



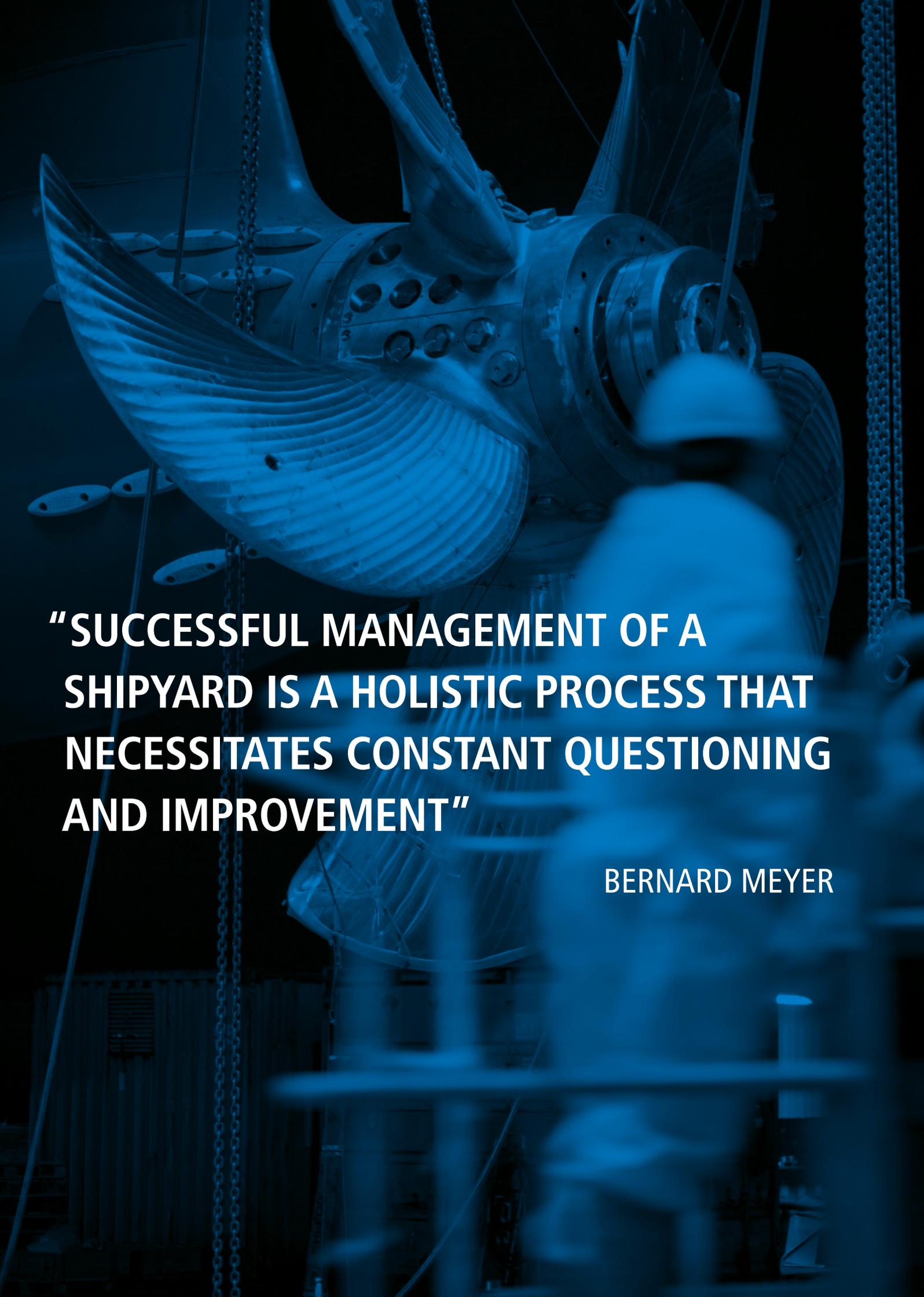
**MEYER WERFT**

PAPENBURG 1795



**SOCIAL RESPONSIBILITY**

2016



**“SUCCESSFUL MANAGEMENT OF A SHIPYARD IS A HOLISTIC PROCESS THAT NECESSITATES CONSTANT QUESTIONING AND IMPROVEMENT”**

**BERNARD MEYER**







**FOREWORD**



**PAPENBURG  
A PLACE OF SHIPBUILDING**



**CORPORATE ENVIRONMENTAL  
PROTECTION**



**THE GREEN-SHIP-CONCEPT**



**EDUCATION, HEALTH  
& SOCIAL MATTERS**

**SOCIAL RESPONSIBILITY 2015**

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# HARMONISING BUSINESS, SOCIETY AND THE ENVIRONMENT

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MEYER WERFT is inextricably associated with the Ems region, its people and its shipbuilding. As a company that has contributed so much to the history of the region, not only does it take its responsibility very seriously but it is everyday practice. The Papenburg company began devoting attention long ago to factors beside its main activity of shipbuilding.

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Now more than ever before, its commercial activity not only requires a high degree of engineering craft and technical know-how but equally an open-minded and responsible attitude to the quality of the natural landscape along the Ems. This extends to the well-being of the people who live in the region and those who are employed at the shipyard, as well as the company's social and cultural involvement beyond the borders of the shipyard. The successful running of a shipyard is a holistic process that must be subjected to constant scrutiny and enhancement.

Out of a sense of conviction, the shipyard emphatically upholds a harmonious relationship between economy, society and ecology. Central premises of the company philosophy are to create a healthy and sustainable environment in which to live and to secure a high quality of life. This begins with innovative shipbuilding based on new, environmentally friendly technologies and extending far beyond providing training for the top specialists of tomorrow.

The Ems is and will always be our central lifeline, but we are well aware that there are still many unsolved problems surrounding the state of the Ems. This is a challenge that we can only solve with the participation of all the parties and organisations involved. Today, MEYER WERFT is one of the cleanest and most environmentally friendly shipyards in Europe – a benchmark that we intend to maintain and one that drives us on. Not only for the good of the company, but also for the people and their region.



Bernard Meyer Dr. Jan Meyer Tim Meyer Lambert Kruse



Bernard Meyer, Dr. Jan Meyer, Tim Meyer, Lambert Kruse – CEOs of MEYER WERFT



1.

**PAPENBURG  
A PLACE OF SHIPBUILDING  
SINCE 1795**



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# TRADITION AND SELF-IMAGE

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The Meyer family has been keeping its shipyard on a steady course for seven generations now. The shipbuilding company was founded in 1795, and it remains in family ownership to this day. The successful development of the company is rooted in tradition and innovation.

The MEYER WERFT shipyard was the first compact shipyard in Europe and is one of the most modern shipyards in the world today. Comprising two covered dry docks with computer-assisted production facilities and equipped with the latest technology, everyday working life at the shipyard is guided by a philosophy of short distances. The focus is directed consistently towards ensuring sustainable development at all levels. MEYER WERFT pursues economic, social and ecological goals to equal degrees and it does so out of conviction. Environmental management is one of the company's central corporate priorities and it fulfils a key role in the shipyard's continued development.

## AS SHIPS GROW IN DIMENSIONS SO DO THE CHALLENGES

Shipbuilding has a long tradition in Papenburg. Enormous cruise ships like the „Quantum of the Seas“ (length 348 metres, width 41 metres, 18 decks), the first ship of its kind to be built by MEYER WERFT and which passed along the Ems in September 2014, are ringing in a new era of shipbuilding. As ships grow in dimension so do the challenges – and the responsibility – that they present to the shipyard. For MEYER WERFT, a future without motivated employees or an intact environment would be equally unthinkable. By focusing on ecological balance, the company is constantly working to create technologies and applications that are both sustainable and make economical use of resources. Transparency is of vital importance to the company; this goes far beyond the direct view of the building activities in the shipyard hall enjoyed by guests in the visitor centre.

The company actively seeks dialogue. Indeed, close dialogues are maintained not only with state environmental protection agencies and environmental groups but also with employees, partner companies, suppliers and customers, as well as classification societies, universities and not least, the general public. Communication and cooperation are more than just slogans – for MEYER WERFT they are an essential requirement and an integral part of successful environmental protection as it is practised.

MEYER WERFT frequently undergoes voluntary inspection. The efficiency of its technological and production processes is scrutinised on a regular basis. Environmentally friendly production, responsible handling of chemicals, water and other input materials and the treatment of waste, emissions and wastewater created during production are part and parcel of the company's self-image.

The principle of sustainability is a central component of the shipyard's environmental policy. As it continues to develop, the company has its sights set on the needs of present and future generations. All the people living in the region must be allowed to expect and enjoy a high quality of life. The shipyard develops its activities in line with this maxim. Effective environmental protection takes into account the considered development of all areas of life and commerce. MEYER WERFT has created thousands of jobs in what is a structurally weak region and it intends to maintain and expand these jobs. The shipyard is the guarantor of a stable, high quality of life in the north west of Germany.



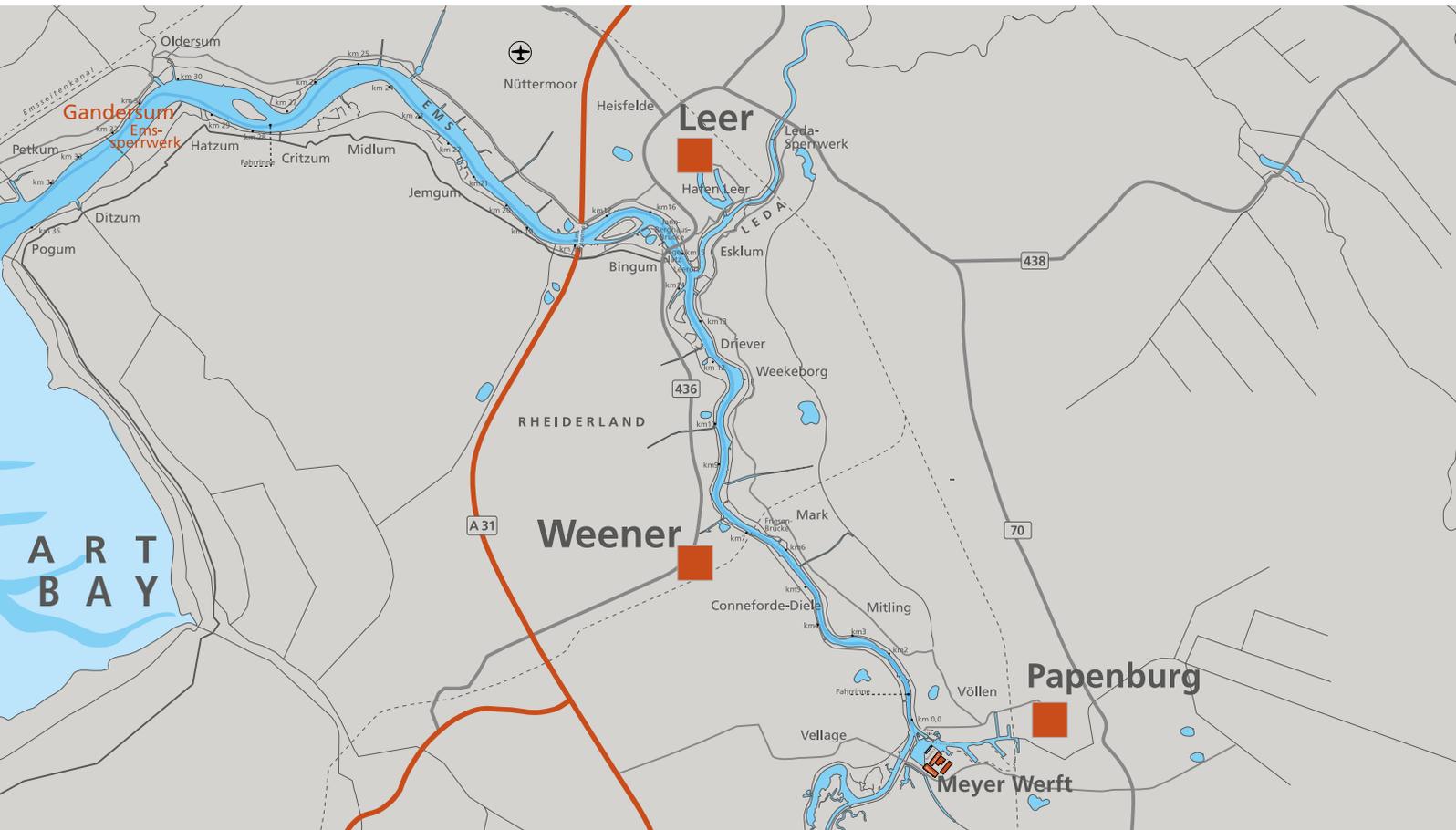


## THE EMS AS A WATERWAY AND VITAL LIFELINE

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The Ems is much more than just a 380-kilometre-long river that flows from eastern Westphalia to the North Sea. Together with the Dortmund-Ems Canal, which was built in 1899, it forms an important inland waterway for inland and marine shipping, as well as a vital lifeline for many companies, from shipbuilding firms to logistics operators.

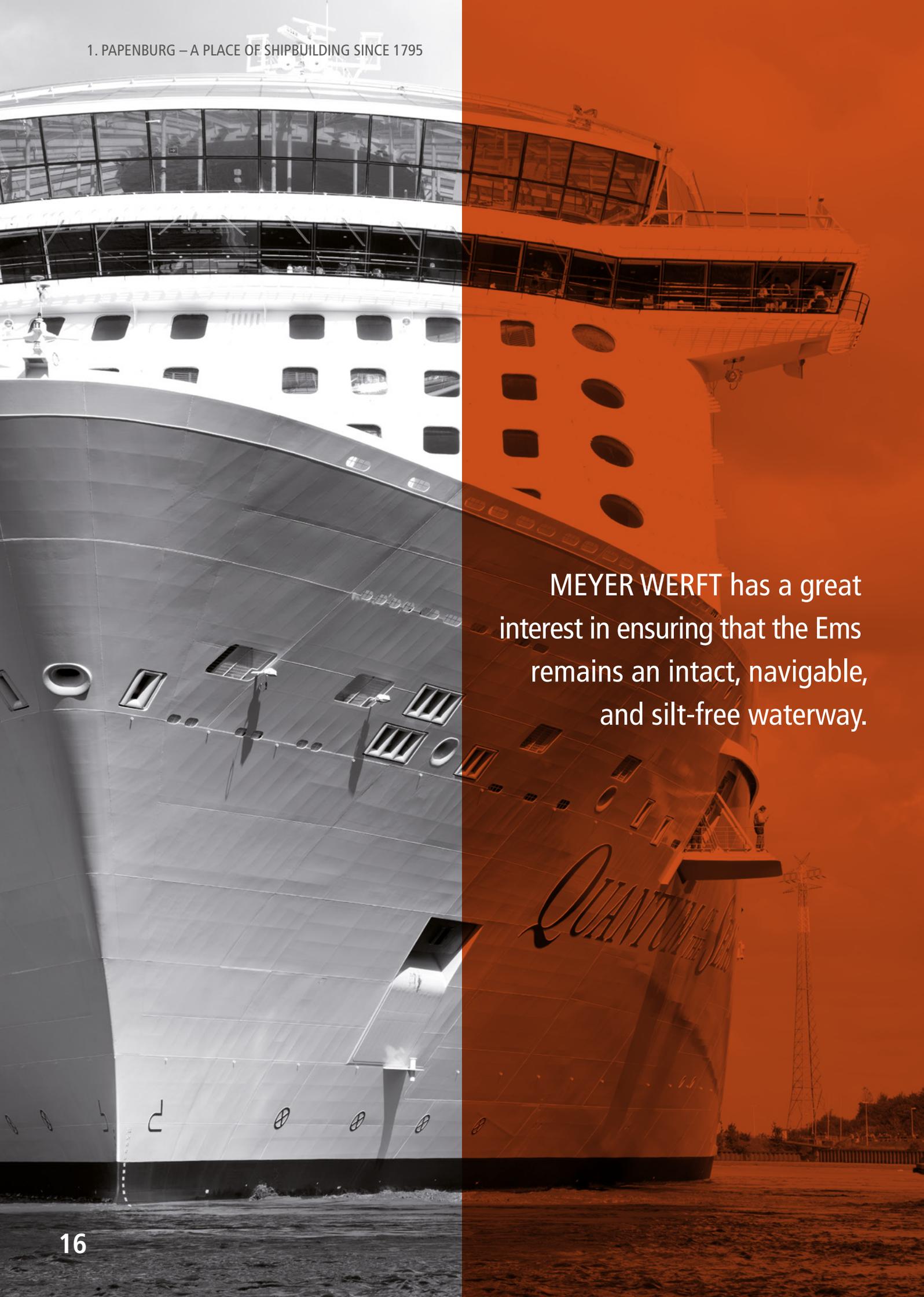
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Thousands of tonnes of goods including cars, timber and plastics are handled on both sides of the Ems in the harbours of Dörpen, Papenburg, Leer, Emden and Haren on the German side and in Eemshaven and Delfzijl in the Netherlands. The volume of goods handled has increased continually over the past two decades. The regional port economy is on a successful course and more than 9,000 ships travel along the river each year – an economic growth that is also changing the demands placed on the river.

