace traditional boilers using fossil fuels.

Vahterus has been designing and delivering steam generators to various industries for years. Currently, we are developing a more standardised range of steam generators that can be easily taken into use with various types of heat pumps. We are preparing a launch of these new products for the fall. More information soon!

Fully Welded

Welding is at the core of Vahterus' innovation and one of the most important processes in the building of Plate & Shell heat exchangers. To guarantee continuous production, Vahterus employs 105 welders and welding operators, and is constantly recruiting more.

Vahterus Editorial Team

The story of Vahterus' fully welded plate heat exchanger stretches back more than 30 years. The first plate heat exchangers were manufactured in the 1890s in Germany. Their construction was based on a corrugated plate with a rubber gasket. This type of heat exchanger, called Plate & Frame, radically improved thermal efficiency compared to the previously developed Shell & Tube heat exchanger, and also reduced the size of the unit. The only weakness of the Plate & Frame heat exchanger was the rubber gasket, which limited the maximum operating pressure and temperature. Rubber also hardens over time, which can cause leaks. For the end-user this means high maintenance costs – even higher than the cost of a new model.

Almost 90 years on, in the late 1980s, Vahterus founder **Mauri Kontu** started developing a completely new type of heat exchanger with the aim of finding an improvement to the weakness of the Plate & Frame heat exchanger. 'The idea was to investigate whether the pressure and temperature duration of the Shell & Tube heat exchanger could be combined with the good heat-transfer properties of the Plate & Frame heat exchanger. The goal was to create a next-generation product suited to a wide range of applications', says Kontu.

The result of the research and development was a fully welded plate heat exchanger – the first of its kind in the world. The main innovation of the product is the fully welded structure, in which the round corrugated plates are welded together and enclosed in a shell without rubber gaskets between the plates. The product was named the Plate & Shell Heat Exchanger.

In Vahterus' Plate & Shell Heat Exchanger, the problems caused by the gasket have been eliminated because the gaskets are replaced by welded connections. Thus, each unit has a durable and compact structure designed for safe and long operation. Developing and refining the Plate & Shell Heat Exchanger for various applications has been the focus of the company for more than 30 years. Vahterus also holds numerous patents related to the product and its production.

A visit to Vahterus production facilities disproves the belief that welding is only suitable for men. 71% of the welding operators overseeing the plate-pack production are women. 'Modern workshops are clean, safe and fully automated. Working in them does not depend upon age or gender.'

Welding of pressure vessel surrounding the plate pack.

Saddle nozzle welding of pressure vessel, the shell specially made for each individual unit. Vahterus currently produces around 4,000 heat exchangers per year, which means an average of 90 units enclosed in their glossy white shells every week.

'Welding is one of the most important processes in Vahterus' production, and without skilled welders, we wouldn't be able to build our heat exchangers', says Kontu. Vahterus employs 105 welders and welding operators, and recruiting is ongoing. The employees responsible for welding specialise in different stages of production. The main components of the Plate & Shell Heat Exchanger are the plate pack and the pressure vessel. The plate pack is composed of a series of circular plates welded together around the perimeter and the port holes. The plate-pack production is largely automated and overseen by welding operators. The production line brings to mind a design-oriented tech company rather than a traditional workshop. Individual metal plates pass through an automated welding station for welding and quality control. After that, the finished and leak-tested plate packs are transferred for assembly either at the Valintie factory located a kilometer away, or to Vahterus subsidiaries in the United States or China.

Since the heat exchangers are individual and customised according to the customer's needs, the pressure vessel surrounding the plate pack is specially made for each unit, most commonly of carbon steel or stainless steel. The shell production is mostly manual work and requires great precision. Vahterus currently produces around 4,000 heat exchangers per year, which means an average of 90 units enclosed in their glossy white shells every week.

A visit to Vahterus production facilities in Kalanti disproves the belief that welding is only suitable for men. 71%

Jonne Uotila has found a job he has a natural talent for. Uotila has worked in the Vahterus welding team for nearly two decades.

Having worked at Vahterus since the beginning, welder Olli Sainala has followed the development of the heat-transfer industry for three decades.

