

Kelvion



Marine market

**GREEN
POWER
FULL SPEED
AHEAD**

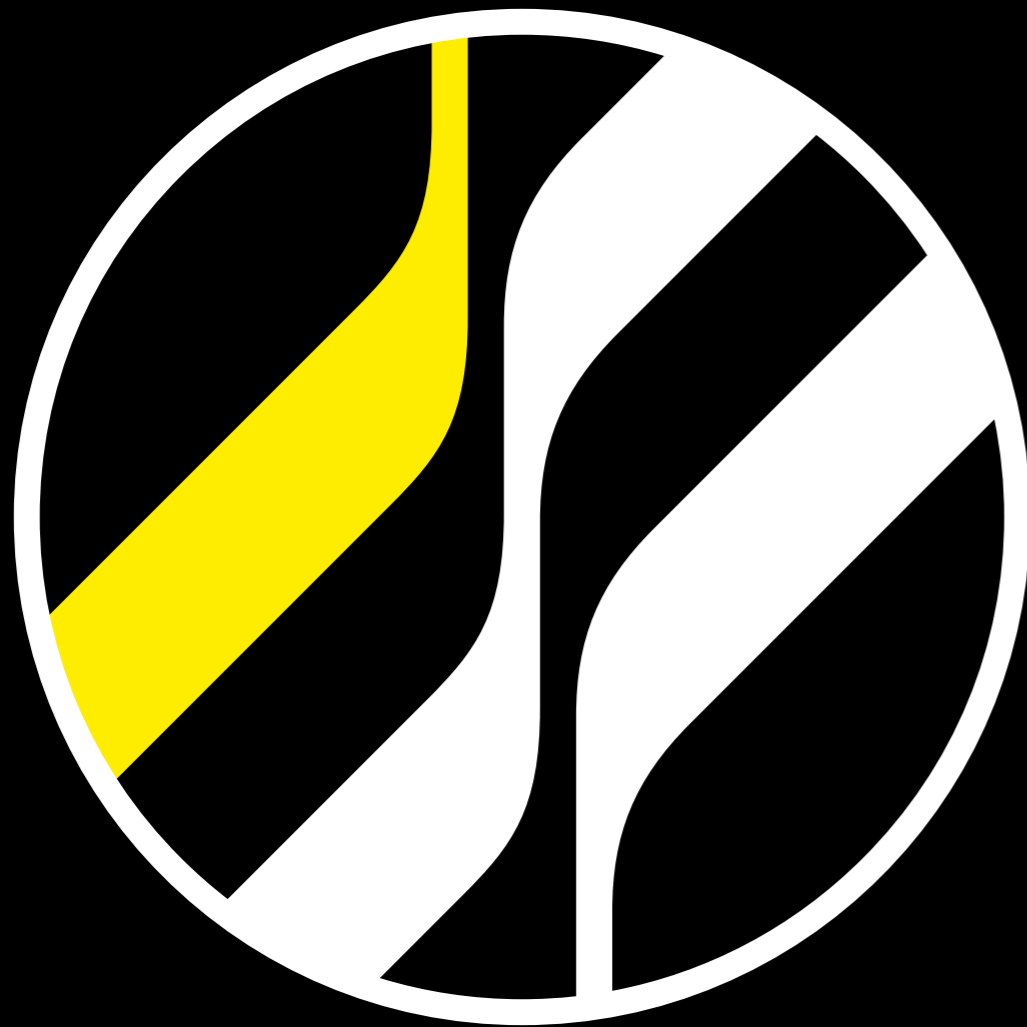


**Kelvion –
a tribute to
Lord Kelvin**

**70 branches and
sales partners
worldwide**

**More than 4,000
employees
worldwide**

Lord Kelvin (1824 – 1907) formulated
the laws of thermodynamics



EXPERTS IN HEAT EXCHANGE – SINCE 1920

Welcome to Kelvion. As successor to the GEA Heat Exchangers Group, we continue to break new ground, making discerning customers more successful than ever with our integrated heat exchanger solutions.

Our solutions for your applications:

We offer our customers one of the world's largest product portfolios in the field of heat exchangers. It includes individual solutions for practically all conceivable applications and complex environmental conditions: plate heat exchangers, shell and tube heat exchangers, finned tube heat exchangers, modular cooling tower systems, and refrigeration heat exchangers.

Your markets are our markets, too:

The markets in which you and we together operate are among the most important in the world: the chemical industry, food and beverages, the heavy industry, climate and environment, marine applications, the oil and gas industry, energy, refrigeration technology, sugar and transportation. We provide every single market segment with solutions of outstanding efficiency, safety, and sustainability.

We are highly committed to earning your trust:

We want to win your trust with everything we do and convince you with the solutions we offer. With this high aim in mind, we invest our extensive know-how, our great precision, and our passion in everything we do: including product development, manufacturing, installation, and after-sales support.