In addition to this, shipbuilding enjoys a centuries-long tradition on the Ems and the river used to provide a means of subsistence for numerous shipyards. Right up until the nineteen-nineties, there were still many shipyards located on the Lower Ems, but the majority of these shipbuilding operations fell victim to the wave of shipyard closures that began in the nineteen-seventies.

Indeed today, MEYER WERFT is the only one of what used to be 23 shipyards in Papenburg that has managed to assert itself amid the competition and has not only survived but even expanded its operations. This is partly thanks to the decision taken early on to specialise in the building of cruise ships and to invest sustainably in new technologies. There are still a few small shipyards on the Ems in addition to MEYER WERFT, such as Kötter-Werft in Haren, Schiffswerft Diedrich in Oldersum, Bültjer Werft in Ditzum, Cassens in Emden and Emden Werft und Dockbetriebe.



MEYER WERFT has a great interest in ensuring that the Ems remains an intact, navigable, and silt-free waterway.

# DEEPENING OF RIVER EMS

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Economic growth in north west Germany since the nineteen-nineties has brought about changes in the demands placed on the Ems, particularly around the Lower Ems. In 1982 the Federal Transport Plan was published, foreseeing a deepening of the river channel to enable the seaports of Papenburg and Leer to handle the rise in the number of shipping vessels.

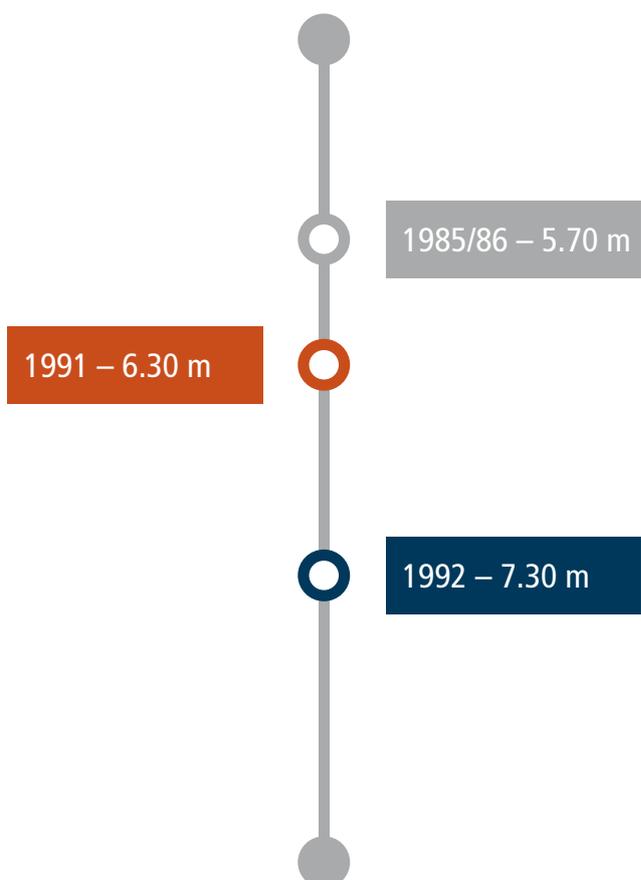
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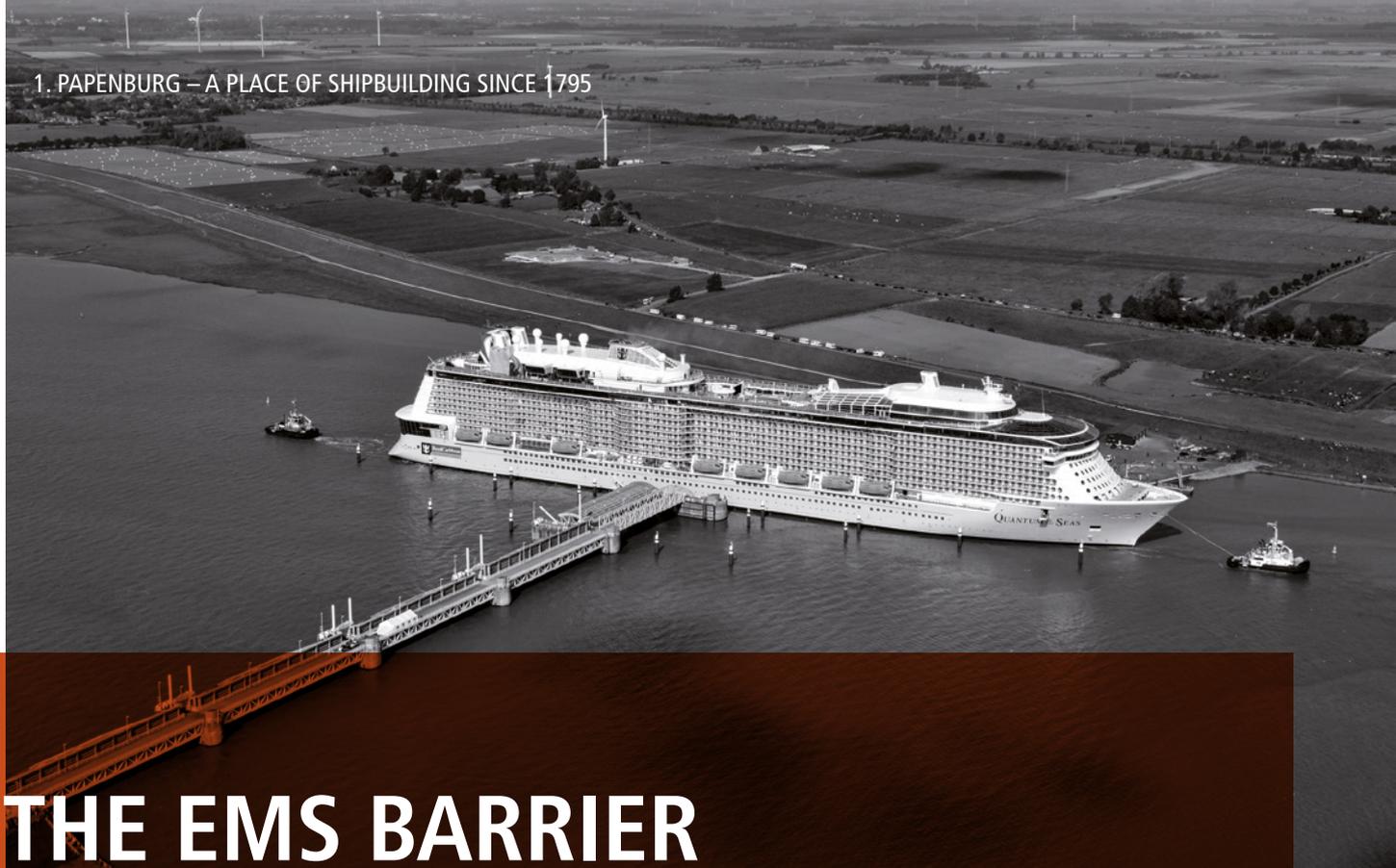
The first stage of development took place in 1985/86, after which the Ems was navigable by ships with draughts of up to 5.70 metres. The deepening and widening of the navigable channel now allowed ships to approach each other from opposite directions and pass by each other without problem. In 1991 the river was deepened, which benefited ships with draughts of up to 6.30 metres – particularly coasters.

## INCREASING DEMANDS ON THE RIVER

However, when MEYER WERFT began to construct cruise ships the demands placed on the river would change even more. In 1991 the shipyard received a large order for the construction of the „Oriana“ and to enable the project to proceed, the Ems channel was deepened to 7.30 metres in close coordination with the state government of Lower Saxony. By enabling the construction of this cruise ship to go ahead, employment at the shipyard was secured and this laid the foundation of the company’s successful position within the worldwide cruise sector.

Plan approval procedures were conducted for all impending deepening measures to examine the impact they would have and to lay down compensatory measures. The hydraulic, hydrological, biological and ecological effects of the measures were each examined in detail to ensure that any necessary changes would be performed with maximum regard for the environment. An important factor right from the start was to perform renaturalisation measures at other places, for example in the embankment forelands.





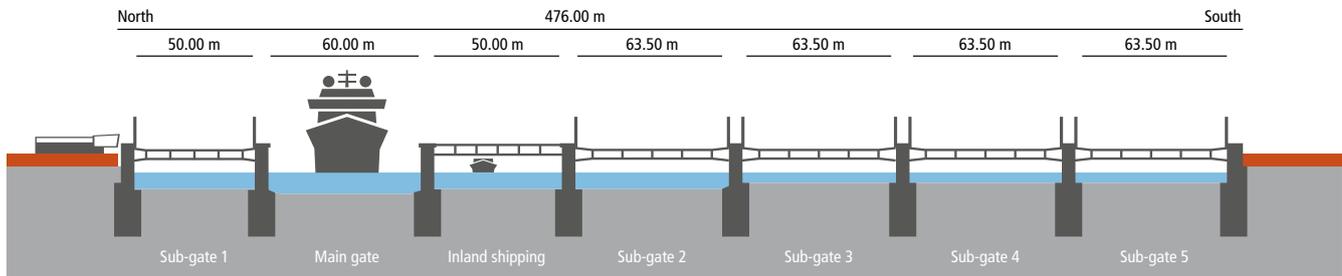
## THE EMS BARRIER AND 'MASTERPLAN EMS 2050'

The River Ems barrier of Gandersum was built between 1998 and 2002 and it has been in operation since September 2002. The enormous construction has fundamentally solved two problems: it serves as a storm-flood barrier and as a river dam and as such enables the passage of ships with draughts of up to 8.50 metres.

The River Ems barrier is one of the most modern barriers in Europe. The 476-metre long construction is operated and maintained by the Lower Saxony Water Management, Coastal Defence and Nature Conservation Agency (NLWKN). The barrier considerably improves the level of protection against storm tides and relieves not only the Ems but also the Leda-Jümme region with the Leda barrier. If a storm surge exceeds 3.70 metres above sea level it is closed. As a coastal protection mechanism, the barrier has proven its worth on multiple occasions and provides a higher level of protection than the former conventional modification of the 110-kilometre-long main dykes along the Lower Ems.

The dam function of the barrier largely secures the flexibility of shipping on the Ems between Papenburg and Emden. The water can be dammed up to a maximum height of 2.70 metres above sea level and enables ships with draughts of up to 8.50 metres to make their passage. Thanks to the barrier, it now only takes 12 to 24 hours for large cruise ships to pass through the Ems.

Compensatory measures were implemented for the construction of the barrier pursuant to the environmental guidelines. Additional hectares of salt marshes were created and feed bed biotopes planted on the south bank of the barrier and by the municipality of Hatzum. Despite all of this, the building of the barrier has triggered considerable discussion with the environmental associations BUND, NABU and WWF Germany, and has even involved the courts.



Despite all of the disputes directed at the construction and its environmental impact on the Ems, the focus was on maintaining a constructive and solution-oriented dialogue. By way of a settlement, the state of Lower Saxony undertook to provide nine million euros to improve the overall ecological situation in and around the Ems. In a further important step in this dialogue, MEYER WERFT and the environmental groups amicably agreed in summer 2009 to lay down clear regulations on the subject of bird protection and damming times for the Ems barrier.

### METICULOUS PLANNING FOR THE FUTURE

The possible damming time has been limited to 104 hours per year. Moreover, it only applies to the winter half of the year. The foreland must not be flooded during the actual nesting season, to protect the clutch and the rearing of young. Accordingly, ships are permitted to pass along the river from mid-July to the end of March. This regulation was agreed in close coordination with the environmental agencies. It has so far not been legally implemented.

Moreover, since 2009 political representatives and the three environmental agencies have entered into a dialogue to try to find solutions to the future of the Ems. The discussions have focussed on the renaturation of the Ems estuary and the Lower Ems. In later summer 2013, the tug-of-war surrounding the conservation activities on the lower course of the Ems finally ended. Since then, both the Lower Ems and the Outer Ems have been considered a European protected area in accordance with the Flora Fauna Habitat Guidelines (FFH).

A feasibility study in the construction of an Ems canal between Papenburg and Leer concluded that the project was technically possible but could not be financed (total estimated costs approx. 1.1 billion euros). Further attempts were made to devise solutions that were both economically viable and environmentally acceptable in the form of the „Perspective for a Viable Lower Ems“ project.

### MASTERPLAN EMS 2050

In early 2015 the 'Masterplan Ems 2050' was signed by all involved parties in northwestern Germany. A permanent measures package was agreed for the future handling of the river. This dealt with environmental problems such as silting and oxygen depletion in the Ems but also took into consideration the economic utilisation of the Ems. The state of Lower Saxony undertakes to provide 700 hectares for compensatory nature conservation. The initial sum of 22 million euros has been set aside to cover a period of three years. With the 'Ems Master Plan 2050', the state of Lower Saxony, the federal government, the districts of Emsland and Leer, the nature conservation organisations and MEYER WERFT undertake to accept joint responsibility for the Ems region as a nature, economic and living zone. First positive results has been recognized already after one year.

# THE IMPORTANCE OF THE SHIPYARD TO THE REGION



**MEYER WERFT is of great economic importance both to Lower Saxony as a whole and the Weser-Ems region in particular. This was confirmed once again by an independent report by the Lower Saxony Institute for Economic Research in October 2014. The report was commissioned by the districts of Emsland and Leer.**

As the city's primary employer, the shipyard employs more than 3,300 people in Papenburg. Added to this are 2,200 further jobs with indirect suppliers plus 200 with direct suppliers. The report assumes an effective employment rate of approximately 21,000 full-time jobs in Germany by 2017. The number of jobs dependent on the Meyer shipyard in Emsland and the district of Leer is now higher than was previously assumed. The proportion of advance outlay rose from 12 percent in 2008 to 21 percent in 2012. A fifth of supplier companies in the region also profit from the technological impetus and innovation initiated by MEYER WERFT.

The shipyard is not only an engine of employment for the region but it also invests sustainably in know-how and specialists of today and tomorrow. Its employee base includes around 270 trainees in twelve different professions. Moreover, the company offers career starters the opportunity to take a dual course of study combined with practical periods in which theory and practice are closely enmeshed. Students of electrical engineering, mechanical and computer engineering and business administration obtain their bachelor qualification in a maximum of 4.5 years along with a trade proficiency certificate. The findings of academic theses supply fresh impetus for the rapid integration of innovations in everyday company activities.

Link to the Lower Saxony Institute for Economic Research:  
[www.niw.de/index.php/home.html](http://www.niw.de/index.php/home.html)

# ECONOMIC DATA WITH RESPECT TO THE SHIPYARD



## Employees

There are 3,300 people who are directly employed at MEYER WERFT, 94% of whom live in the districts of Emsland and Leer. The shipyard provides more than 21,000 jobs in total.