On the plate pack production line, individual metal plates pass through an automated welding station for welding and quality control.

For several members of the team, welding is not their first profession. The work requires basic training in the metal industry and hand-eye coordination as a special skill. If a person has natural ability to this type of precision, welding can be learned quickly. In the picture, Sirle Bulak operates a submerged-arc welding machine.

Talented hands taking a break. Pictured from the left, assembly worker Jorma Laaksonen and welders Olli Sainala and Heikki Siloranta.

of the welding operators responsible for the production of plate packs are women. On the assembly line, conditions are tougher, but even there, women make up 24% of the total number of welders. 'Modern workshops are clean, safe and fully automated. Working in them does not depend upon age or gender', says Kontu.

Olli Sainala has worked as a welder at Vahterus since the very early days, when a former cowshed was repurposed as a workshop. Having followed the development of the industry for three decades, he considers the most obvious change in his work to be the tightening of various measures over the years. And, of course, the production looks very different these days, with state-of-the-art facilities and equipment. 'I remember us assembling large, 5 to 6-metre-long heat exchangers outside in wintertime. The sense of achievement was remarkable when the project was finished', says Sainala.

Before joining the Vahterus welding team, **Henna Okkonen** worked as a pattern cutter and seamstress in a local company in Uusikaupunki. After the company ceased operations, Okkonen applied for Vahterus' recruitment training, through which she became an in-house welder 12 years ago. For Okkonen, a good day at work is one where steady progress is made with minimal interruptions, there are no material deficiencies and everything is planned correctly. 'The best thing is when I get a lot done during the work day and the result is impeccable', Okkonen says.

The most common issues encountered are related to materials and machines. Sometimes you have to re-think the material and style used for welding in order to achieve

Heat transfer plate production taking place. As an innovation-led company, Vahterus has its own product, around which the entire production and equipment have been designed.

Henna Okkonen concentrates on TIG welding, one of the hardest types of welding to master. The process requires excellent hand-eye coordination, and results in very strong and clean welds.

a great result. It's not uncommon to find colleagues gathered together to consider a problem such as a cracking seam. 'A while back, there were problems with the new automated stup end welding machine and we couldn't get two tubes, clear and black, welded together' says Okkonen. 'I designed a new bevel for it, with which trial welding and various method tests were carried out, and now the machine can be used in production.'

For several members of the team, welding is not their first profession. The work requires basic training in the metal industry and hand-eye coordination as a special skill. If a person has natural ability to this type of precision, welding can be learned quickly.

Jonne Uotila has worked at Vahterus since 2004. Besides his welding talent, he's known as a skilled drafter. 'I don't have a problem interrupting what I'm doing, switching to another task on the fly. Nothing is an issue because my work feels somehow very natural and easy for me', Uotila says.

Alongside product innovations, operations and machines are currently developing at a fast pace. Vahterus has its own product, around which the entire production and equipment have been designed. In recent years, the company has invested significantly in automation – not to replace skilled staff, but to improve the flow of work. Automation means consistent quality, yet some tasks still require the agility of human hands. 'I'm proud of how much the machines and quality have developed during the past 12 years', Okkonen sums up. 'Thanks to technology, we get more done than before, and with a better end result.'

The demand for heat pumps has increased dramatically in recent years and more research and development is needed within the field.

Vahterus Takes Part in Collaborative Research Project to Develop Next-Generation Heat-Pump Solutions

Valtteri Haavisto, Customer Service Director at Vahterus

Vahterus' experience in refrigeration and heat-pump systems is far-reaching. However, the demand for heat pumps has increased dramatically in recent years and more research and development is needed within the field. There is a need for higher temperatures, and new refrigerants are being introduced into improved systems.

This year, Vahterus takes part in a collaborative research project to develop next-generation heat-pump solutions together with LUT University and a number of other Finnish industrial partners and organisations (Yaskawa Environmental Energy / The Switch, Fincoil LU-VE, Suomen Tekojää, Nevel, Suur-Savon Sähkö and Suomen lämpöpumppuyhdistys).

Vahterus has been part of the collaboration since summer 2022. The overall aim of the project is to improve the global competitiveness of the Finnish heat pump industry. The two-year research project is funded by Business Finland.