Seeing things from the customer perspective:

Your specific requirements count – and nothing else. Whatever we offer you, it must meet these requirements. Our entire way of thinking and working is geared towards this aim. Our customers truly appreciate this: after all, this is how we make their companies more efficient.

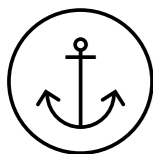
We are at your service.

Kelvion – Experts in Heat Exchange.



The marine market – facts and figures

SHIPPING KEEPS THE MODERN WORLD TURNING



The marine industry plays a crucial role in linking the global economy – more than 90 per cent of the world's goods are carried by sea.

Merchant fleet

There are over 50,000 merchant ships trading internationally, transporting a wide range of cargo. Without them it would be impossible to supply goods on the scale needed to meet the demands of the modern world.

Outlook is plain sailing

A rising population, together with a predicted long-term economic growth in the developing markets of Asia, Africa and Latin America, means that seaborne trade is set to increase further over the next decade. Higher disposable incomes in the emerging economies will boost demand for imported products.

At the same time, more and more people are spending their leisure time afloat. The popularity of cruising holidays has seen annual passenger numbers increase by nearly seven per cent since 1990. Larger, more diverse, ocean liners with a

huge choice of on-board facilities and activities have made the vessels destinations in themselves.

Emission control

While the average container ship emits 40 times less CO₂ than a large freight aircraft and more than three times less than a heavy lorry, shipping has come under the environmental spotlight due to emissions of nitrogen and sulphur oxides (NO_x and SO_x). In 2010 the International Maritime Organization imposed a global cap on the sulphur content of marine fuel to 3.5 per cent and 1 per cent in Emission Control Areas (ECAs). In 2015 the ECA limit was reduced to 0.1 per cent.

On-board solutions

Safety, reliability and durability are essential to a ship's operations. As experts in heat exchange technology, Kelvion offers the widest range of cooling applications to help keep engines running efficiently, reduce emissions, recover waste heat and supply fresh water. All of our products are built to withstand the rugged conditions at sea and are backed by years of experience in supplying the marine industry.

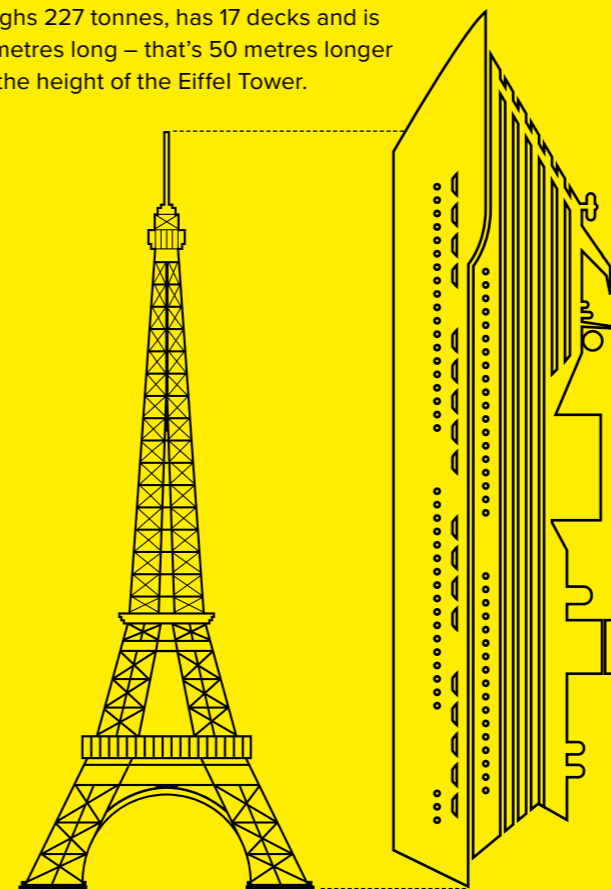
Ships are getting bigger:

WORLDWIDE SHIPS ARE GETTING BIGGER AND ALSO MORE SPECIALIZED TO MEET THE GROWING DEMAND FOR GOODS AND ENERGY.

Water giants

Cruise travel is growing at a record pace – up 68 % in the past ten years. It contributes US\$ 119.9 billion to the global economy, which equates to 22.04 million passengers and 939,232 jobs. Between 2016 and 2017, 15 more cruise liners will be launched, adding 39,637 (8.1 %) to passenger capacity.

One of the largest cruise liner is „Harmony of the Seas“. It weighs 227 tonnes, has 17 decks and is 362 metres long – that's 50 metres longer than the height of the Eiffel Tower.