**3,300**

The total direct and indirect employment effect in the region and the districts of Emsland and Leer amounts to approx. 6,970 jobs.

**6,970**

The training activities and 270 training places at MEYER WERFT and its supplier companies make an essential contribution to improving the level of qualification in the region.

**270**

The average age of employees is 38 years and the average length of employment is 12 years.

**38**



## Suppliers

The total number of jobs at supplier companies is more than 14,400 – almost exclusively in Germany and the EU.

**14,400**

There are around 2,000 firms working as suppliers to the shipyard, with approximately 900 companies working on one ship.

**2,000**

According to a survey, almost 80% of suppliers enjoy benefits in other sales markets by virtue of their cooperation with MEYER WERFT.

**80**

Orders with a value of 200 million euros are awarded to suppliers in the region.

**200,000,000**



## Regional effects

MEYER WERFT is a regional tourist highlight that attracts around 250,000 visitors per year and creates approximately 340 full time jobs.

**250,000**

Around 60% of employees at the Papenburg shipyard own their own house.

**60**

The unemployment rate in the city of Papenburg is only around 4.5%.

**4.5**



## „THE CRUISE SHIP SECTOR FACES SERIOUS CHALLENGES!“

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Interview with Bernd Stecker, professor of leisure and tourism policy & planning, ecology and sustainability at Bremen University of Applied Sciences

**You are concerned on an academic level with the field of sustainability. How would you define the term?**

**Prof. Dr. Bernd Stecker:** I would liken it to the following principle: don't slaughter your cow if you want it to give milk tomorrow. The point is that whatever you do, your actions must allow future generations to live in an intact environment and an economically stable and just social system. It is generally accepted that there are three dimensions of sustainability, each of which are accorded equal value: ecological compatibility, social justice and economic performance ability. In the latter case, the focus is on far-sighted economic management rather than short-term profits. There is also a fourth level that refers to institutional sustainability.

**A company like MEYER WERFT that builds cruise ships is closely associated with the tourism and leisure industry. How far has the sector come?**

**Prof. Dr. Bernd Stecker:** Sustainability is becoming a factor of increasing importance and not just because of the major challenges facing the cruise ship industry. There are many companies that treat CSR as a central theme in their corporate policy. However, there is often a lot of so-called "green washing", but all efforts made must be meant seriously and they must undergo onward development.

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„Don't slaughter your cow if you want it to give milk tomorrow.“

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**What does this mean for business and sustainability efforts?**

**Prof. Dr. Bernd Stecker:** Companies have to find answers in several different areas. For instance, in environmental management the aim is to reduce emissions of CO<sub>2</sub> – which is damaging to the environment – by employing more renewable forms of energy and to minimise pollution of the air, water and soil. Part of this involves creating an awareness of the need for consistent environmental management among employees and suppliers. Moreover these efforts must be integrated within a permanent and intelligently constructed economic framework. There should be no exploitation, which means that the company must pay fair wages and take responsibility for the region in which is located.

In their purchasing policies, companies can act by choosing suppliers that operate a green policy and are located locally. Finally, every company must accept that ecological stress limits and social justice function as guide rails and they must remain inside these limits if they are to continue functioning economically in the future.

**There are differences of opinion when it comes to cruise ships. Can you appreciate the concerns of the conservationists?**

**Prof. Dr. Bernd Stecker:** The criticism is primarily directed at the diesel engines and the high level of contaminants that they emit, as well as the extremely high levels of air pollution found in the harbour areas. However, the industry meanwhile seems to be steering a different course, not least due to the more stringent legal regulations. A number of companies (e.g. AIDA Cruises) have announced that they will be fitting their cruise ships with modern exhaust fume technology. Alternative types of engines and fuels are also being tested. On-board technology can therefore become increasingly environmentally friendly.

**But?**

**Prof. Dr. Bernd Stecker:** Not many future visions are actually being implemented. The possibilities that exist must be adopted. One example is the alternative fuel LNG. It has meanwhile been proven that natural gas works as a transport fuel, and engines that use it have been developed but it is taking too long for them to be implemented. Even companies known for their pioneering spirit are being held back by the framework conditions or lack of infrastructure. This is also an area in which something needs to be done to enable the implementation of genuinely long-term solutions.

**Thank you very much for the interview.**



# 2.

## CORPORATE ENVIRONMENTAL PROTECTION



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# THE MEYER WERFT PRODUCTION CONCEPT

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For decades the name MEYER WERFT has been known internationally for its expertise in the construction of highly sophisticated ships, in particular cruise vessels. However, the shipyard also builds a wide range of special-purpose ships, such as car and passenger ferries, river cruisers, research vessels and gas tankers, all with a maximum of innovation and environmental friendliness. Irrespective of the type of ship, production at the shipyard always follows the principle of block construction. Moreover, automation processes and elements of series production have been adapted to allow the construction of prototypes and single vessels.



The shipyard has committed itself to “lean shipbuilding”. The central elements of this are a continual improvement process (CIP) and the application of lean management; these represent the Papenburg shipyard’s response to global competition. The goals are ambitious: the aim of lean shipbuilding is to increase working efficiency, promote constant improvement in all areas, enhance working methods and framework conditions, eliminate waste and increase added value.

The aim is to consolidate the position of the shipbuilding company in the market and secure its future through high customer satisfaction, shorter throughput times and increased competitive ability.

## THE COMPLEX PROCESS CHAIN

The aim and scale of the shipyard’s approach to production is to build all common types of ship efficiently and involving the shortest possible distances. Since 2008 MEYER WERFT has been operating one of the biggest shipbuilding hall in the world (length 504 metres, width 125 metres). The ships in the docks on the Ems are constructed from prefabricated segments and blocks. First, sections are made from steel panels, which in turn are formed into blocks. At least 70 such blocks are required to form the final vessel, which can easily weigh up to 50,000 tonnes. The interior furnishings and technical equipment in the ships are also, as far as possible prefabricated before they are installed in the ship’s interior. By employing a modular construction method based on individual prefabricated blocks, it is possible to build a ship highly efficiently in a very short space of time. For example, equipment and interior fittings can be installed in the ships simultaneously. All processes are customised and merge from one to the next. An extensive proportion of the production process is digitised and projects can be tested virtually using 3D simulation and logistics processes are computer-supported. All of these factors save time and costs.



## FLOATING CITIES

The construction of a cruise ship is highly complex and is often described as akin to developing a small city. The aim is for passengers to enjoy a rich, contemporary range of leisure activities and services, which demands considerable know-how in the construction of such ocean giants. The resulting "floating city" caters for all modern comforts including a theatre, cinemas, shops, fitness centres, catering kitchens, restaurants, casinos, suites and even hospitals. All of this necessitates the installation of fresh water generators and waste and sewage treatment systems on board the vessel.

At MEYER WERFT, special attention is devoted to production processes that affect the environment. These include activities such as welding, grinding, not work, coating and cleaning, as well as the subsequent testing and ultimate commissioning of the ship. Also of environmental relevance are the packaging and transport protection materials used for the various equipment units needed for construction.

## CLEAR RULES OF COOPERATION

The shipyard is committed to transparency and conducts constant screening of all environmentally relevant processes, procedures and input products – not always an easy undertaking. Throughout the whole production process, not only must the company's own employees but also suppliers and subcontractors be accommodated in the information chain. The construction of a cruise ship, for instance, involves more than 5,000 people working at the shipyard. Moreover, depending on the order, there may also be changes among the suppliers and subcontractors used. Information must be kept up to date. In 2013 the shipyard compiled a code of conduct for suppliers, which defines clear rules of cooperation.

# ENVIRONMENTAL MANAGEMENT AND DATA

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**At the shipyard, modern procedures are not only of great value in shipbuilding processes. For the last two years MEYER WERFT has also been devising contemporary corporate environmental protection procedures and has on several occasions served as a pioneer for other shipbuilding operations. The company is committed to sustainable environmental management and data-based environmental control.**

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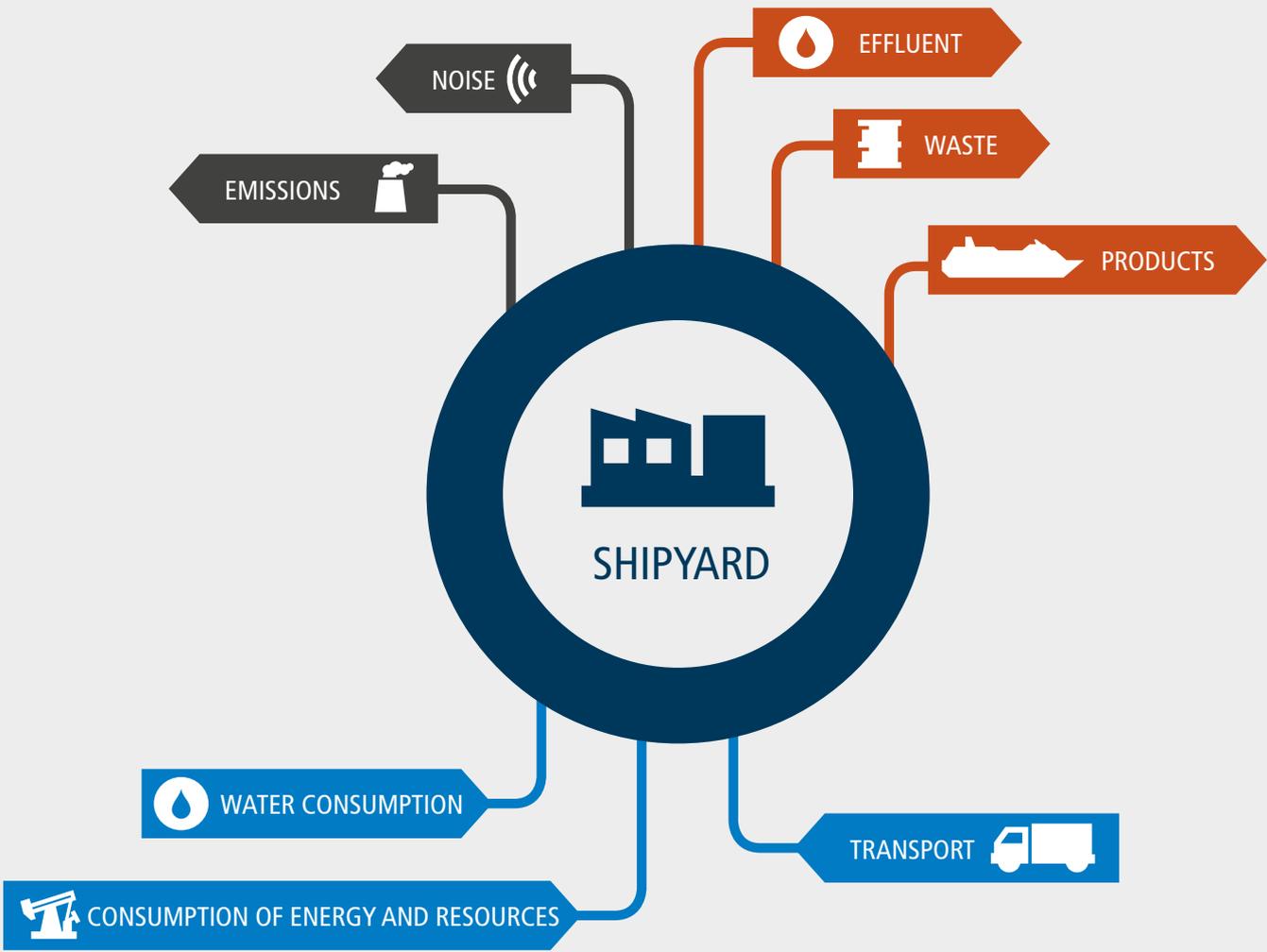
All internal operational processes and flows are inspected with regard to their environmental compatibility. Environmental protection on the shipyard is firmly rooted in the company's corporate principles and is far more than just a statement on paper. At the Papenburg shipyard there is a central office dedicated to all matters relating to environmental protection. The aim of this coordinating office is to promote continual improvement of corporate environmental protection, for example through regular evaluation of internal environmental audits.

## CENTRAL DATA COLLECTION FOR ENVIRONMENTAL PROTECTION

An indispensable tool and core element of all activities surrounding corporate environmental protection is the environmental software developed by MEYER WERFT for its own use. This software enables all environmentally relevant data and information relating to the management of materials, waste, water and energy to be gathered, structured, evaluated and communicated. This benefits both employees on the shipyard and suppliers. Extensive data relating to all environmentally relevant aspects of the operation is continuously fed into the system and processed. Elementary requirements of this database are that it is always kept up to date, presents data in an easily understandable way, can be easily integrated into existing computer-supported structures on the shipyard and allows an up-to-date view of developments in environmental law.

The software filters heterogeneous information to facilitate the transparent presentation of data. At a glance, users can display tables, graphics or small animations of all environmental data relevant to their needs. This includes, for example, what material and energy flows are currently entering the shipyard and, in turn, which flows are exiting the premises as products, waste, emissions or waste water. In this way, ecological weaknesses, such as the increased incidence of waste, can be detected at an early stage and targeted research can be initiated to determine the cause.

So-called material and energy balances are the bottom line for companies aiming for optimum ecological development and sustainable process optimisation. These balances provide a transparent picture of all operational material and energy flows and give an overall view of the inputs and outputs of material and energy. For MEYER WERFT, this involves a detailed analysis of substances brought in on the input side (materials, auxiliaries and operating consumables) and energy (electricity and natural gas) as well as, on the output side, the ships as products and also emissions (exhaust air, noise, waste water, waste, etc.).



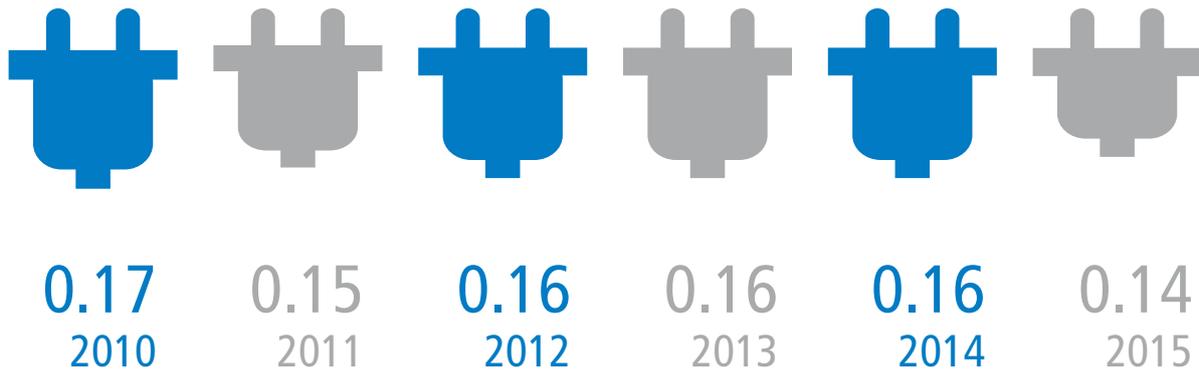


# INPUT

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The basic economic principle by which MEYER WERFT works is to make careful use of energy and resources. The input side of the balance includes both substances (materials, auxiliaries and operating consumables) and energy (electricity and natural gas).

# ENERGY AND RESOURCES



## Electricity consumption (MWh/GT)

To enhance climate protection, the conservation of resources and its economic competitive advantage, the company is working constantly to ensure its efficient use of energy. In recent years, energy consumption on the shipyard has been reduced significantly. The theme of energy efficiency remains of central importance in industrial operations. It is one of the most important energy sources, not only now but also and particularly in the future. MEYER WERFT is already recognised as one of the cleanest and most environmentally friendly shipyards in Europe.

### ENERGY MANAGEMENT

Good, effective environmental management is of paramount importance. After all, energy expenses are a not inconsiderable cost factor in a shipbuilding company. In this context, MEYER WERFT is in close exchange with the Oldenburg energy company, EWE, the aim being to sustainably improve its own energy management whilst discovering additional energy saving potential. In August 2015 an energy management system pursuant to ISO 50001 was implemented.