To create the best solutions for heat-pump applications in the process industry, expertise in general refrigeration and the heat-pump process is required, as well as knowledge of the applications and industry-specific requirements, writes Marko Rantala.

From Talk to Action in The Post-Pandemic World

Green hydrogen, energy recovery, a shift towards natural refrigerants and alternative marine fuels: with the green transition accelerated by the war, investments in next-generation solutions are on a sharp rise.

Chemical and Process

Marko Rantala, Chemical and Process Business Director at Vahterus

The outlook for the chemical industry in 2023 is challenging, especially in Europe. Natural gas is the main feedstock for many processes in the industry and due to the interruptions in its supply (and cost), chemical production in Europe has declined. Despite the reduced production volumes, however, the need for heat exchangers remains positive – companies continue developing their decarbonisation strategies and investments in sustainable solutions. Additionally, a shift in production capacities with better availability of feedstocks and access to the growing markets has resulted in significant orders and growth for Vahterus in this sector during 2023.

This magazine focuses on industrial heat pumps. In process industries, there is vast potential for energy recovery from different process streams, improving internal plant efficiency or providing energy for external users – either directly or with industrial heat pumps. Steam is often used as a heating medium in process industries and there is increasing interest in steam-generating heat pumps.

Another growth area in our business in the chemical and process sector has been green hydrogen applications. Producing hydrogen through electrolysis using renewable power offers a huge opportunity for the heat-pump industry. Investments in green hydrogen, especially in colder climate areas like the Nordic Countries, are allowing the excess heat from processes to be utilised in district heating.

To create the best solutions for these heat-pump applications in the process industry, expertise in general refrigeration and the heat-pump process is required, as well as knowledge of the applications and industry-specific requirements. Our team is glad to help.

We will be exhibiting again at Achema 2024 in Frankfurt, and this year there are some interesting events to note: **Gastech** 2023, Singapore (5–8 September), **Hydrogen and Carbon Capture Technology Expo**, Bremen, Germany (27–28 September), **Heat Exchanger World**, Pasadena TX, USA (17–18 October). We look forward to seeing you there!

We can't operate without heating and cooling, but this doesn't justify accelerating global warming or contaminating drinking water. Both companies and customers must take responsibility for future decision-making, writes Heikki Oksanen.


VAHTERUS
We build safe
refrigeration solutions
for the next generation.

Fully welded Vahterus Plate & Shell Heat Exchangers are the perfect fit for demanding applications, providing extreme safety levels, and avoiding harmful and dangerous leakages, writes Frans Launonen.

Refrigeration

Heikki Oksanen, Refrigeration Business Director at Vahterus

A record warm summer is behind us, as well as record dry conditions. Food production is in danger. We've been forced to limit water consumption. A long winter is ahead of us. The gas crisis is yet to be solved in Europe.

Energy recovery and energy saving needs to be taken seriously. Geothermal energy and heat pumps could be part of the solution. We can't operate without heating and cooling, but this doesn't justify accelerating global warming or contaminating drinking water. Both companies and customers must take responsibility for future decision-making.

These will be the central themes as we develop future solutions together with our customers. Natural refrigerants, safety issues and technical innovations will create a basis for building a safe future for the next generation. We look forward to a busy heat-transfer winter.

Energy

Frans Launonen, Energy Business Director at Vahterus

2022 brought a handful of challenges, many of them related to war and the unstable political climate. With increasing inflation, higher interest rates and the energy crisis, there's a lot to cope with. Despite that, Vahterus' business in the energy sector has grown. Every crisis brings with it an opportunity to create something better. TTF gas prices in Europe have reached an all-time high during the last year. Asia is competing with Europe for the same LNG cargoes. But peaking gas and electricity prices combined with scarce availability have provided a major push for process-efficiency improvements and more emphasis on cutting operational expenses. High oil prices are triggering Oil & Gas projects. And despite the war, most of the western countries have become closer and more united than ever. In the long term, the work currently being carried out to replace Russian gas in Europe will increase reliability and boost the renewable energy sector. The time of cheap gas is over.