Source: Cruise Lines International Association

The main drivers fuelling marine sector growth



Increasing population

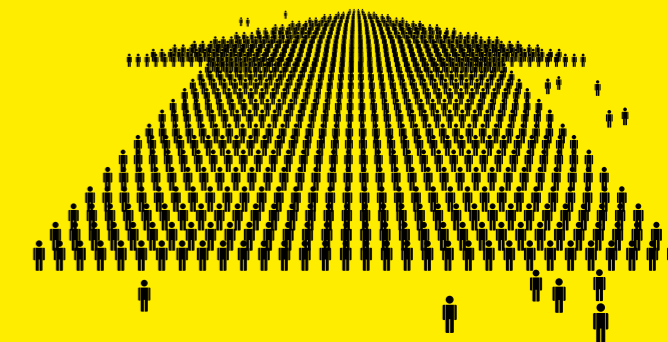


Developing markets



Cruise travel

8,800,000,000



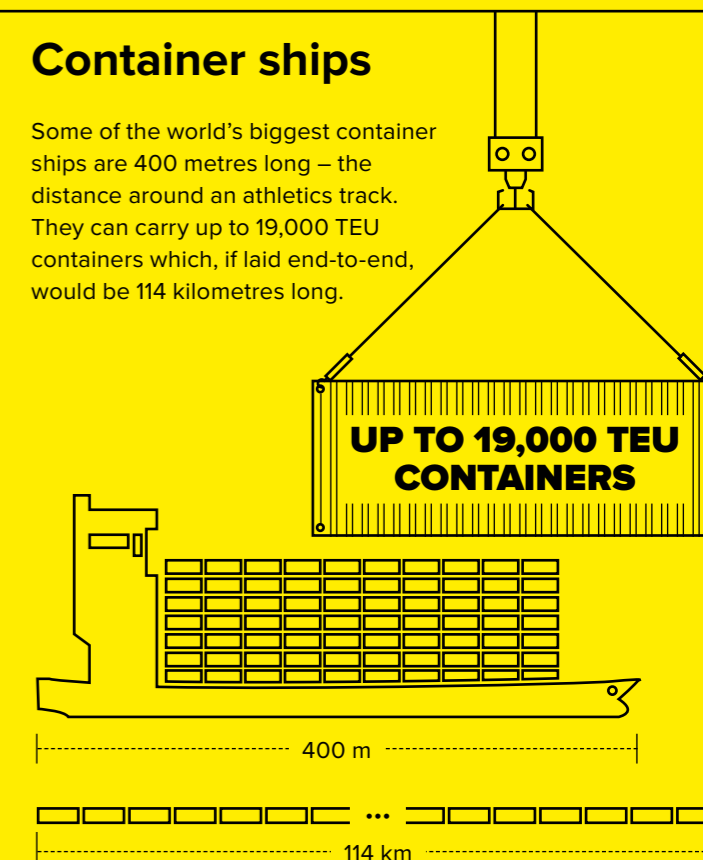
Global population and developing markets

The world's population is set to reach 8.8 billion during the next 20 years. At the same time, long-term economic growth in emerging markets will have an impact on the shipping industry. A demand for more and larger vessels will require more investment in ports, infrastructure, technology and services to keep trade and energy supply flowing.

Source: IHS Maritime & Trade

Container ships

Some of the world's biggest container ships are 400 metres long – the distance around an athletics track. They can carry up to 19,000 TEU containers which, if laid end-to-end, would be 114 kilometres long.