### LONG-TERM REDUCTION IN ENERGY CONSUMPTION

The shipyard strives to handle its energy and resources as efficiently and economically as possible. As an example, relative electricity and natural gas consumptions have been lowered in the course of a decade. Minimising energy consumption and reducing emissions remain of central importance to the shipyard – not only due to the fundamental requirement of environmental law to reduce CO<sub>2</sub> emissions.

In recent decades, contemporary measures have been repeatedly taken to improve operative energy efficiency at MEYER WERFT.

- The shipyard decided early on to install condensing boilers. In use since 1988, these boilers consume low quantities of fuel and function highly effectively at low temperatures.
- New technologies and energy-saving systems such as inverter-based welding machines, which require considerably less no-load current, are also deployed in high-tech companies.



- Air-conditioning and ventilation systems are controlled by sensors and regulate themselves automatically according to their place of operation, the time of day, and operating requirements. Moreover, an environmentally friendly air supply and extraction system has been installed in many of the shipyard's buildings. Air in the halls is cooled or heated by means of earth and component cooling. The system is regulated by a computer-supported building-control system. In addition, the temperature in the halls and workshops can be set and controlled automatically. New facilities and buildings includes latest control systems and energy-saving measures, such as exploiting geothermal heat and cooling.
- Heat recovery systems in the compressed air areas serve to lower energy consumption. Heat is recovered from buildings by means of heat exchangers and is fed to the shipyard's utility water system. As a result, boiler units can be fully dispensed with in the summer months.
- Lamp systems are gradually being refitted with low-energy and LED bulbs.
- Since 2009 the shipyard has been generating renewable energy. A solar-power system with an area of 250 m<sup>2</sup> has been installed at the large construction dock. Hot water is produced from the 100 collectors. This represents an energy saving of around 30 percent per year for hot water production on the shipyard, corresponding with a reduction of 41,500 kilograms in CO<sub>2</sub> emissions.
- In the most recent measure, many office roofs in the company premises have undergone greening, while in 2012, the administrative building was given an energy-optimised facade. A new Design Center and the new offices for the Site office teams were built by state-of-the-art technical standards. These steps have led to a further reduction in energy consumption.



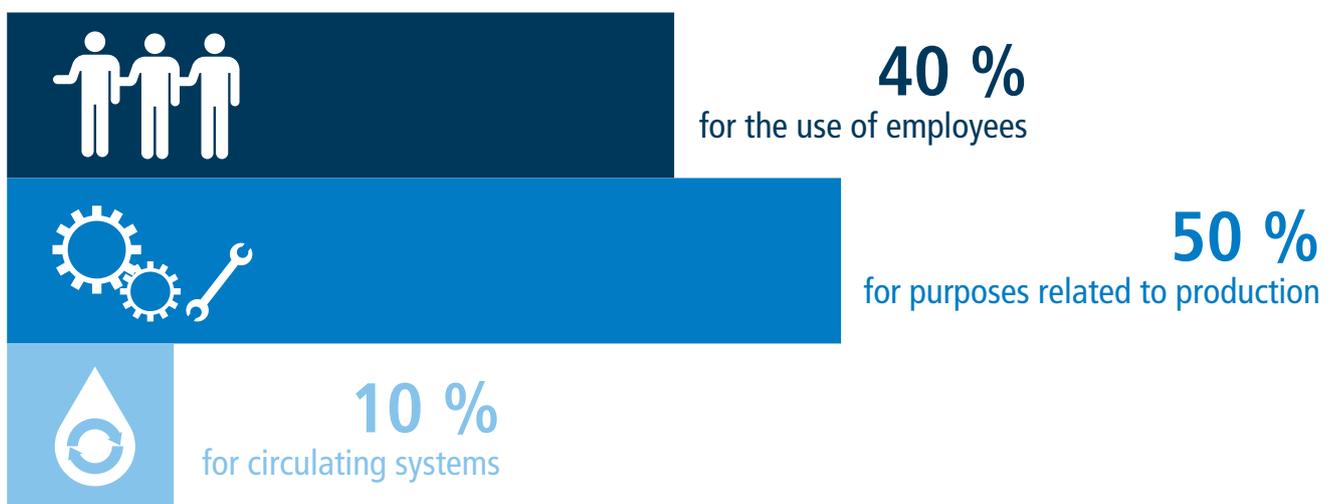
Natural gas consumption (cbm/GT)

# WATER CONSUMPTION



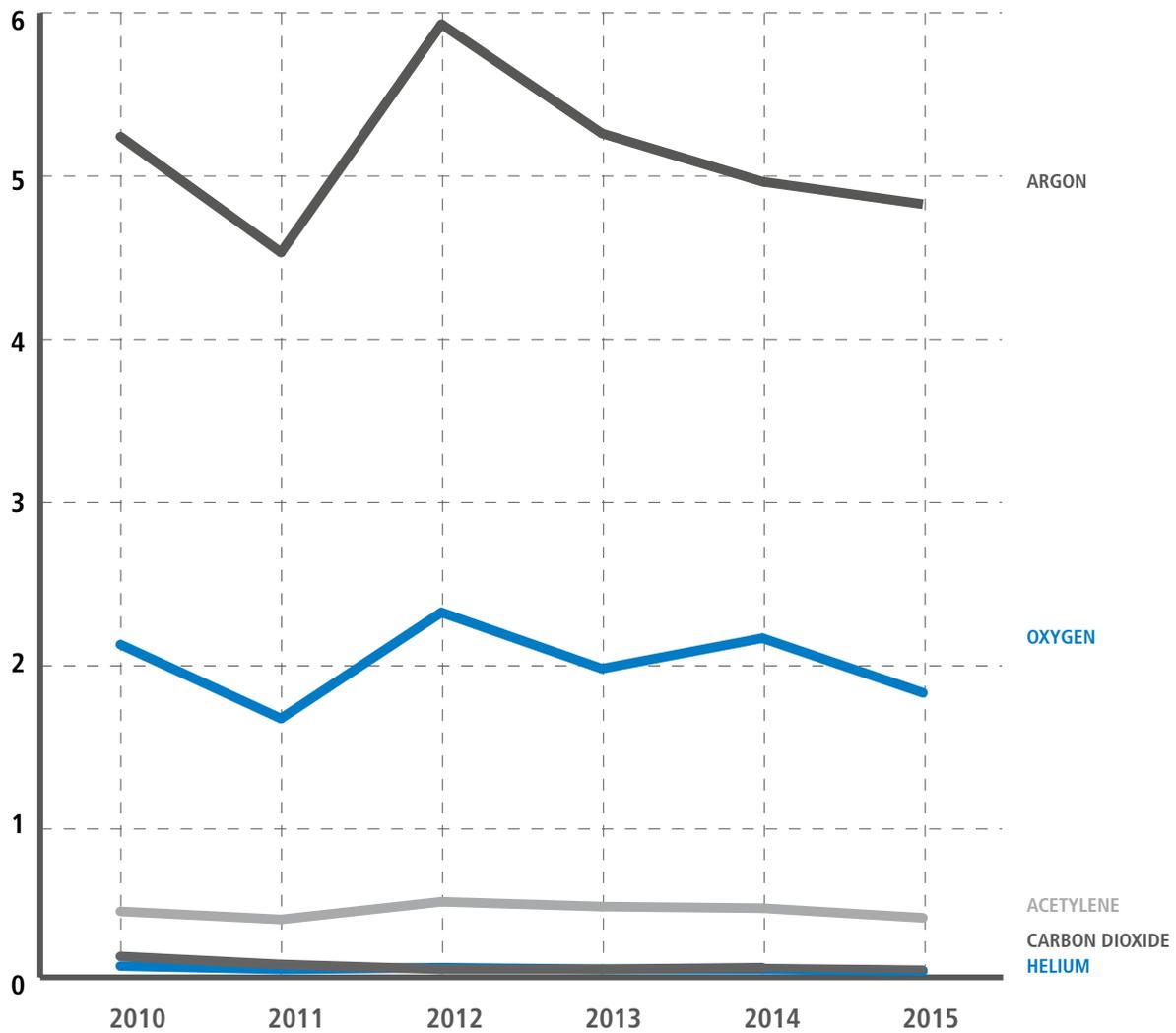
Drinking water consumption (cbm/GT)

Water is not just the medium that ships sail through once they have left the shipyard. It is also drinking water and, as such, it is a resource that is becoming increasingly scarce. Alongside oil scarcity, scarce water supplies are the main resource-based problem facing us in the future. For this reason, the sustainable use of drinking water at MEYER WERFT is of central importance. The relative consumption of drinking water over the course of the years shows a slightly falling trend.



Drinking water consumption subdivided into three areas

# TECHNICAL GASES



For the shipyard, technical gases are elementary consumable substances. They are used in metal-working processes such as welding and cutting. Over recent years, relative consumptions of the various gases have remained constant or even display a falling trend (see graphic). Gases used at the shipyard include:

- Acetylene
- Carbon dioxide
- Nitrogen
- Helium
- Oxygen
- Argon



# TRANSPORT

Large, technically complex projects would not be possible without a well-functioning logistics system. Thousands of individual parts and components are installed on board a cruise. All processes and areas in shipbuilding must be coordinated perfectly and the right components must always be in the right place at the right time.

Building ships like those at MEYER WERFT not only demands engineering craft and technical know-how but also logistical performance of the highest calibre. To enable internal transport processes to be as environmentally compatible as possible, the company began at an early stage to dedicate itself to the field of "green logistics". More than a decade ago, the shipyard introduced an innovative, automated transport control system, which plans and performs transportation on the premises as well as logistical processes in real time. The new system has not only made it possible to deploy forklifts and in turn considerably reduce vehicle exhaust emissions but, by controlling their deployment according to requirements, empty journeys can be avoided, transport vehicles operated at optimum capacity and material flows consistently traced. This process is again supported by contemporary computer technology. The forklift driver can view regularly optimised transport flows on the display in his vehicle terminal.

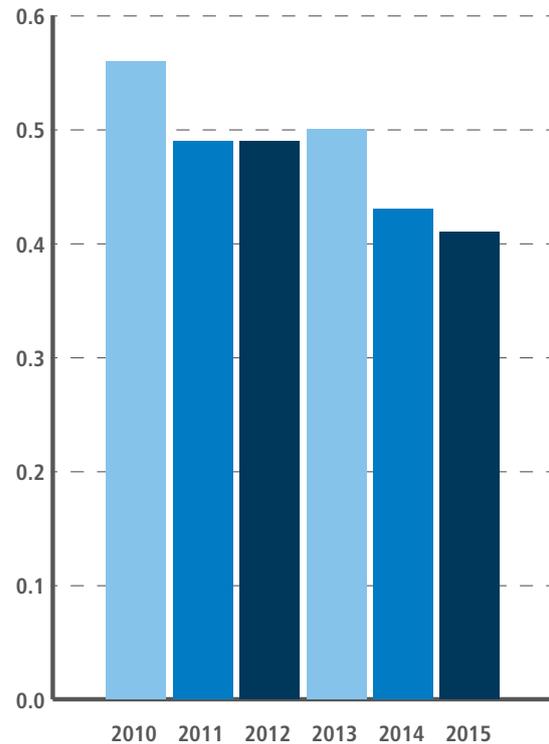
The shipbuilding company's sustainable logistics processes are based on a concept of short distances, a sophisticated transport control system, as little truck transport as possible, and the use of low-emission vehicles. MEYER WERFT repeatedly seeks out alternatives to diesel to allow forklifts, Mafi trailers and heavy-goods transporters to run on environmentally friendly fuel. Biodiesel made from rapeseed oil methyl esters has been used at the shipyard as vehicle fuel since 1994.

Although biodiesel was seen at the time as an advancement in terms of environmental balance, the production of biofuel remains disputed. The disadvantages include the ecological and geological consequences that can result from the one-sided cultivation of rapeseed. Moreover, biodiesel emits a higher quantity of exhaust fumes, such as nitrous oxide, that are known to deplete the ozone layer. The use of biodiesel is also accompanied by the eutrophication of surface waters and contamination of water bodies from pesticides and nitrates.

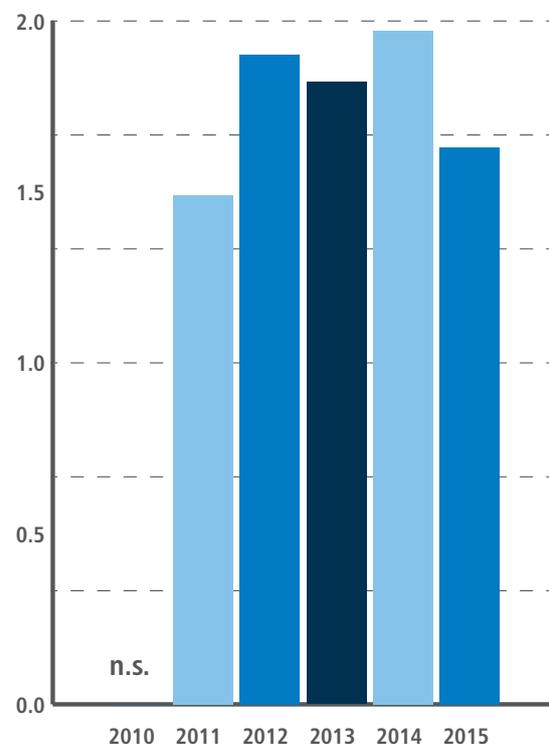
### CONVERSION TO LIQUID GAS

For these reasons, the shipyard has stepped up its efforts to find alternatives. All forklift and industrial trucks have been converted for use with liquid gas and a catalytic converter. The main advantages of this are that liquid gas does not pollute the air with soot, and the low level of contaminant emissions is very environmentally friendly. Liquid gas engines with catalytic converters also release far lower emissions of carbon monoxide (CO), hydrocarbons (HC) and nitrogen oxides (Nox) than diesel engines.

It is not just because of the environment that conversion to liquid-gas operation is worthwhile, but it also benefits engines. Liquid gas ensures low-noise, smooth and elastic engine running characteristics. The virtually residue-free combustion increases the engine's service life. Not only does this protect the environment thanks to the decrease in air pollution, but it also saves on vehicle maintenance costs and repurchasing.



Fuel consumption in industrial trucks (litres/GT)



Liquid gas in industrial trucks (litres/GT)

# HAZARDOUS SUBSTANCES

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Safety has always been a major factor in the field of shipbuilding. The use of hazardous substances in shipbuilding can never be fully avoided, but the risks of their use can be minimised. Worker's health and safety at MEYER WERFT are of central importance to the company. To ensure optimum conditions, the company employs innovative occupational safety methods.

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For instance, there are joint operational instructions within the company for the safe and environmentally friendly handling of hazardous substances. To avoid unnecessary piles of paper, this is in the form of a modern IT database. The database of environmentally dangerous products and hazardous substances is structured so that a single click will display the relevant product information. It has been constructed in collaboration with the company's occupational safety department and undergoes continual modification. Moreover, any supervisor can print out the current operational instructions directly from his computer. The compiled information has proven to be a practical tool for instructing industrial employees in the workplace.

Furthermore, to illustrate the safe use of substances that are potentially dangerous to the environment and health on the shipyard, a special instructional film "How to work safely at MEYER WERFT" has been made. This explanatory film has been created in seven different languages to ensure that all employees of all nationalities working at the shipyard can understand and comprehend the measures. In addition, a safety brochure has been compiled to inform new employees and suppliers of the shipyard of existing safety and environmental regulations in force at the shipyard, along the lines of the energy management measures.

MEYER WERFT has already amassed good results in reducing the use of hazardous substances. For instance, it has been on the lookout for alternative cleaning agents for cleaning oily components. Component washing stations used at the shipyard have been re-equipped from hydrocarbon mixtures to aqueous cleaning agents. As a result of this conversion, solvent emissions and waste products can now be avoided and environmental protection improved. Additionally, the occupational health and safety of the employees has also increased.