And while energy is in transition, so is our energy business. Only a decade ago, our focus was on onshore power generation, especially steam and district heating. Nowadays, a big portion of our energy business is marine and offshore-related. As Vahterus' new Energy Business Director, after taking the helm from my predecessor **Tobias Häggblom**, my ambition is to further develop our sustainable solutions for our customers' businesses.

One opportunity is alternative marine fuels. Until recently, only about 1 percent of a fleet of 100,000 commercial vessels has used alternative fuel. Times are about to change: the number is now closer to 30% of vessels on our global newbuild order book (approx. 5,100 vessels order in July 2023). In terms of gross tonnage, it is even higher: 50% of the current order book. LNG will continue to be the dominant alternative fuel in the short term, but meanwhile methanol has shown the biggest rise during the last years. Vahterus is delighted to have been selected as the heat-exchanger supplier for several of these newbuilds. In addition, carbon-free fuels such as ammonia are around the corner. Vahterus is more than ready for this, thanks to our years of experience and development around natural refrigerants. Fully welded Plate & Shell units are the perfect fit for demanding applications, providing extreme safety levels, and avoiding harmful and dangerous leakages.

Understanding the client's needs is essential to Mikko Vilola's work as a Key Account Manager. Vilola (right) photographed on site outside Budapest, together with General Manager Sándor Murin (left) from QPLAN Cooling Technical Design & Services Co. Ltd.

Meet Our Team

Customer Orientation Is Key

Mikko Vilola works as a Key Account Manager responsible for our refrigeration sales in Central and Eastern Europe. His collaborative approach has borne fruit in his work with clients – and at the local soccer club.

What is your work history at Vahterus?
I started working here in July 2011. I've spent the past 11 years in the refrigeration sales group, first as a sales engineer and then as a key account manager. I'm responsible for the refrigeration sales in Central and Eastern Europe, as well as supporting our resellers in Spain and the Netherlands. Previously, I worked with domestic refrigeration sales, and I'm still responsible for some of that.

What do you like best about your job?
I like that each day is different and I get to deal with a lot of different people. I consider meeting clients and understanding their needs to be particularly important.

How is your typical workday?
I like to start the workday early. Remote working is perfect for this, as you don't have to spend any time commuting. My day starts with checking emails and taking care of urgent matters. The majority of the day is spent calculating offers and moving the already sold heat exchangers towards production. Days at the office are also pleasant and important, because that's where I meet my colleagues. I spend two to three days a week at our Raisio office, and visit the Kalanti headquarters once every two weeks.

When do you feel you've succeeded in your work?
As my job is to sell our product, I naturally feel that I've succeeded when the customer places an order. And it's always rewarding to find a solution that meets the customer's needs. Since the client is the starting point of sales, their feedback feels especially good.

When are you at your best?
When meeting and interacting with clients. I'd like to think I've succeeded in creating close relationships with all my clients, and I operate in such a way that they know they're important to me.

What, to you, is Vahterus' most important value?
Customer orientation is key. Every commission is important, because at the end of the day, it's our customers who enable our operation and development as a company.

What delights you in everyday life?
I've always followed sports, and now my children are getting to the age where this can be our shared hobby. It's nice to watch a game or support a team together. Participating in my children's hobbies is also pleasant.

How do you spend your time outside work?
I'm active in a couple of clubs and associations. Of these, my son's soccer team in particular is a good counterbalance to my work. When I'm at a soccer practice or game with the children, work matters automatically drift into the background.

What has impressed you recently?
Two different and difficult Corona years are behind us, during which there were hardly any public events. In the past summer, various festivals and markets were organised again. I can imagine how difficult it was to find volunteers and employees for these events, many of which had to be built and re-planned from scratch. Not an easy task for sure, and yet many succeeded, which I found impressive.

What new skill would you like to learn?
I've been cooperating with our Spanish distributor for a long time. In customer meetings, I've thought how useful it would be to know the language. I've often thought about starting Spanish studies, but this hasn't happened yet. One day, I'd like to find the time.

What do your co-workers not know about you?
I don't think my co-workers know that while I was studying, I worked as an elementary school substitute teacher on several occasions.