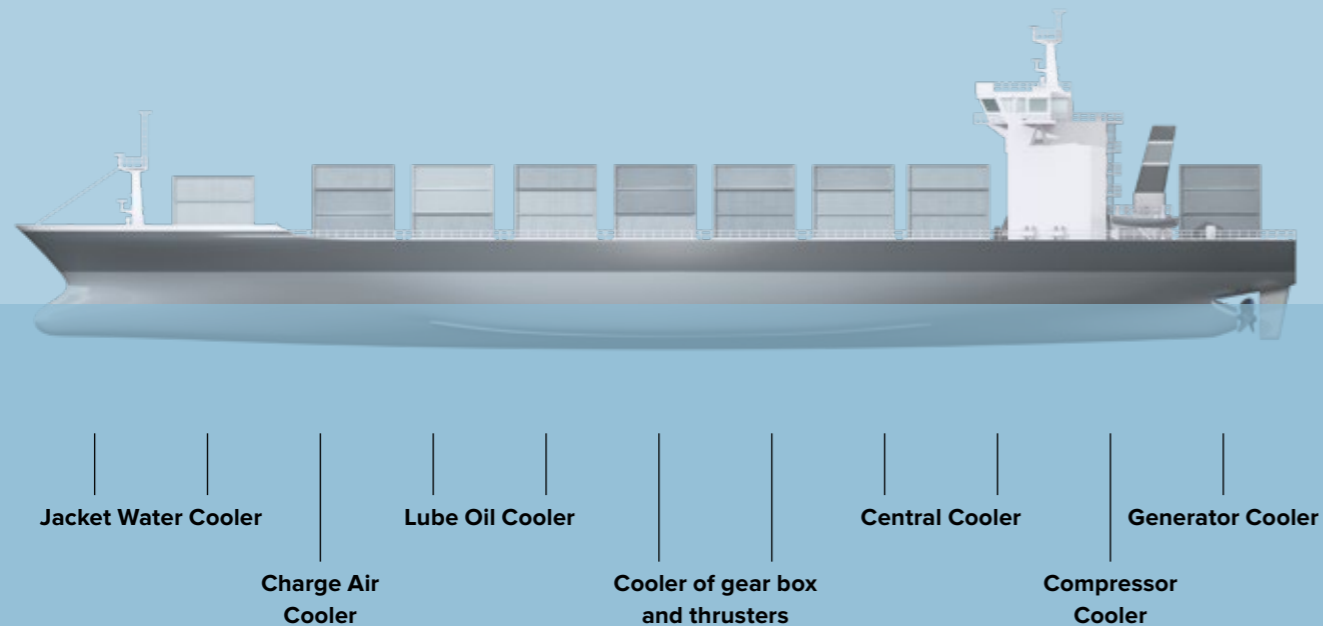


RELIABLE AND EFFECTIVE HEAT EXCHANGE FOR CRITICAL OPERATIONS ON BOARD

From cruise ships, container vessels, bulk carriers and mega-yachts, to icebreakers, trawlers, tankers, barges and tug boats, Kelvion offers an extensive portfolio of heat exchangers that provides reliable, effective cooling and heating to enable critical on-board systems to operate efficiently. Our state-of-the-art technology is designed and manufactured to the highest standards to ensure a long operational lifetime and durability in all conditions. By working closely with our customers, we provide them with the expertise and solutions they need to boost the performance of their vessels.

INNOVATIVE HEAT EXCHANGE SOLUTIONS FOR MARINE PROPULSION SYSTEMS

Most modern ships are powered by diesel/gas engines. As well as being the simplest, most robust and economic method of propulsion, they are suited to nearly all types of vessels. The set-up of the propulsion system depends on the vessel size, trade or type of operation. Whatever the system, the key requirements for a marine engine are reliability, economical fuel consumption, speed and long life.



Engine Cooling

FIRST-CLASS TECHNOLOGY FOR KEEPING ENGINES COOL

Without adequate cooling, the high temperatures created by burning fuel would cause marine engines to fail. Keeping them cool during operation is therefore crucial and requires a range of different components for reducing the temperature of the circulation water, charge air and lubrication oil.

The size and dimensions of the cooling systems are determined by how the engines are configured by the manufacturers. Whatever the specifications, Kelvion offers first-class cooling solutions, which is why many prominent engine manufacturers regard us as innovation partners.

Kelvion solutions:

Jacket water coolers, Charge air coolers, Lube oil coolers, Cooler for gear box and thrusters

Jacket Water Cooler

A fresh water circulation system absorbs heat from the engine. This high temperature (HT) water, known as jacket water, is subsequently cooled by a low temperature (LT) water circuit.

A third circuit, containing seawater, is used to cool the LT water. We offer two solutions that help to ensure optimal engine performance:



Our state-of-the-art plate heat exchangers have been used successfully for cooling and heating all types of fluids. Made from the highest quality materials, they ensure maximum heat transfer, high performance and a long service life. Our plate heat exchangers are particularly recommended for cooling jacket water on large ships.



We recommend the box cooler for small and medium-sized vessels. It is virtually maintenance free and can be customized for all operating conditions. The box cooler is fitted in the sea chest on the side of the vessel, saving space in the engine room. This solution offers the additional advantage of eliminating the need for a seawater circuit.

FIRST-CLASS TECHNOLOGY FOR KEEPING ENGINES COOL

Lube Oil Coolers

Marine diesel two-stroke and four-stroke reciprocating engines have to be lubricated with oil to ensure the smooth movement of the piston and crankshaft in the bearings, reducing to a minimum the friction which interferes with engine efficiency and damages components. To prevent the oil overheating, heat exchange technology is required. Where the oil cooler is incorporated into the engine, Kelvion can supply the core components for a shell and tube heat exchanger, which is then mounted on the engine block.

In addition, our gasketed plate heat exchangers and shell & tube heat exchangers have a proven track record in helping diesel engines to maximize performance.



Our compact, highly efficient plate heat exchangers guarantee the ideal oil inlet temperature for the lubricating oil circulation system, thereby minimizing the effects of friction and wear on the engine.



With its revolutionary plate fin technology, the shell and tube heat exchanger is specially designed to achieve the highest performance, within the most compact format. A wide variety of shell sizes, tube bundle inserts and materials enables us to select the best cooling configuration for each application.

Charge Air Coolers

During compression in the turbocharger the combustion-air is heated to more than 200°C. Before entering the engine, the air needs to be cooled down within the CAC.