Further demonstrable success has resulted from a process change at the main engine suppliers. Rather than applying a thick layer of wax to protect engines, only a thin film is now used. This has been found to suffice as a protection against corrosion, since the engines are installed directly at the shipyard. The considerable time and effort involved in cleaning that used to be needed has now been minimised. This not only requires a smaller amount of cleaning agent but also results in considerably less waste water.





# OUTPUT

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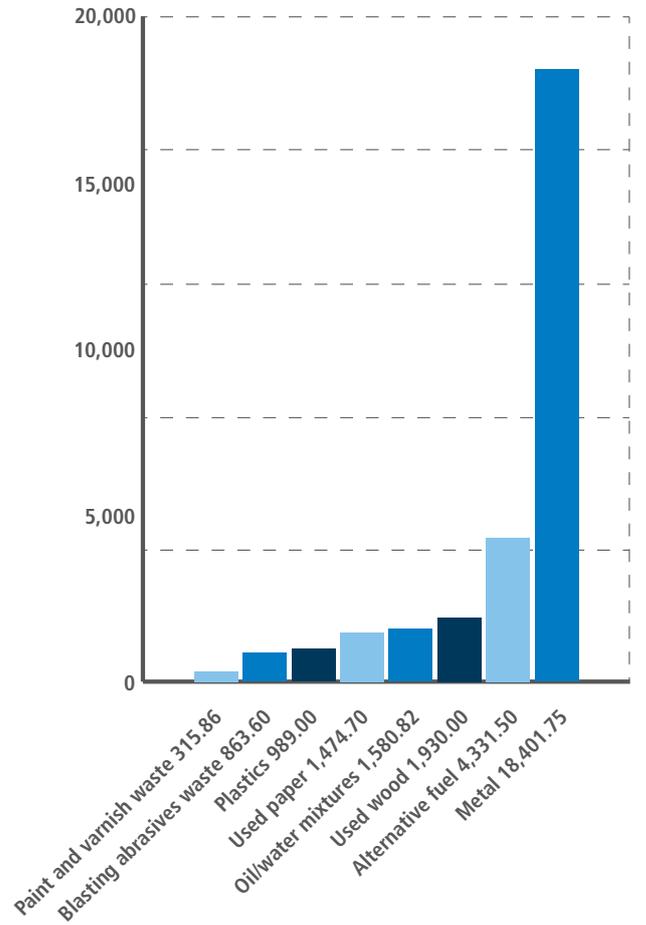
The output side of the balance waste products, material and noise emissions and waste water.

# WASTE

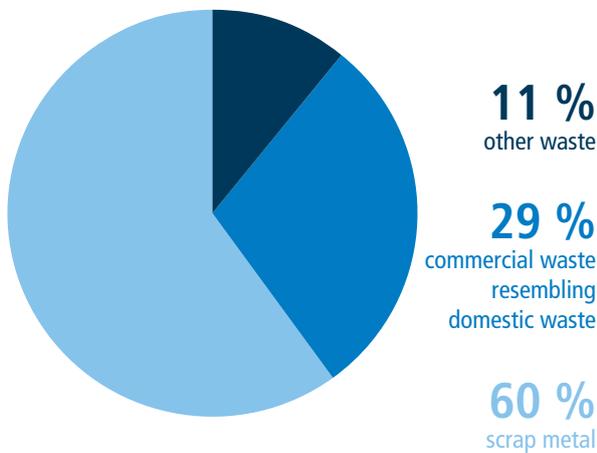
As in any company, the production of waste is unavoidable in a high-quality shipbuilding operation and it is not always possible to independently control the quantities of waste occurring.

A large proportion of waste at the shipyard is scrap metal of a wide variety of types as a result of strict fire regulations. This scrap metal accounts for at least 66 percent of the total waste product occurring at the shipyard and is all given over to recycling. Every year, up to 20,000 tonnes of scrap are produced. The metal is sorted and re-used in the metal production area.

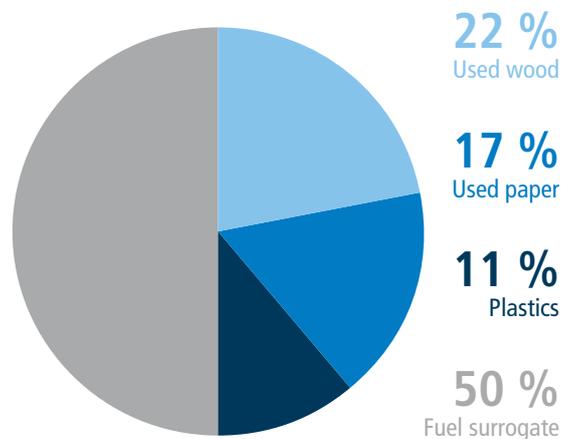
Scrap metal is one of three waste components produced at the shipyard. The second component, with a total of around 26 percent, is primarily packaging waste, which can be described as industrial waste comparable to domestic refuse. The third component, which represents 8 percent of the total waste produced, comprises various miscellaneous types of waste product.



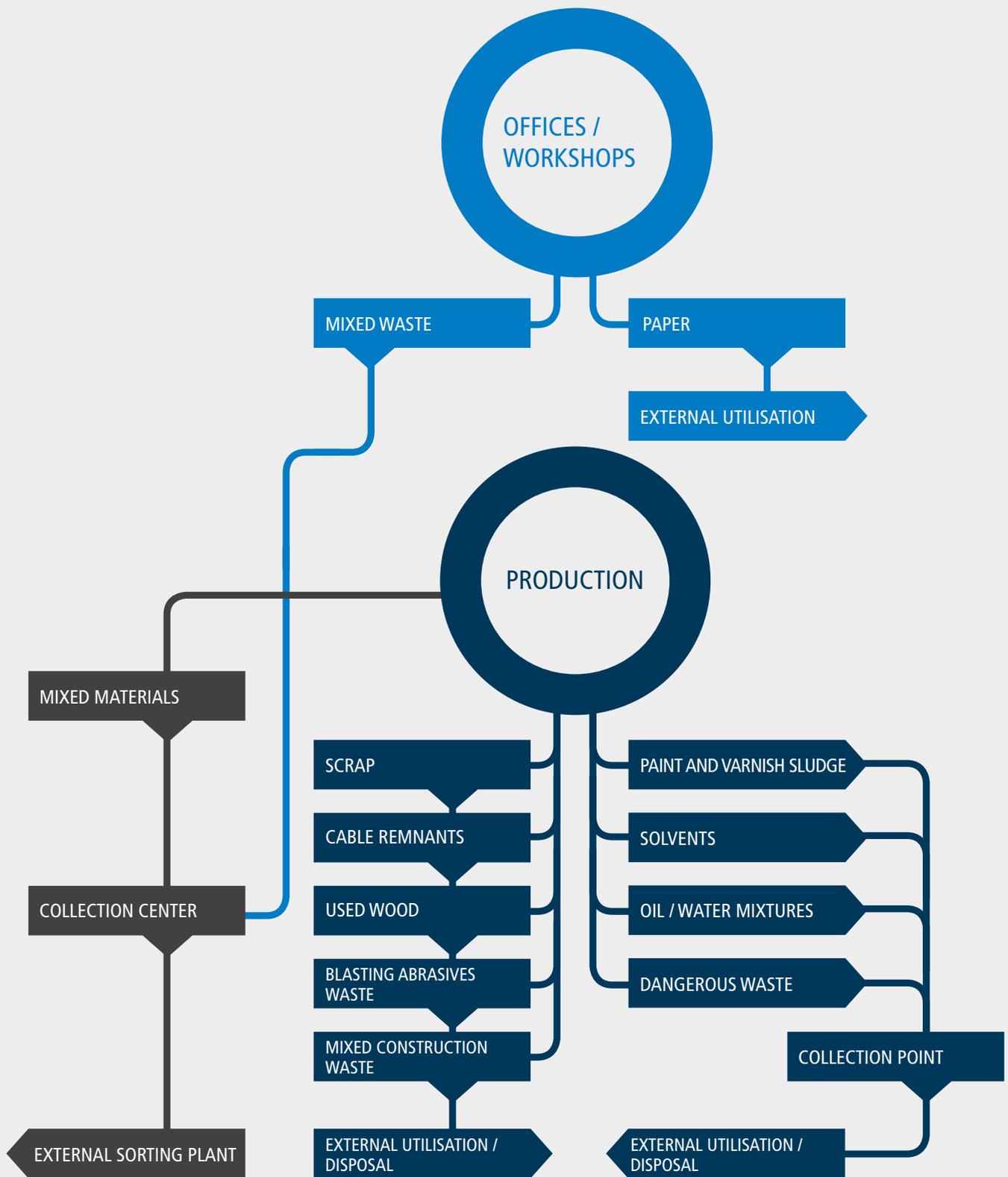
Waste in tonnes



Percentage distribution of waste quantities



Percentage distribution of waste similar to domestic refuse



# WASTE FLOW

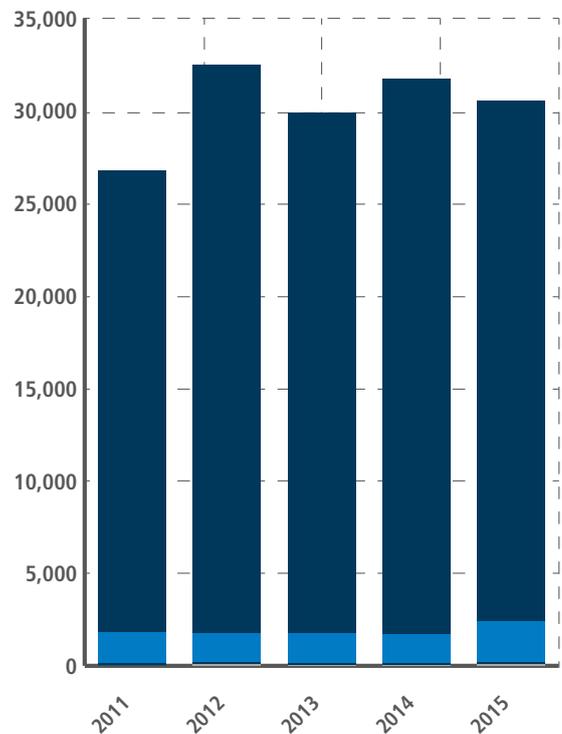
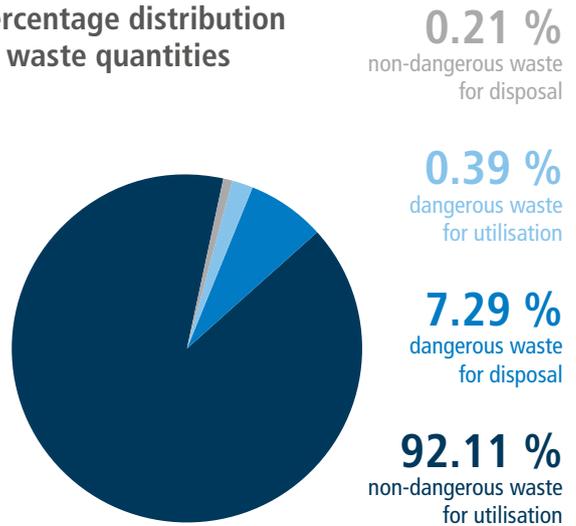
# RECYCLING WHEREVER POSSIBLE

The recycling of waste is an essential part of the shipyard's general waste management concept. In autumn 2005 a new recycling hall was built on the premises, which is divided into two sections. In one section preliminary sorting of hazardous substances is performed and readied for collection by specialist disposal companies.

These hazardous substances are primarily paint and varnish sludge, solvents, waste products from the paint shop, oil/water mixtures, old oil and operating materials contaminated with oil and grease. Furthermore, a recycling system for non-hazardous blasting grit residue has been set up at the shipyard. Despite the considerable expense involved, the company make this decision in order to keep the level of ecological contamination to a minimum.

In the other half of the hall, commercial waste resembling domestic refuse is collected and compressed for transport with the aid of compactors. This waste is then taken to a local specialist disposal firm that operates a modern waste sorting system. It is separated into recyclable materials, such as old wood, waste paper or plastic, which are re-used. All remaining residual waste is subjected to thermal or mechanical-biological disposal.

Percentage distribution of waste quantities



- non-dangerous waste for disposal
- dangerous waste for utilisation
- dangerous waste for disposal
- non-dangerous waste for utilisation

Waste in tonnes

# WASTE AVOIDANCE

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Waste avoidance is accorded top priority at MEYER WERFT. The company has been doing its utmost for many years to minimise the amount of waste occurring at the outset, in keeping with the life-cycle management law's principles of "avoidance comes before recycling" and "recycling comes before disposal". Approximately 95 percent of waste created at the shipyard is recycled.

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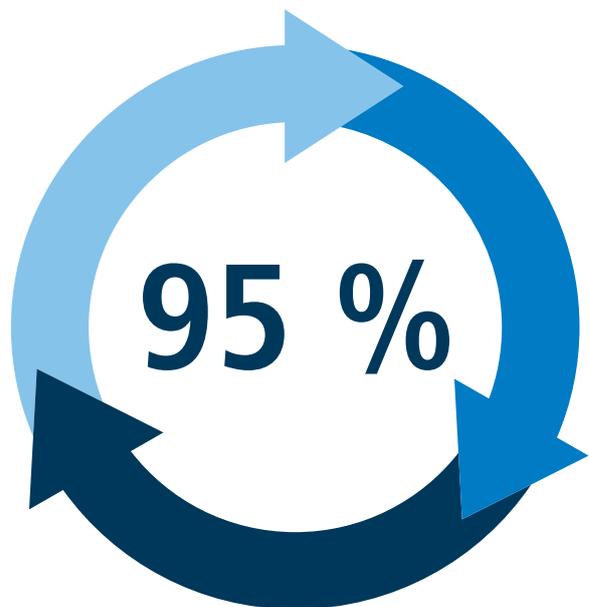
One scheme that has proven effective in reducing waste is the introduction of a container warehouse. Here, suppliers are provided with containers for their material deliveries and materials can be stored on the premises whatever the weather conditions, which also reduces the amount of packaging required.

Further effective measures have been initiated, aimed at reducing the volume of waste produced. Wherever possible, single-use systems are being replaced by returnable systems. By installing pre-manufactured cabins and balconies, it has been possible to minimise the amount of packaging material on board. In addition, various collection vessels have been implemented in and near ships that serve to avoid the build-up of unsorted refuse, while also considerably reducing the risk of fire.

All of the measures implemented rely on the integration of the shipyard's suppliers in the process.

It has even been possible to effect a constant reduction in the incidence of hazardous waste products, for instance by treating solvents in a distilling system on the premises. This allows solvents to be put to multiple uses and avoids the unnecessary consumption of expensive original diluting agents for cleaning.

With a growing market, the number of cruise ships produced and the growth in vessel volume, the overall tonnage of both hazardous and non-hazardous waste destined for disposal and recycling has risen. Nevertheless, MEYER WERFT's aim is to maintain a constantly high proportion of recycling at all times.