Who of your co-workers would you like to praise?
I can't single out one colleague, because the work is a collaboration with so many different talents. I feel very strongly that deep cooperation within my sales group as well as with other sales groups, design, product development and marketing is important. Together we create a functioning whole.

What are your goals for 2023?
My goal is to build a deeper understanding of our refrigeration customers and the differences in the market. The market is developing and I'm sure one of the big things in 2023 will be the application of heat pumps to produce steam. The application combines Vahterus' knowledge of heat pumps and steam generators, and it's something I want to learn more about. Personally, I want to find time for my family and be involved in my children's hobbies. I was recently elected as the new president of my son's soccer club, which brings responsibility and new experiences.

How Dare You Continue to Apply F-gases!

Prof. Dr.-Ing. Armin Hafner, NTNU, Trondheim, Norway

From now on, end-users should insist that new refrigeration and heat-pump systems must be future proof. They should neither risk facing legal operation restrictions, nor the event that their units become 'scrap assets' before reaching their technical end of life. If this occurs, and it turns out that the cooling technology sold as 'green' was based only on a narrow-minded focus on the Global Warming Potential[1] of the refrigerant, the end-user will have every right to blame the vendor for cheating.

By 2023, we should all know better and since alternative technology is available, continuing to use non-natural working fluids is quickly becoming a reputation issue for manufacturers and vendors. It is not good enough to carry on with business as usual and postpone the implementation of new systems with natural working fluids by claiming that the F-gas solution is still a legal option. The newly published content of the PFAS restriction proposal[2] by the European Chemical Agency ECHA is crystal clear: F-gases that decompose to PFAS are a risk to the environment and human health. Changes in standards, rules and regulations take years to come into effect, as shown in the case of FDA against the chemical giants.[3] Therefore, every installation should require the vendor to supply thorough information to the end-user regarding the environmental impact of the F-gases used in their assets, and must confirm that they are taking responsibility for:

– Green House Gas (GHG) emissions related to the entire manufacturing process of the F-gases, a value that for R.1234yf can reach several hundreds of CO_2-equivalents per kilogram of refrigerant.[4]

– HFCs and especially unsaturated HFCs, which are decomposing in our atmosphere to trifluoroacetate (TFA), a salt of trifluoroacetic acid, in water and on the ground.[5] TFA is very stable in water and dangerous to some aquatic organisms. It cannot be removed with the purification processes used in today's drinking water treatment.[6]

– PFAS – Per- and polyfluorinated alkyl substances, also known as Forever Chemicals, a large family of over 9,000 highly persistent chemicals that do not occur in nature but are produced by decomposing HFCs.[7]

– Green House Gas emissions that are related to these decomposition products. As an example, when R-1234ze decomposes due to common UV at sea level, there is a significant risk that harmful R-23 is part of the decomposition products. R-23 has a GWP value of up to 15,500![8]

Since there are currently no legal restrictions on end-users implementing F-gas based units, a financial deposit like that currently implemented in Norway[9] for substances in relation to their greenhouse gas emissions (2023: 952 NOK / 1000 kg CO_2) should be implemented in order to fund clean-up operations in the future.

Natural working fluids for refrigeration and heat-pumping systems have no hidden or secret environmental impact. The long-term operation of these systems can be guaranteed, as well as reduced energy demands when applied in accordance with design guidelines. All temperature levels and most applications can be cooled or heated by applying natural refrigerants. No single refrigerant can cover all applications, but the group of natural refrigerants can be used in all the applications that can be covered by fluorinated hydrocarbons and even more. Fluorinated hydrocarbons can neither go as low in temperature nor as high as the natural refrigerants; they only work in the medium temperature range in the most profitable markets.

Refrigeration and heat-pump systems must have no hidden environmental impact, writes Armin Hafner.

1 GWP value: is the heat absorbed by any greenhouse gas in the atmosphere, as a multiple of the heat that would be absorbed by the same mass of carbon dioxide (CO_2). Carbon dioxide is the reference. It has a GWP of 1 regardless of the time period used. Estimates of GWP values over 20, 100 and 500 years are periodically compiled and revised in reports from the Intergovernmental Panel on Climate Change IPCC. Currently the 100 year time period values are applied.