For more than 50 years, we have led the way in developing and manufacturing charge air coolers. Designed for diesel and gas engines, they have a worldwide reputation for excellent performance and reliability. Working in close collaboration with leading engine manufacturers, we develop dedicated solutions tailored to customer requirements.

Engine Cooling

FIRST-CLASS TECHNOLOGY FOR KEEPING ENGINES COOL



Coolers for gear box and thrusters

Our shell & tube heat exchangers and gasketed plate heat exchangers also play an important role in cooling down the gearbox – used to change the rotation speed of the propeller shaft - and thrusters, which are used for manoeuvrability.



Engine Room Cooling

HEAT TRANSFER EXCELLENCE FROM KELVION **KEEPS THE HEART OF THE SHIP BEATING**

The engine room is the beating heart of the ship. In addition to the propulsion system, it is home to the generator that supplies the on-board electrical power for everything from lighting and heating to air-conditioning and refrigeration.

At Kelvion, we have decades of experience in providing robust heat exchange systems that can withstand the rigors of operating at sea, safely and reliably, whatever the class of ship.

Kelvion solutions:

Central Coolers, Compressor Coolers, Generator Coolers



Central Cooler

The central cooling system on board a marine vessel is essential for taking the heat out of the fresh water and oil streams that circulate through the machinery within the engine room. As seawater is generally used as the cooling medium, it places stringent demands for corrosion-resistant materials to be used in all products that come into contact with it.



Our advanced plate heat exchangers and box coolers are optimally designed for maritime applications and made from the highest quality materials. They provide efficient, powerful cooling of liquids, reliably and over a long service life. Box coolers also provide efficient central cooling on smaller vessels.

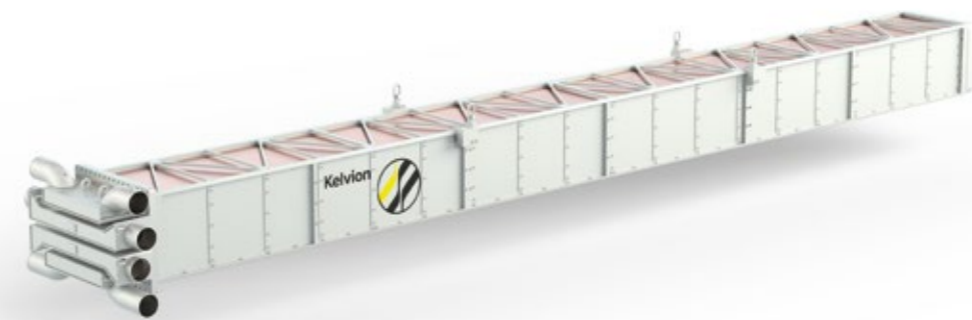
HEAT TRANSFER EXCELLENCE FROM KELVION **KEEPS THE HEART OF THE SHIP BEATING**



Compressor Cooler

A marine air compressor supplies high-pressurised air for starting the main and auxiliary engines. To ensure that the bearings are not damaged by friction, they are supplied with lubricating oil to keep them running smoothly. During operation the lube oil heats up and needs to be cooled.

The shell and tube oil cooler is fitted with our innovative plate fin technology and has been proven time and time again as an efficient and cost-effective solution. Because of the large heat exchange surface around the tubes, the cooler is very compact and therefore easy to service. What's more it can be produced in different configurations to suit customer requirements.



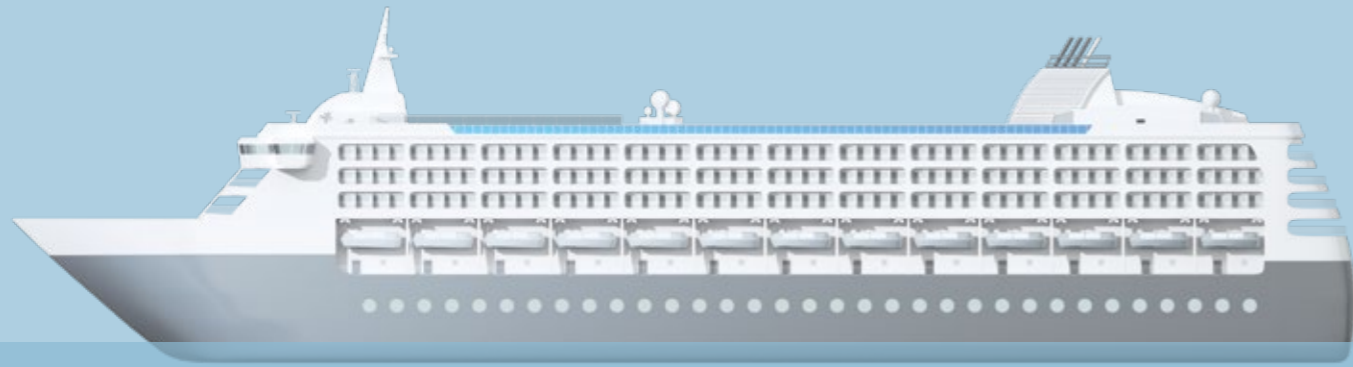
Generator Cooler

The generator is the lifeline that supports all the functions on board ship and keeping it running round-the-clock requires special care, attention and maintenance. Cooling technology has an essential part to play in supporting optimum operation.