# MATERIAL EMISSIONS

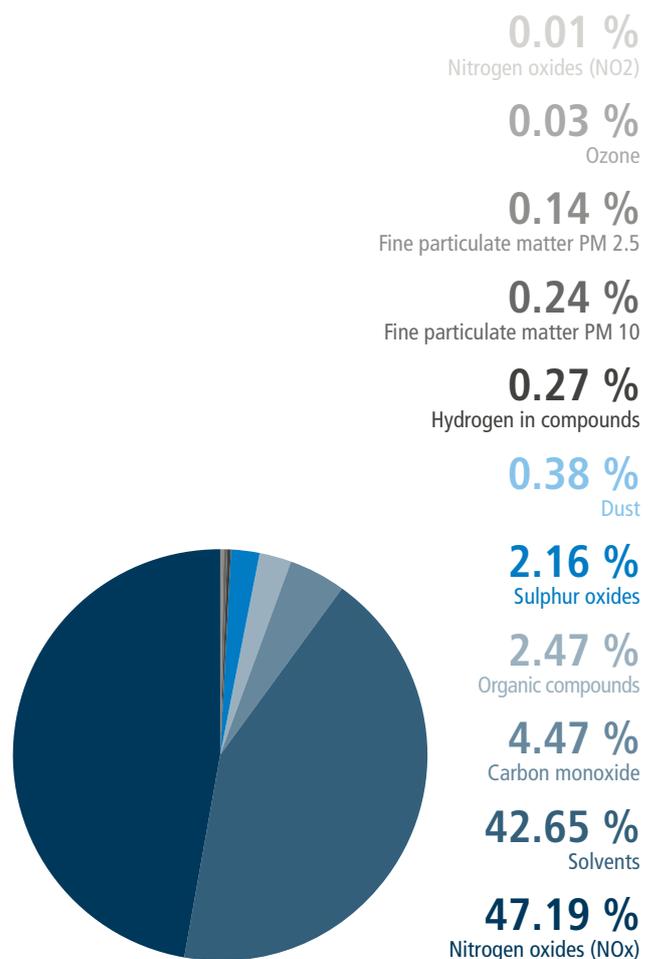
Welding, grinding and other hot work activities, coating and cleaning processes and ship testing and commissioning are the prime causes of material emissions. The substances emitted include solvents, nitrogen oxides, carbon monoxides, organic compounds and sulphur oxides. The biggest proportion at emissions on the shipyard are attributable to solvents used in paint conservation and nitrogen oxides emitted by combustion processes.

## EMISSIONS DECLARATION 2012

Operators of industrial facilities are required by law to submit an emissions declaration every four years. This state emissions declaration (Eleventh regulation on the implementation of the Federal Emissions Control Act) was first implemented in 2008. Accordingly, MEYER WERFT is required to determine all the substances emitted from its plants and to pass on the data to the Federal Ministry for the Environment, Energy and Climate Protection. The next emissions declaration is due for submission in 2016.

## INTERNET DATA PORTAL – THRU.DE

In only a few clicks, the portal Thru.de (operated by the Federal Environment Agency) displays relevant data relating to emissions in air, water and soil originating from large industrial facilities in Germany. As of 2012 Thru.de has succeeded the Pollutant Release and Transfer Register (PRTR); data has been collected and published in the register since summer 2009.



## Distribution of emitted substances

Thru.de is carrying on this function and compiles information on the quality of the environment in Germany based on detailed company data. For instance, it examines how many contaminants are emitted into the environment by industrial facilities and how much waste they dispose of outside their premises.

Link to the Federal Environment Agency portal:  
[www.thru.de/thrude/?L=3&cHash=f424ac14fa0a6d3946e1af756bdbc210](http://www.thru.de/thrude/?L=3&cHash=f424ac14fa0a6d3946e1af756bdbc210)



The regulations on solvents have been limiting the emissions of volatile organic compounds (VOC) since August 2001. The regulations cover a broad spectrum of various organic substances and represent the implementation of European law in Germany. Of central importance is the use of organic solvents in certain facilities. The regulations were moderated in 2013.

From an environmental point of view, solvents are a core aspect of the emissions of volatile organic compounds. At MEYER WERFT, solvent emissions make up the biggest percentage. One way of reducing these dangerous emissions is to employ so-called "water-based shop primers", a fast-drying anti-corrosive primer. A partner company, ND Coatings, from Papenburg, was established in 2011. A blasting, straightening and priming plant for series production was put into operation there in September 2014, until now the only facility of its kind in the world.

## REGULATIONS ON SOLVENTS



Solvent emissions are thought to be an essential factor in the formation of high ground-level ozone concentrations in summer, also known as summer smog. The aim of the solvent regulations is to reduce emissions in certain types of facilities, including shipyards.

The shipyard has been on the lookout for alternative procedures for a long time. Great attempts are being made to devise new approaches, including using innovations by the shipbuilding supplier ND Coatings, and establishing low-solvent or solvent-free coating systems for ship protection. Increased use is being made of water-based acrylate coatings in ship interiors and of solvent-free epoxy coatings in tank coatings.

# ALTERNATIVE ANTI-FOULING COATINGS



Intensive research is being conducted into future underwater coatings that protect against the growth of algae with a focus on both ecological and economic needs. A research project conducted at the Fraunhofer Institute for Mechanics of Materials between 2009 and 2013 delivered promising results, involving an electrically charged ship coating that kept the hull of a ship free of algae.

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The “GANaS” (Controlled anti-fouling layer system made from nanocomposites for shipping) project, funded by the BMWi (Federal Ministry for Economic Affairs and Energy), has developed an environmentally friendly alternative. The electrochemically active coating system creates regularly changing pH values on the surface of the ship’s hull, which prevents the build-up of algae, nodules and shells without having to resort to biocides. A newly developed paint was tested in everyday use over a nine-month test phase using a boat from the fishery inspectorate in Mecklenburg-Western Pomerania. It was shown to hinder algae growth and increase the durability of the anti-fouling coating.

Unwanted colonisation in the underwater surface not only creates favourable conditions for the corrosion of the ship’s hull but also causes financial damage of a magnitude of billions every year. The deposits increase the hull’s roughness and decelerates the ship in the water. Depending on the extent of the problem, this can increase fuel consumption by up to 40 percent. With a large container ship, bio-fouling can result in additional annual costs of several million euros.

Nanotechnologies and other processes based on silicones and associated developments are seen as alternative coatings for the future, although they have been in use for several years already at MEYER WERFT. Ultrasound has also proven its effectiveness in practice and is being treated as a further alternative to anti-fouling paints.

The search for environmentally friendly solutions is, however, nothing new. The pursuit of new types of anti-fouling coatings has been going on for several decades. MEYER Werft is one of the initiators of innovative coatings. For over a decade, the company has been searching for a way of establishing new environmental standards in shipbuilding, and it has been using TBT-free anti-fouling coatings for many years. The latest technical developments are being implemented at the shipyard; both the environment and customers stand to benefit from this.

Only a few years ago in 2008, the shipyard entered new shipbuilding territory with the development of a new fluoropolymer-based underwater coating developed from silicon. The smooth, non-adhering coating contains no chemicals or pest-control microorganisms. Unlike conventional methods, this underwater system only needs four coatings and not up to seven as was previously required. By treating the hull with this underwater coating, not only is less solvent required but fuel consumption can also be reduced – so far a potential average saving of up to eight percent has been indicated. Following the success of the pilot project in 2008, subsequent new ships have also been treated with this new underwater coating.

#### CONSISTENT REDUCTION OF POLLUTANTS

In 2011 MEYER WERFT established a supplier in Papenburg named ND Coatings which specialises in the fields of corrosion protection, surface treatment and insulation. Using modern technologies and new production facilities, the company cleans and prepares processing surfaces and applies the subsequent coatings.

ND Coatings coordinates and conducts all preservation painting activities up until the end of the warranty period. Of central importance here are product quality and customer satisfaction as the corrosion protection of a ship is an indication of its quality. All painting activities are performed in accordance with current ISO and VSM (German shipbuilding and ocean industries association) standards and in line with the IMO-PSPC standard for tank coating. The company is one of the “Top 100 innovators 2014”.

## PAINTING HALL

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Optimising production processes, increasing efficiency and enhancing quality are all factors that concern innovative companies wishing to position themselves ahead of the competition. To optimise its production processes, MEYER WERFT decided to encase blocks to be coated using modules in a scaffolding structure. In addition, the end faces of the blocks are covered with canvas and sealed, closing them off completely from unwanted emission sources. Once in the enclosure, the blocks are in final painting, and shipyard workers can significantly enhance the quality of the coating while increasing efficiency.



## ECODOCK RESEARCH PROJECT

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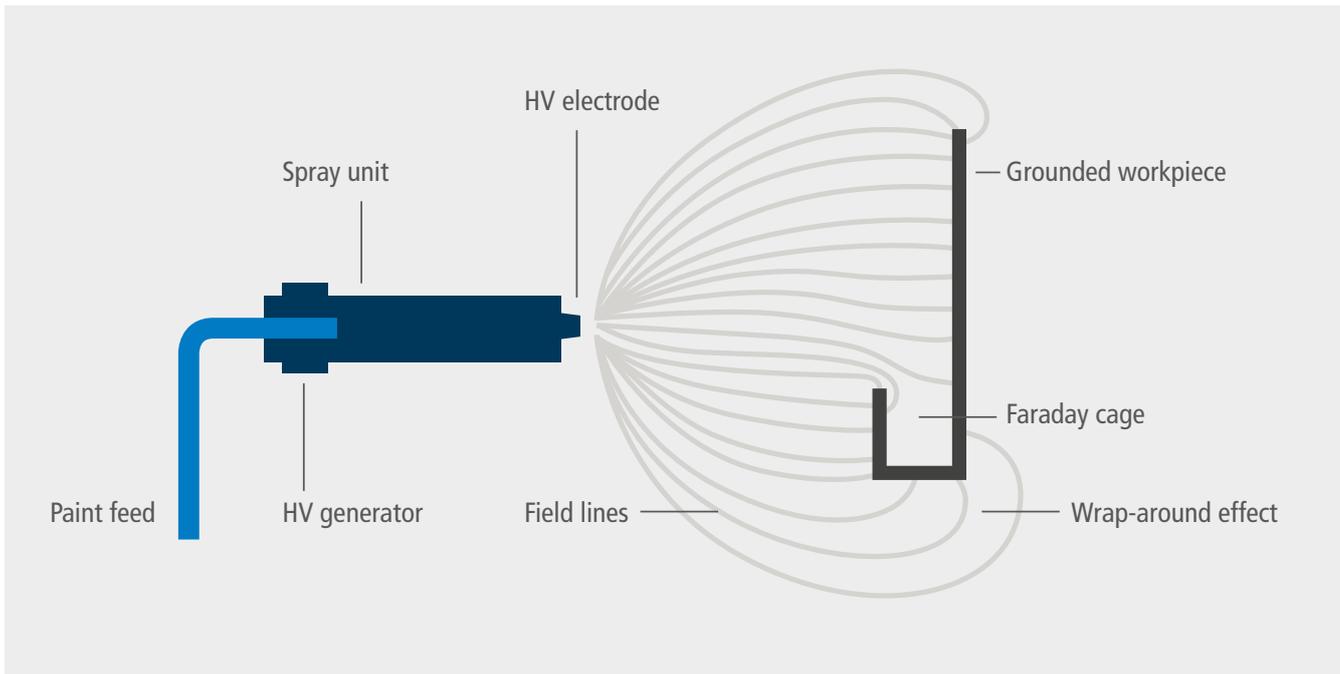
For MEYER WERFT, adopting a modern and innovative position also means participating in interdisciplinary research activities, such as the “Environmentally friendly coatings for ship building and ships in operation” (Ecodock) project. Over a period of four years shipyards, paint manufacturers and suppliers conducted joint basic research into nanoparticles and self-cleaning paints.

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Link to Ecodock project:  
[www.ecodock.net](http://www.ecodock.net)

# ELECTROSTATIC PAINT-SPRAYING PROCEDURE

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The advantages are self-evident: reduced loss due to overspraying, minimal solvent and paint-particle emissions, higher quality, material savings, reduced paint waste, electrostatic wrap-around and improved edge protection. This also creates a better workplace for paint shop workers, coupled with higher productivity resulting from a shortening in the time required for coating. All good reasons why MEYER WERFT decided to employ an electrostatic paint-spraying procedure for corrosion protection in all external areas in which new ships are built.

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Using this procedure, paint can be applied better, more evenly and with better edge protection. By applying low pressure, less paint is used in the spray process, resulting in a lower incidence of paint dust and less solvent in the creation of a smooth surface. As well as complementing the conventional airless process, this approach combines paint spraying with an electrostatic charge.

The method is based on electrostatic force fields. The paint spray is created at the outlet of the spray jet and a high voltage electrode gives it a positive charge. The component undergoing coating must be earthed to allow an electric field to build up. Within this field paint particles are attracted to the steel surface and the positively charged paint particles distribute themselves around the element being treated.

# DRY ICE BLASTING FOR CLEANING SURFACES

Dry ice cleaning is a process that uses the latest technology and it is not only highly effective but also extremely environmentally friendly. MEYER WERFT began using dry ice blasting in shipbuilding back in 1995 for cleaning surfaces and as a substrate preparation prior to applying corrosion protection in many interior spaces.

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Steel must be treated with paint coatings to protect it against rust. The more thoroughly a surface is cleaned the better the subsequent coatings, no matter what type, will adhere to it. This not only improves the quality of the ship and but also promotes customer satisfaction.

The cleaning effect of dry ice blasting derives from a combination of extreme cold and high velocity. The dry ice is in the form of solidified carbon dioxide pellets of varying sizes. Its temperature is around -79 degrees Celsius under atmospheric conditions. Dry ice is odourless, non-toxic and non-flammable and is a naturally occurring component of the earth's atmosphere.

In the dry ice blasting process, pellets around the size of grains of rice are made from pure carbon dioxide (CO<sub>2</sub>). Liquid CO<sub>2</sub> is first of all transformed into dry ice and then forced through a pelletising matrix. The pellets are accelerated by a mobile system to speeds of up to 300 metres per second. The dry ice impacts on the to be cleaned surface at a speed approaching that of sound and removes every particle of dirt while creating virtually no perceptible dust. The dirt is detached from the steel while the dry ice literally dissolves into thin air. The method produces no blasting substances such as sand, chemicals, water or abrasive materials that need to be disposed of.

Up to now, more than 1,000,000 square metres have been cleaned in the shipyard using the dry ice method on newly built ships. This has resulted in a more than 70 percent reduction in dust pollution in the workplace. Not only has the impact of dust on the environment and the workforce been reduced to a minimum but the method has also proven to be extremely economical.

# SPONGE JET – CLEAN AND EFFECTIVE

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The sponge jet blasting method of surface treatment represents a new development in the possibilities of corrosion prevention. MEYER WERFT employs this method in all external areas as a substrate preparation prior to conservation. Sponge jetting not only protects the environment but also reduces disposal costs.

The technology used in sponge jet cleaning is similar to that of conventional blasting techniques with abrasives. The difference is that it is cleaner and drier and produces less dust; it is also re-usable. The essential difference to conventional blasting methods is in the granulate – it is a sponge material that has been impregnated with aluminium oxide. The granulate can be recycled up to ten times.

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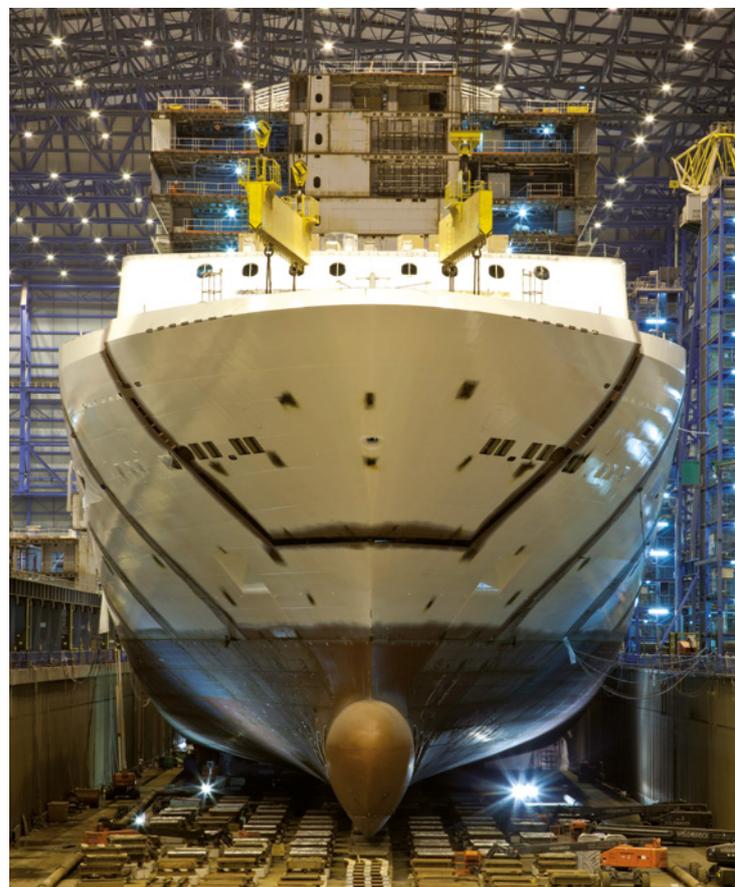


## NOISE EMISSIONS

Despite the major efforts that have been taken, shipbuilding is just not possible without noise emissions. It is however possible to keep the effects of noise on workers and the environment down to a minimum. The main noise sources at the shipyard are the halls, which radiate sound through their walls, roofs, doors and ventilator openings. For this reason, MEYER WERFT has fitted its production halls with special noise insulation.