2 https://echa.europa.eu/documents/10162/1c480180-ece9-1bdd-1eb8-0f3f8e7c0c49 & https://echa.europa.eu/de/registry-of-restriction-intentions/-/dislist/details/0b0236e18663449b

3 https://www.theguardian.com/environment/2021/may/12/chemical-giants-hid-dangers-pfas-forever-chemicals-food-packaging-dupont

4 https://ecostandard.org/wp-content/uploads/2021/05/ECOS-briefing-on-HFO-production-and-degradation_final.pdf

5 https://www.openaccessgovernment.org/hfo-refrigerants/112698/

6 https://www.umweltbundesamt.de/en/publikationen/persistent-degradation-products-of-halogenated

7 https://pubs.acs.org/doi/10.1021/acs.est.0c06978

8 https://www.theguardian.com/environment/2021/may/12/chemical-giants-hid-dangers-pfas-forever-chemicals-food-packaging-dupont

9 https://www.skatteetaten.no/en/business-and-organisation/vat-and-duties/excise-duties/about-the-excise-duties/hfc-and-pfc/

GEA Turns Energy from Coal Mine into Renewable Heating

Kenneth Hoffman, Product Manager Heat Pumps, GEA

GEA has secured the order to deliver the UK's largest capacity heat pump for district heating. 6 MW of heating energy will be provided to a heat network in Gateshead (South of the river Tyne, near Newcastle). The project has secured governmental funding and is part of the UK's strategy for a low-carbon future.

The UK has targets to reduce greenhouse gas emissions by 57% over the 2028–32 period. Doing so will rely on a significant contribution from decarbonising heat by installing efficient heat networks in areas of high heat demand.

The goal is for heat networks to provide 17% of heat demand in homes and up to 24% of the heat demand in non-industrial business and public-sector buildings. This will require a significant increase in current growth rates and investment in heat networks. Use of heat storage and electric heat (for example from heat pumps) offers significant electricity system balancing opportunities.

This is not the first time Gateshead has taken the headlines: Gateshead Council won the Visionary Project Award from the Association for Decentralised Energy (ADE) at its 50th anniversary awards ceremony at the Science Museum in London for phase one of its district energy scheme. The special award was given in recognition of the most significant schemes of the past decade, as well as those that set the bar for the next decade of energy initiatives.

Gateshead was once the World's largest supplier of coal, with more than 400,000 tons being shipped out in 1625, providing essential heat for households. However, the last coal mine in the area closed in 1926 and it is the tunnels dug during this time, which have since filled with water, that work as the heat source for the heat pump. So once again, Gateshead is providing essential energy for heating its homes and industry, but this time in an environmentally friendly way, which helps reduce CO_2 and NOx emissions.

The water is pumped out of the mines from a depth of 70 m at a constant temperature of 15 °C. The heat is abstracted from the water and returned to another area of the mine at 7 °C. The low-grade energy is then transformed into high-grade heat at 80 °C by using an ammonia heat pump. The heating water is fed into the district heating network. By the time the water returns to the energy centre, the temperature has dropped to 65 °C. The heat pump uses electricity to run, but it only uses 1/3 of the total heat output, since most of the energy (2/3) is taken from the water-filled coal mine.

The heat-pump installation consists of 2 x 3 MW heat pumps. For optimised performance, a two-stage compression cycle with screw compressors is used. The ground source water is filtered and pumped through Plate & Frame heat exchangers. Titanium was selected for their evaporator plates. On the heating side, several Vahterus heat exchangers in series optimise the efficiency of the heat-pump.

Ammonia was chosen as the refrigerant because of its optimal efficiency. In the given conditions, ammonia heat pumps are 10–20% more efficient than F-gas (HFC/HFO) solutions, and with the subsidy from the UK government only being available if a COP of minimum 2.9 can be achieved, F-gas was not an option for this application.