Our finned systems, which are individually developed according to customer specifications, improve the heat transfer in tube systems. This means that they require less material to achieve the optimum performance – an important consideration for ships which have strict rules governing the size of installations.

COMPONENTS TO SUPPORT GREEN POWER AND ENERGY EFFICIENCY

Air pollution from international shipping has been a growing concern. In response, in recent years the International Maritime Organization has strengthened its regulations on reducing emissions of sulphur and nitrogen oxides (SOx and NOx) from marine diesel engines. Kelvion is at the forefront in supplying green technology to help the marine industry to cut emissions and boost energy efficiency.



Scrubber
Water Cooler

Exhaust Gas
Recirculation Cooler

Surface
Condenser

SOx Reduction

HEAT EXCHANGE IS KEY TO **SOx** CLEANING SYSTEMS

The International Maritime Organization has limited the sulphur content of marine fuel to 0.1 percent for all ships trading in the Sulphur Emission Control Areas and 3.5 per cent outside these areas. In order to comply, ships must either switch to cleaner fuels or install scrubbers to wash the SOx particles from their exhaust gases. Our gasketed plate heat exchangers play an essential role in cooling down the water used during the scrubbing process.



Scrubber Water Cooler

Plate heat exchangers from Kelvion have proved highly efficient at cooling and heating fluids of all types. Made from the highest quality materials, they provide maximum, reliable heat transfer and a long service life.

NOx Reduction

RECIRCULATION COOLER SETS NEW STANDARDS ON EMISSION CONTROL

NOx emissions are a major pollutant from ships and regulatory bodies around the world are imposing ever stricter guidelines for lowering them. One method of reducing the emissions is by using an exhaust gas recirculation cooler. Kelvion is setting new standards in this area, with an effective solution that enables ships to comply with both current and upcoming regulations.



Exhaust Gas Recirculation Cooler

Based on a recently developed fin tube system, this patented design has the capability to cool gases down from more than 700°C to 50° C. We developed the technology in close collaboration with our customers, ensuring that the recirculation exhaust gas is mixed at the lowest possible temperature with the combustion air to reduce NOx emissions most effectively. Our compact, service-friendly, recirculation coolers are customized for each diesel engine manufacturer and made with corrosion-resistant materials.

Waste Heat Recovery

RECYCLING HEAT BOOSTS ENERGY EFFICIENCY ON BOARD

During operation at sea a ship produces a lot of heat. Recycling this heat has benefits for the environment but it is also an effective way of saving energy and reducing costs. Recovered heat on board can be used to generate steam in the boiler for driving the turbine. When it comes to condensing the steam and returning the water to the cycle, the Kelvion portfolio has the answer.



Surface Condenser

Over the last 40 years, Kelvion has forged long-lasting relationships with turbine makers, main EPC contractors, engineering companies and plant end users. Our surface condensers have the reliable and efficient performance that is essential in a steam turbine cycle. We create customized solutions to meet our customers' specific requirements. All our condensers are manufactured in a range of materials to suit the quality and nature of the cooling water.

RELIABLE SUPPORT FOR ON-BOARD SYSTEMS

Heat exchangers are critical for heating and cooling a variety of media during the operation of many on-board services and systems. From supplying fresh water and air-conditioning to improving environmental performance, Kelvion has the answer. Our heat exchangers are robust and reliable, even in the most turbulent sea conditions.



Fresh water supply

Without fresh water ships would be unable to set sail. While drinking water is vital for crew and passengers, it's also essential to have a supply of fresh water for cooling engines and other equipment. Kelvion is a leading supplier of gasketed plate heat exchangers to manufacturers of generators used to distil fresh water from sea water.

HVAC/Refrigeration

The versatility of our plate heat exchangers makes them the ideal choice for many on-board services. They can be found in refrigeration units used to store and preserve food – including on most of the fishing trawler fleet – as well as swimming pool heating systems on cruise ships and in the circulation of potable water for drinking, washing and showering. Our plate heat exchanger range incorporates special safety features, including a double wall which prevents the potable water mixing with the engine cooling water. The Kelvion portfolio of brazed plate heat exchangers and shell and tube heat exchangers can be found in ships' air-conditioning systems, helping to maintain a comfortable climate on board.

Deck machinery

Merchant ships, cargo and other supply vessels are often fitted with heavy-duty lifting machinery, including cranes and winches. Their many moving parts need to be lubricated with oil which, in turn, needs to be cooled with air or water to prevent friction damage to the components. Our plate heat exchangers and shell and tube heat exchangers offer effective solutions and a guaranteed high performance. This technology is also used successfully for anchor handling equipment.