Vent stacks on the various production halls and filter units in the outside areas, re-cooling plants and other installations are further sources of noise found at the shipyard. Considerable noise is also generated by all the steel construction activities performed in the outside areas, roads and surfaces provided for motor vehicle use on the premises and test runs of the ship's engines in the construction dock and the fitting-out berth.

Despite all of these unavoidable sources of noise, the shipyard attaches great importance to ensuring compliance with emissions requirements controlling the impact of noise in the neighbourhood. Noise emissions are marked as average sound levels (moving with the wind) on so-called "noise maps". These maps are used to evaluate the impact of noise on sensitive surrounding natural spaces.



## CARTRIDGE FILTER CLEANING

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Just what environmental protection and the constant development of standards look like from the bottom up can be seen from the initiative shown by trainees and young skilled workers at the shipyard. In a joint project, a mechatronics trainee and a maintenance technician built a system for cleaning cartridge filters. After being put to use, this considerably reduced the number of cartridges disposed of in the space of a year.

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Welding activities at the shipyard create fumes that are collected by extractors and released into the environment after first passing through a filter system. This process employs cartridge filters which need to be replaced one to two times per year, depending on their rate of use. The filters must be cleaned. There are more than 600 such filters in use.

In the newly developed system, cartridges are cleaned by a sophisticated compressed airflow system, which not only protects the environment but also saves considerable costs.





# WATER BODY POLLUTION MANAGEMENT

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Nothing is possible without water. This applies in particular to the maritime industry, for which water is the most fundamental element of its activities – and of course to every shipbuilding company and every ship builder. It is no different for MEYER WERFT. Sustainable water body protection is even more than a commitment to environmental protection. Water is a precious commodity and a resource that must be suitably protected and handled by the maritime industry.

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Ships and water belong together. In everyday shipyard operations, working on a ship in a flooded dock is standard procedure. The conservation of steel or initial testing of the main engines also takes place in the dock hall. Oil skimmers and floating barriers are employed at the shipyard to fulfil and secure necessary environmental standards. This allows contaminants to be filtered from the water and disposed of. Additionally, a twin-chamber system is installed with an oil and petrol separator and an upstream sand trap, to provide additional water body protection.

The shipyard is well equipped for emergencies and critical situations. In the event of a crisis, not only MEYER WERFT benefits from this. An oil emergency plan was drawn up several years ago together with the city of Papenburg and the port's neighbouring businesses. The shipyard supplies the equipment necessary for containing the oil in the event of an accident in the harbour.

A functioning system is also in place that prevents liquids that endanger the environment from entering the sewage network in the wake of an accident or during fire extinguishing activities on the shipyard's premises. The work fire brigade has a supply of sealing cushions that it uses for closing off and sealing drains and pipelines, thus preventing the spread of substances that might be harmful to water.

Other examples of active water protection in the shipyard include the treatment of bilge water and the secure transport of substances that constitute a hazard to water. The shipyard has a modern system in place that is able to process bilge water – which comprises a mixture of oil and water – formed on board the vessel. In this process, the bilge water is first fed into a calming system, in which a large proportion of the oils are separated. In a subsequent step, the remaining free oils are removed using a modern coalescing separator. What then remains is clear water, which can be safely disposed of in the sewage system.

Paints, solvents, chemicals, oils and other similar substances are put into special transport tanks. Should there ever be a leak the product can be contained to prevent it penetrating the soil or entering the sewage system.

# 3

## ■ THE GREEN SHIP CONCEPT





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# ENVIRONMENTAL PROTECTION ON BOARD CRUISE SHIPS

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Ships in general, and passenger ships in particular, are a very environmentally friendly form of transport. The maritime industry is concerned with making it even more environmentally sound by fostering its sustainable management. The entire industry, from engine manufacturers to shipyards to shipping companies, is expending considerable effort in developing products with enhanced environmental compatibility that are capable of further reducing emissions while increasing efficiency.

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Green shipping is on everyone's lips but it is far more than just a slogan. A number of research projects are being conducted that focus on alternative drive systems and fuels, such as LNG, as well as emission control systems (scrubbers) and techniques such as exhaust gas recirculation and heat recovery.

MEYER WERFT is heavily involved in the development of ships that are compatible with the climate and the environment. The company pursues a green-ship concept, a sustainable environmental protection strategy that accompanies the construction of its vessels. Its fundamental aspects are to reduce emissions and energy consumption and to increase energy efficiency. All new cruise ships built at the shipyard are fitted with innovative emission purification systems or scrubbers. Shipping companies operating passenger ships are particularly interested in this technology. Environmentally friendly water and waste water treatment as well as waste disposal systems have been fitted as standard for several years.

As a central partner of the shipyards, the diesel engine manufacturer MAN is intensively researching the concept of "clean ships", which proposes employing gas-powered ship's engines instead of conventional drive systems, which are generally powered by heavy fuel oil. Due to the great deviations in load requirements, it has so far not been possible to deploy engines running solely on gas.

However, so-called "dual-fuel" engines, which can be operated both with gas and a second fuel (marine diesel), are an exception. Unlimited gas operation could reduce nitrogen (NO<sub>x</sub>) emissions, for instance, by approximately 85 percent. Sulphur oxide (SO<sub>x</sub>) could be significantly reduced to only one percent of current emission levels, while a reduction of around 20 percent in CO<sub>2</sub> emissions could be effected by gas engines.

Fuel costs represent a considerable proportion of a passenger ship's operating costs. As engines require less and less fuel for more and more transport performance or for generating energy, the effect is not only to reduce resource consumption and to protect the environment but the shipping companies stand to profit considerably from reductions in costs.

The players in the maritime industry are focusing more and more on green technologies and have put together a research consortium known as "The green ship of the future". The challenge and goal of this initiative is to reduce CO<sub>2</sub> emissions by 30 percent and those of nitrogen and sulphur by 90 percent. Both known and newly developed technologies are being employed. The alliance is focusing, for example, on the kind of big two-stroke engines found in large overseas container ships and tankers.

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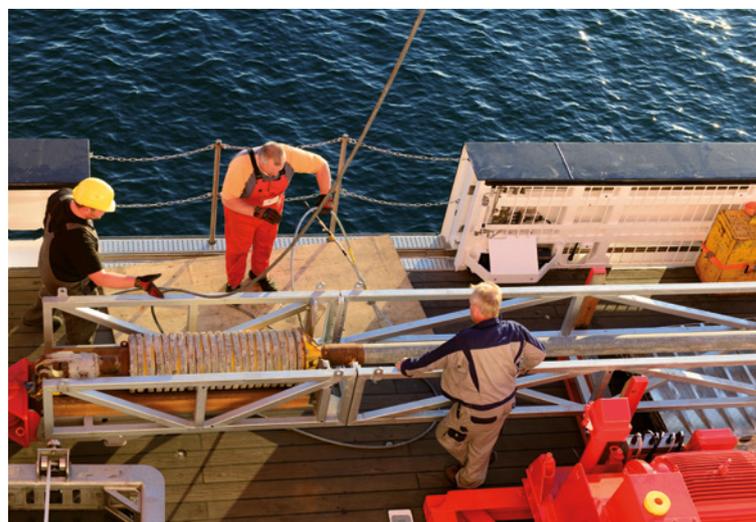
Link to the organisation:  
[www.greenship.org](http://www.greenship.org)



### 3. THE GREEN SHIP CONCEPT



In November 2014, MEYER WERFT delivered the most modern deep sea research ship in the world in the form of the German research vessel, the "Sonne".



# GENERATING ENERGY ON BOARD

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Shipyards, engine producers and shipping companies are increasingly focusing on the use of green technologies in the maritime industry. Furthermore, the new, stringent regulations of the International Maritime Organisation (IMO) lay down the applicable target values for emissions of carbon dioxide, sulphur oxide and nitrogen oxides. The marine emission control areas (ECAs) are also being expanded. These factors all have an impact on energy generation on board ships.

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A ship's energy is generated by modern diesel engines. The engines function both as power sources for the drive systems and for other uses on board cruise ships, such as hotel operations. Diesel engines are based on the latest common-rail or fuel-injection technology, which uses a high-pressure pump.

A central aspect of all these developments is the reduction of emission pollutants. For instance, fuel water emulsion (FWE) technology, which mixes the fuel on board with fresh water. Experts refer to this as a "wet system", used for reducing the level of nitrogen oxide in the exhaust gas. The system operates at lower temperatures than the conventional method, which leads to a lower level of NOx formation. The method relies on the continual supply of the fuel-water emulsion. The process is controlled electronically and energy can be produced while the engine is running. Sulphur oxides, on the other hand, cannot be reduced by means of the combustion process in the engine. The sulphur content of the fuel is released into the atmosphere as unfiltered exhaust gas. It is therefore only possible to effect a significant reduction in sulphur emissions by replacing the traditional fuel in the form of heavy oil with alternative fuels such as marine diesel, natural gas, fuel cells or emission purification systems.

Emission purification systems, or so-called "scrubbers" are already a standard feature of shipbuilding. They reduce the sulphur oxide content of exhaust fumes by up to 95 percent. A reduction in nitrogen oxide can also be achieved using selective catalytic reduction (SCR), a method that is employed on the new research ship, "Sonne". Ammonia or urea is added to the exhaust gas, which is then passed through a catalytic converter at a temperature of 300 to 400 degrees Celsius. Unwanted nitrogen oxides are reduced by more than 80 percent using this selective chemical procedure and at the same time, secondary effects such as the oxidation of sulphur dioxide and trioxide are suppressed. Instead of NOx, only nitrogen and water vapour are emitted from the smokestack following selective catalytic reduction. Achieving the right emission temperature is an essential factor of the system's success.

## INNOVATIONS FROM PAPENBURG

The problem of NOx in exhaust gases can thus be largely solved using SCR. However, the procedure can be optimised by modifying the engine. The great environmental friendliness of the method is offset by the increased investment necessary for procurement, storage space and the large quantities of ammonia/urea that are needed. SCR therefore results in an increase in annual expenses corresponding to around five percent of normal fuel costs.

The market is in movement and high-tech innovations from Papenburg are at the top of the world rankings. The "Sonne" not only fulfils all the latest technical requirements but was also designed, constructed and built in accordance with the latest environmental standards – moreover it was awarded "Blue Angel" environmental certification.

# EMISSION CONTROL AREAS

Emission control areas (ECAs) are special shipping zones in which particular restrictions apply with regard to sulphur and nitrogen oxides. The extent of the zones, to which environmental guidelines covering waste-product and process-water disposal also apply, is determined by the International Maritime Organisation (IMO). These special zones, which have been defined since 2006, are continually being expanded.

So far, they constitute the Baltic Sea, the North Sea including the English Channel and the areas 24 nautical miles from the Californian coast and 200 nautical miles from North American coasts of the USA and Canada, including Hawaii. The most recent protected areas, included since 2014, are the coastal waters around Puerto Rico and the American Virgin Islands (the so-called "U.S. Caribbean Emission Area"). Further ECAs are planned for the entire Mediterranean region and southern Japan. The addition of such emission control areas around Alaska, Australia and South Korea as well as in the Black Sea are under discussion.

Requirements are becoming increasingly stringent and demand new technologies and more environmentally friendly ships. Under the terms of the International Convention for the Prevention of Pollution from Ships (MARPOL) (Annex VI), virtually the entire North American coast (USA and Canada) was declared a marine environmental zone on August 2012. Besides sulphur oxide and nitrogen oxide emissions, fine dust particle emissions are also restricted. This controlled area thus differs from previous ECAs, which prescribe stricter regulations for sulphur and nitrogen oxide emissions only.

Since July 2010, sulphur content in fuel within the ECAs of the North Sea and Baltic Sea must not exceed 1.0 percent. From January 2015, sulphur content is limited to 0.1 percent. Moreover, the IMO demands that by 2020 the concentration of sulphur in fuel be reduced to 0.5 percent. A reduction of the sulphur content in fuel from 4.5 to 3.5 percent has already applied since 2012. The limit has been ambitiously set to 0.5 percent by 2025.



■ = Existing ECAs   ■ = Possible ECAs   — = Main trade routes



# USE OF SCRUBBERS

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**The reduction of sulphur emissions in shipping is of the highest priority for the IMO, owing to increasing environmental problems and the accompanying stricter regulations. In addition to the general framework conditions that already apply, a number of international regulations are due to be enforced in the near future. These not only present shipping companies with additional, not inconsiderable, financial demands but also bring about stricter technical requirements that have to be met.**

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These include new regulations prohibiting the ejection of sewage into the sea, implementing a ballast water management system and new provisions contained in the MARPOL Convention "Regulations for the prevention of air pollution from ships" Annex VI. The convention not only covers emissions of pollutants such as sulphur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>) and exhaust particles (PM) but in the new Section 4, which discusses the reduction in CO<sub>2</sub> (GHG) in newly built vessels, the implementation of an EEDI (energy efficiency design index) and an SEEMP (ship energy efficiency plan) is stated as a mandatory requirement for all new ships.

MEYER WERFT deploys scrubbers on its Quantum Cruise Line ships for RCI and Breakaway Plus class of ships for Norwegian Cruise Line. In its latest ships, the company has tested prototypes from the manufacturer Wärtsilä and from Green Tech Marine, which differ fundamentally from each other in terms of their structure. Such scrubber systems have been installed in the Quantum of the Seas, the Anthem of the Seas and the Norwegian Escape and have been successfully accepted by the shipping company, class and flag state.

Scrubbers are highly effective and reduce the sulphur oxide content of exhaust fumes by up to 95 percent. Just before it is emitted into the atmosphere, the exhaust gas is enriched with seawater in the smokestack. The process causes water and sulphur to react to form sulphurous acid. The alkaline components of the seawater neutralise the acid and filters separate particles and oil from the mixture; the water is then returned to the sea in a purified state. The advanced scrubber technology still has considerable space requirements on board, where there is little space available. A scrubber requires 40-50 cubic metres of seawater per megawatt-hour of engine power. Not only is space on a ship limited, the facilities also need to be light and display a high degree of resistance to acceleration and vibration. The load capacity, stability and stowage volume are altered by the installation of the treatment equipment, in accordance with the ship's construction.

## CONTINUOUS MONITORING OF GAS EMISSION VALUES

The ship's engines run under varying conditions and with varying fuels. The exhaust gas also varies in terms of its chemical and physical composition. The emission purification system must continue to function reliably under these conditions and this must be verified in accordance with the regulations. All systems available on the market rely on the constant monitoring of threshold values. Emission values are continually logged in operation and transmitted as GPS data (Scheme B pursuant to Marpol). Only a small amount of experience is currently available due to the low number of emission purification systems so far in use, most of which are pilot projects installed in only a few ships.

The Ship Operations Research Institute (ISF) at the Flensburg University of Applied Sciences compiled a large-scale study in 2012 entitled "On the Selection of Emission Purification Systems". This was the first time that the methods of exhaust gas treatment with purification systems examined in detail. The study was intended as a decision-making aid designed to help smaller shipping companies install available systems. For ship operators, the purification of the sulphur contained in fuel is becoming an increasing financial burden. This is not just due to the fact that alternative fuels are currently considerably more expensive than conventional heavy oil, but they must also allow for losses in revenue from the installation of treatment systems, as well as their maintenance, repair and disposal.