Over the last years, a lot of research into the environmental impact of using F-gas (HFC/HFO) refrigerants has been published and many environmental issues have been highlighted questioning the longevity of these refrigerants. When investing in low-emission technology, care must be taken not to create new environmental issues like polluting our rivers and lakes with TFA (a fluoride salt that is a by-product of F-gas refrigerants).

Based on the ambitions of the UK government to significantly increase district heating in the UK, we expect to see many new projects over the coming years.

Vahterus Technology at The Heart of Queens Quay's Award Winning Heat Pumps

Rebecca Casale, Key Account Manager at Vahterus

Back in 2017, Vahterus UK received a quotation request from Star Renewable Energy for Plate & Shell Heat Exchangers (PSHEs) as part of the landmark Queens Quay heat network project. These PSHEs were to form an integral part of two 2.65 MW River Source Heat Pumps drawing water from the Clyde Estuary. Each heat pump was designed to include four PSHEs operating as a condenser, desuperheater, sub-cooler and oil cooler. One of the main drivers in selecting Vahterus' Plate & Shell technology was its compact size and low ammonia charge.

Five years later, using ammonia as the working fluid, the heat pumps are the largest, hottest, natural-working-fluid, water-source heat pumps in Scotland. In 2021, the European Heat Pump Association awarded West Dunbartonshire Council (which commissioned the project) the '2021 City of the Year' award for its work on the Queens Quay project.

A Leisure Centre, 130 newly built apartments, a Town Hall, two Business Centre buildings and a Health Care Centre are currently being served by the network, which is expanding every month and over the next few years will also include a Hospital, College, and multiple blocks of high-rise accommodation.

In energy terms, $C0_2$ savings on the current system when compared to gas are 80%, and when the grid is fully electrified from renewables (target of before 2030) this will be a 100% CO_2 reduction.

Following on from this award-winning success story, Star is now commissioning two further systems: one in Bristol (3000kW) utilising the floating harbour in Castle Park as the heat source, and a further system in Jarrow, South Tyneside, which utilises the River Tyne.

Commenting on the Queens Quay project, Manager of Star Renewable Energy, **Nicky Cowan** said, 'Heat pumps, whilst an old concept, are not well known. They're relatively simple. The hard bit is to get the best performance and that's where the challenge begins. Star aims to harness every piece of available heat in various heat-exchange processes, but they all interact. I'm really grateful to Paul Button at Vahterus for his diligence, patience and quick responses, which helped us on our way to success.'

Paul Button, Director at Vahterus UK said: 'To see the working benefits of such a successful project with Vahterus technology at it's heart is a very proud moment for us. In the present economic climate, with rising energy costs and inflation, it's encouraging to see systems such as this providing significant savings for users on the Network.'

Star Heat Pump in the Energy Centre at Queens Quay. CO_2 savings compared to gas are 80% and improving.

Vahterus Technology at The Centre of Yet Another Revolutionary Net Zero Project

Rebecca Casale, Key Account Manager at Vahterus

The project to extract waste heat from an underground train network is the first of its kind in the world, and Vahterus Plate & Shell technology is right at its centre. A purpose-built ammonia heat pump was commissioned by Islington Council to sit at the heart of the revolutionary Bunhill Energy Centre in London, located on the site of an old underground station.

The decommissioned station, once named City Road, is now home to an innovative underground air extraction system, whereby warm air created by machinery and trains on the London Underground's Northern Line is extracted via a ventilation shaft. Energy from this warm air is then used by the heat pump to heat water, which is distributed through the 1.5 km network of district heating pipelines. Cheaper, greener heat is then delivered to various buildings within the community, including 550 homes, leisure centers and schools.

Bunhill Energy Centre utilises warm air created by machinery and trains on the London Underground for district heating.

In the colder months the heat pump will be running near full capacity (1,000 kW), delivering energy to the various buildings within the area. However, in the warmer months, when demand decreases, the fan from the ventilation shaft is reversed, and instead injects cooling into the underground network, helping to keep passengers more comfortable.

Islington Council commented: 'This ground-breaking scheme has the potential to be replicated not only across Islington and London but in any major city with an underground network. That's because heat networks, such as Bunhill Heat & Power Network are able to harness a wide range of renewable and waste heat sources that are already available within a city.'