Once cargo has been unloaded, the tanks and containers need to be cleaned. The cleaning systems, which are heated by steam or oil, are sophisticated industrial processes in themselves. Our shell and tube heat exchangers help to ensure that these systems run smoothly and efficiently.

Fluid and fuel treatment

Kelvion is a reliable partner in the quest to protect the marine environment by enabling ships to use low sulphur fuel or switch to LNG and remove pollutants from bilge water. To comply with international regulations on SOx emissions, one solution is for ships to convert to marine gas oil (MGO), which contains less sulphur than the standard heavy fuel oil. However, many marine fuel injection systems are not designed to handle the low viscosity properties of MGO. To avoid damage to the fuel injection components, MGO has to be cooled to increase its viscosity before it can be used. Our range of gasketed plate heat exchangers and shell and tube heat exchangers are ideally suited to the task, playing an important role in the drive towards green propulsion. The opposite treatment is required for heavy fuel oil which has to be heated to lower its viscosity before it can be used. Our shell and tube and plate heat exchangers will ensure that the oil reaches the required level of viscosity. An alternative for reducing air pollution is to install LNG or dual fuel engines. Heat exchange technology from Kelvion plays a key role in the necessary regasification process that enables the fuel to be burned. When it comes to purifying bilge water, treating sludge and recovering fuel oil for recycling, our gasketed plate heat exchangers provide essential cooling to support the separation process – further underlining our green credentials.

OUR SERVICE IN THREE WORDS: PEACE OF MIND



Developing and supplying products and solutions is one side of our business – comprehensive after-sales support and comprehensive services is the other. The most important aspect is always to satisfy your requirements. This principle has made us a highly reliable service specialist. Our tightly woven network of locations worldwide means we can offer our customers maximum availability everywhere and anytime. We are underway for our customers every day, around the world. The service work we perform provides us with a continual stream of new knowledge and experiences that culminates in valuable improvements and enables us to permanently optimize our range of services. These services include precise installation work, in-house or on-site trouble shooting, visual inspection and performance audit as part of proactive maintenance, repair and cleaning, tube replacement, provision of spare parts, and the chemical cleaning of product components in our own service workshops.

Whatever it is we do for you, our services are oriented to specific values:

Quality and safety

We provide the ultimate in service quality with individual customer advice and precision work.

Innovation

Innovative service solutions enable us to fulfill the needs of our customers.

Efficiency

Our parts and services support ensures greater profitability: we optimize in-house workflows and maximize the availability of our systems at our customers' premises.

Professional knowledge

Our customers benefit from the knowledge and experience we have gained through decades of service work.

Trust

The work performed by our service staff is reliable, responsible, and transparent: which is how we have earned the trust of our customers.

The multi-stage model – service as you need it

Our after-sales and service portfolio is based on service levels in which the range of services agreed upon is an integral part of an individually tailored service agreement. The clearly described contents of the various service levels ensure reliable cost transparency. The various service components can be combined as required to form a tailor-made service agreement. You can put together your own personal service package, tailored to suit your individual needs: to include the provision of spare parts, staff training, a help desk, or permanent on-site service.

FAIRNESS FIRST: FOR CUSTOMERS, EMPLOYEES, COMPETITORS, AND THE ENVIRONMENT

Companies such as Kelvion that are internationally active are obliged to conform to internationally accepted conventions: of social, political, and legal nature. Our corporate code of conduct describes the principles and procedures behind our corporate actions. This code applies to all our employees worldwide. We ensure compliance with the regulations in a working environment that is characterized by integrity, respect, fairness, and responsibility.

We respect and observe the law.

The basis for all action at Kelvion is the observation of all applicable laws and other regulations. We supplement these rules with especially designed, particularly strict internal guidelines and training with regard to certain aspects of the law.

We act internationally.

Kelvion strictly observes as binding the statutory regulations that apply to our products and services involved in international commerce. We observe all applicable bans on exports and imports and observe all official authorization procedures.

We wholly reject corruption.

Kelvion rejects any type of commercial corruption, both domestically and on foreign markets. In order to underline this fact, we have drawn up our own anti-corruption guidelines that enforce rules of proper conduct to which we adhere at all times. These rules apply both in our dealings with officials and with the bodies and employees of other companies.

We support fair competition.

In a spirit of fair competition, we work hard, orient this work to our customers' needs and ensure the quality of our products and services. We observe all applicable domestic, supranational, and foreign anti-trust laws as well as any laws pertaining to unfair competition. We also expect this level of fairness from our competitors.

We ensure socially acceptable working conditions.