Paul Button, Director of Vahterus, UK said: This is another great example of the client selecting Vahterus for groundbreaking and innovative technology. The compact size, low ammonia charge, reduced maintenance cost and fully welded construction (less risk of leakage) means Vahterus Plate & Shell technology is perfect for heat-pump applications.We are delighted to have played a part in such a successful project, which is yet another example of modern heat-pump technology helping provide lower-cost greener energy in an area, where affordable heating is more vital for the community than ever before. The Bunhill Energy Centre has already reduced CO_2 emissions by around 500 tonnes per year and this is set to increase due to the long term expandable and flexible solution.

Waste Heat Recovery with Vahterus PSHE – A Path to Carbon Neutrality

Krista Karjala, Global Key Account Manager at Vahterus

The petrochemical and refining industry is a very energy intensive field and is under constant pressure to increase energy efficiency and reduce carbon-dioxide emissions. Waste-heat recovery is essential for modern manufacturing, especially with the current energy situation in Europe.

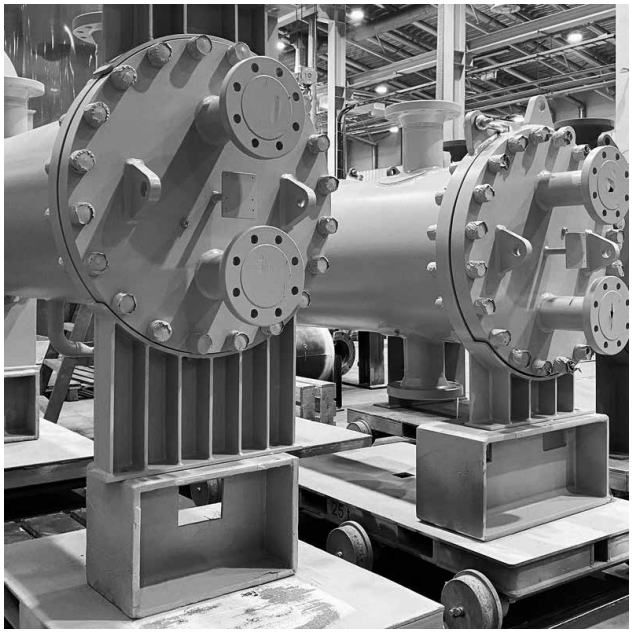
A good example of a heat-recovery project is one that Vahterus delivered to a refinery in Europe last year. In that project, Vahterus supplied 10 heat exchangers, together comprising 20MW of heat. In the refinery, residual heat was utilised from the desulphurisation plant, diesel production units and vacuum distillation to heat a hot-water circuit, from where the heat further transferred to the district-heating network.

Vahterus heat recovery PSHEs cool the refinery product to heat the district-heating water. The PSHE is excellent for these kinds of tight temperature profile cases with high product/water mass flows. One of the installations comprised two PSHE 5HH-736/2/2 models, connected in series, both consisting of two 368 plate packs. The external piping arrangement for the heat exchanged directly matched the customer's piping system. The distillation product was cooled by 80°C in the heat exchanger to provide water of 60°C. The capacity of the installation was 4 MW.

This industrial waste heat recovery system directly heats around 150 industry buildings through the district heat piping and saves 21,000 metric tons of CO_2 annually. In in other words, CO_2 emissions have been cut by 85% when compared to the figures 10 years ago. This is a great example of environmentally friendly district heating.

Vahterus had already supplied heat exchangers for a similar project in Europe ten years ago, and this installation has provided a reliable and efficient operation ever since. In the first part of the project, a 40 MW heat recovery system was built, and five years later a 50 MW heat-recovery system was created from multiple process streams. In that project, over 40,000 homes were heated by industrial waste heat, saving around 100,000 metric tons of CO_2 emissions. At the same time, the energy efficiency of the refinery was increased by 5% and the district heating company was able to provide a stable energy price and independence from the primary energy source.

These successful projects show how our industry can make a valuable contribution to a lower-carbon future with environmentally friendly district heating.



Vahterus heat-recovery units at a refinery whose waste-heat recovery system now heats around 150 industry buildings.

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