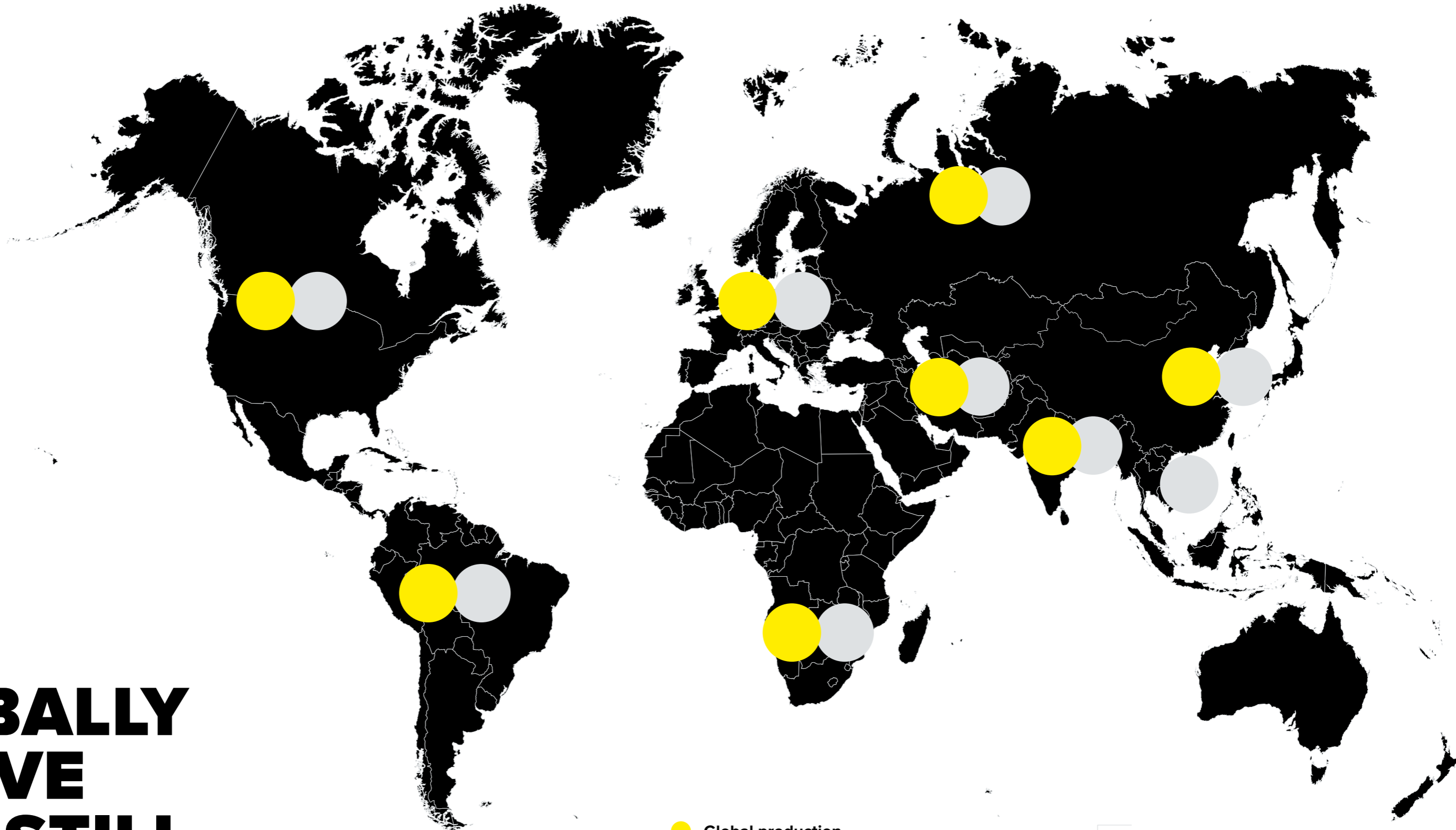
We are committed to the principles of social responsibility towards our employees and society. Kelvion offers its employees fair working conditions worldwide. We reject any form of discrimination, with respect to gender, sexual orientation, origin, skin color, or any other personal characteristics. We see ourselves as a socially responsible employer that treats its employees with respect.

We protect the environment.

From development, to manufacturing, and to the sale of our products, we protect the environment throughout each of these phases. This principle applies not only to the energy we employ, but also to the protection of our natural environment at every workplace worldwide.

We ensure product safety.

For our customers, we develop innovative, high-quality products and processes – and product safety enjoys top priority.



GLOBALLY ACTIVE AND STILL CLOSE BY

No matter where your market is, regardless of country, we are never far away. We are always happy to answer any questions you may have and meet your requirements. Even the largest, most successful project begins with an initial, profitable conversation. We look forward to hearing from you.

- Global production footprint
- Global sales and service



Just scan this QR code with your smartphone or visit our website at: www.kelvion.com – there you will find a highly competent contact in your immediate vicinity.

www.kelvion.com