In autumn 2014, MEYER WERFT installed an advanced exhaust purification system (AEP) in on of the biggest cruise ship in the world, the Quantum of the Seas. The Royal Caribbean International ship has two modern hybrid purifiers for cleaning the SOx and soot particles from the exhaust fumes, each of which is assigned to two diesel generator sets. They comprise the systems following the waste-heat boilers and silencers in the flue stack at the level of Deck 12 and are followed by a pressure-balance ventilator. These units had to be fitted into a pre-existing ship structure without scrubbers, as a result of which only a wet scrubber could be considered since it has smaller space requirements than a dry scrubber. These units can run in both open loop (sea to sea mode, using the natural alkalinity of the seawater) and closed loop (cleaning water recycling) mode as well as in bypass mode.

The intelligent AEP retrofit system is a forward-looking design and the Quantum of the Seas is one of the first ships in the world to be equipped with it. Two more cruise ships will follow in 2015: the Norwegian Escape and the Anthem of the Seas.



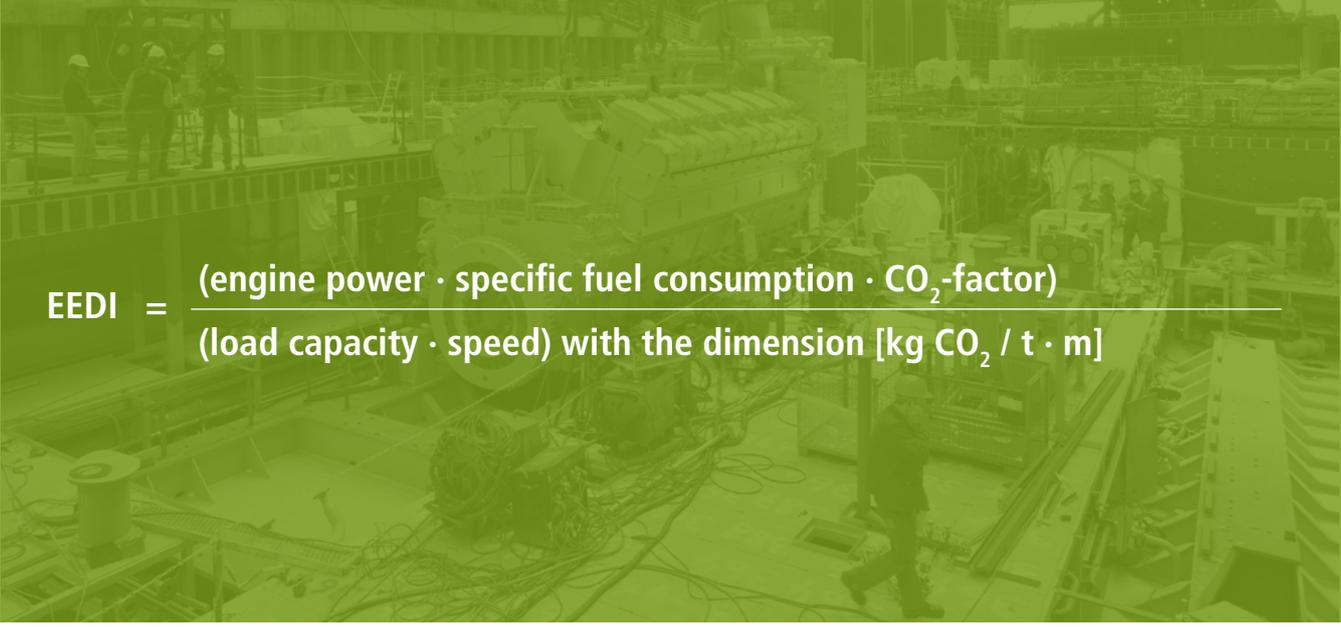
# ENERGY GENERATION AND ENERGY EFFICIENCY (EEDI/SEEMP)

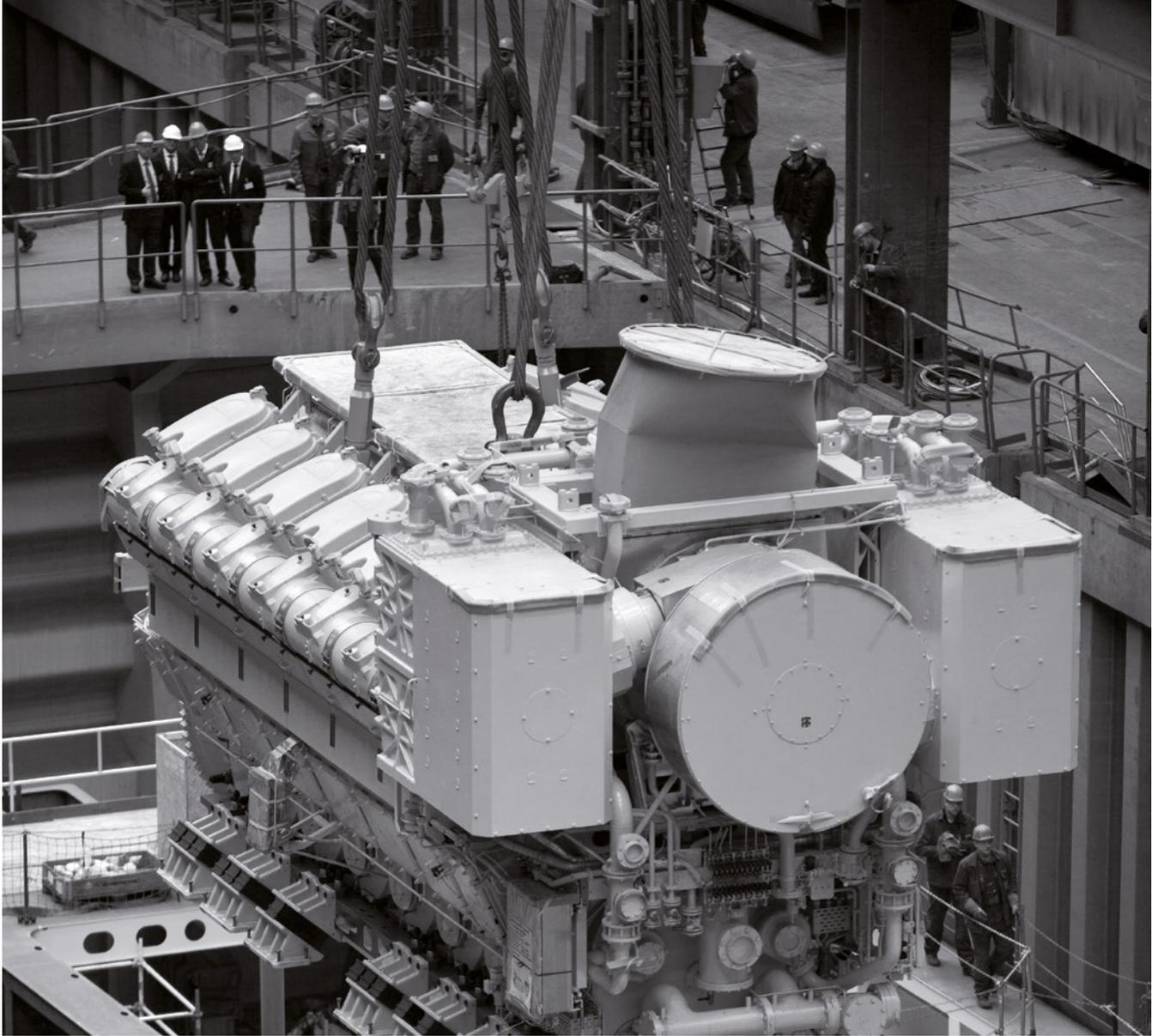
The climate and the company stand to benefit in equal measures from energy efficiency. The introduction of an energy efficiency design index (EEDI) and a ship energy efficiency plan (SEEMP) on board ships is seen as a further milestone on the path towards even better environmental friendliness and economic operations in the shipping industry, including the cruise segment.

The energy efficiency design index passed in 2012 is a value that states the specific carbon dioxide emissions of freight ships. The index was introduced for the purpose of precisely documenting CO<sub>2</sub> emissions due to fuel consumption in new ships and to regulate them in line with environmental guidelines. The EEDI is calculated with a complex equation. It is determined by multiplying the engine power output with the specific fuel consumption of the cargo ship engines and the CO<sub>2</sub> factor. This is then divided by the load capacity (cargo weight) multiplied by speed.

A rough value of 0.2 kg/kWh is taken as a calculation value for the specific fuel consumption of diesel engines in cargo ships (tankers, bulk carriers and container ships). The CO<sub>2</sub> factor for heavy oil as a typical fuel is taken to be around 3 kg CO<sub>2</sub>/kg of fuel. The aim of the EEDI is to ensure that each wave of new ships entering the seas has progressively lower emissions. The index also applies to cruise vessels and passenger ships.

Since 2013, the shipbuilding industry has been required to fulfil the guidelines of the IMO and implement a ship management efficiency plan (SEEMP) on board to optimise the ship's operation. The aim of the management plan is to effect continual improvement of the ship's operation and to protect both the environment and resources. The aim is also to increase the energy efficiency of the ship by implementing a series of measures. Essentially, the purpose is to save fuel and thus reduce operating costs; SEEMP combines steps that together should lead to a reduction in fuel consumption. The guideline envisages the following modules: planning, implementation, monitoring, and self-evaluation & improvement.


$$\text{EEDI} = \frac{(\text{engine power} \cdot \text{specific fuel consumption} \cdot \text{CO}_2\text{-factor})}{(\text{load capacity} \cdot \text{speed}) \text{ with the dimension } [\text{kg CO}_2 / \text{t} \cdot \text{m}]}$$



The challenges of the ship's management are summed up in the following questions: Is a conscious effort being made on board to save energy? Does a fuel saving also result in a loss of comfort? Is it even possible to expect significant cost savings?

#### OPTIMISATION OF SHIP MANAGEMENT WITH SEEMP

SEEMP functions in a similar way to other certification systems, such as the common ISO 14001 standard. A cyclic management process is documented using an energy efficiency plan. Data of relevance to energy efficiency is obtained by a continual process. The aim of a sensibly operated management plan is not just to fulfil the demands of the IMO but to compile a practically based on-board energy handbook, which explains what must be done on board, how, when and by whom. With a SEEMP as a tool, on-board communication can be simplified, as well as communication with inspecting agencies such as surveyors, ports and port states.

The new measure for energy-efficient behaviour is taking effect within a state of changing awareness and operating environments. When performed conscientiously, energy management can be shown to lead to lower costs and an improved environmental profile.

Moreover, individual port and flag states are beginning to reward energy efficiency; these include major European and international ports such as Amsterdam, Rotterdam, Oslo, Bremerhaven, Hamburg, Antwerp, New York and San Pedro. They have joined the World's Port Climate Initiative and act within the framework of the environmental ship index (ESI). There are now nearly 3,100 ships listed in the initiative, which fulfil the requirements of the ESI and are designed energy efficiently.



## IMO GUIDELINES

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Guidelines governing emissions from large diesel engines are being continually intensified. For more than 20 years, the International Maritime Organisation (IMO) has laid down emission standards. These sets of rules are applied as Tiers I to III and prescribe a reduction in NOx emissions. Moving from one level to the next involves a further corresponding reduction. More than ever before, clean diesel technologies are demanded by ship and engine builders, in addition to alternative drive designs. The objective remains to lower emissions and increase energy efficiency with the ambitious vision of near-zero emissions.

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Tier II currently continues to apply until 2016. The subsequent intensification in the form of Tier III will involve a further reduction in NOx emissions. Emissions in emission controlled areas (ECAs) must be 80 percent below the values defined in the year 2000 under Tier I.

Even stricter guidelines already apply in the USA. The U.S. Environmental Protection Agency (EPA) has devised further standards in line with the IMO guidelines. The applicable levels here are EPA Tier III (since 2012) and EPA Tier IV (since 2014) – a further challenge to engine and ship builders as well as ship operators. EPA Tier IV requires a reduction of 90 percent in particle emissions along with an 80 reduction in NOx emissions measured against Tier II standards.

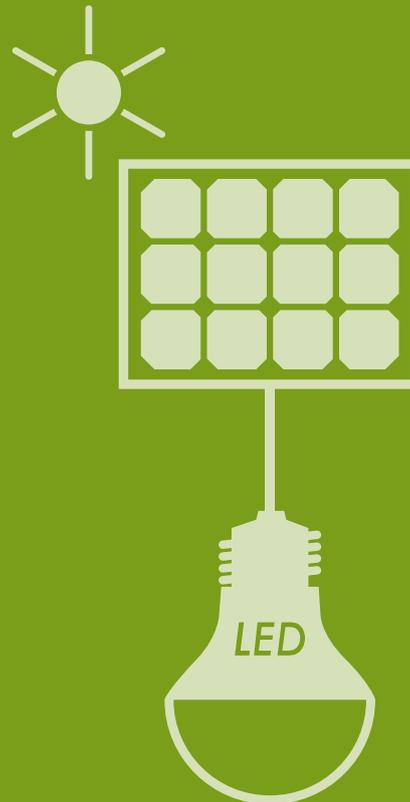
# ENERGY EFFICIENCY OF A SHIP

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Along with all the efforts being made by engine manufacturers, MEYER WERFT has taken several simultaneous measures to improve the energy efficiency of new cruise ships by more than 30 percent. To achieve this, the hydrodynamics of the ship's construction were improved by lowering the water resistance. In addition, new paint coatings are now applied to the underside of the hull and photovoltaic plants are employed on board. Innovative lighting systems based on LED technology are also installed.

This not only reduces electricity consumption – up to 80 percent can be saved from cabin lighting alone with a twenty-times-longer service life – but the lower heating effect means that discernibly less energy is consumed by the air-conditioning. LEDs create lighting effects that are simply not possible with conventional lighting technology. Significant savings can also be made in galleys with glazing and insulation as well as cold absorption equipment.

Energy efficiency technology on cruise ships is becoming increasingly sophisticated, predictive and automated. All systems that serve to monitor technical operations on board the ship come together at the central hub of the bridge. Not only air conditioners but also fans and pumps can run at variable power levels. When the window is open, the cooling system in the cabin switches off. Even the weather forecast is used to control thousands of ventilators on board the ship, to ensure they are only switched on for as long as they are needed. The various operating statuses are monitored and controlled in the engine room. As a result, the ship, for example one in the AIDA fleet, can sail economically and with minimal environmental impact. The various requirements on board are responded to intelligently. For example, the individual generator diesel engines switch on or off automatically depending on energy requirements.



Moreover, the active generators are primarily operated in the optimum efficiency level of 85-90 percent of maximum output. They only generate electricity as required by the propulsion systems and the other power-consuming units on board. The increasing use of shore-side electricity by ships in harbour is a further environmental plus. Until now, they had used an on-board diesel generator. A ship produces an average of 12 grams of nitrogen oxides per kilowatt-hour, while electricity obtained from an on-shore power station only creates 0.35 grams of emissions on average in Europe.

## NEW FORMS OF ENERGY GENERATION

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Quantum of the Seas · year of construction 2014 · 348 m



Norwegian Breakaway · year of construction 2013 · 325.64 m



Celebrity Equinox · year of construction 2009 · 317.20 m

In the search for efficient and affordable alternative propulsion systems, the cruise ship industry generates innovation. The course is set towards leaving heavy fuel oil and moving on to more resource-friendly solutions – this applies to the future of both the shipbuilding industry and component manufacturers such as MAN or Wärtsilä, makers of ship's engines. Gas-powered engines and hybrid solutions are being developed, researched and tested as alternatives to the large, standard four-stroke engine. Now, there are more and more ships entering the seas powered by environmentally friendly fuels.

## THE FUTURE: SMART SHIPS

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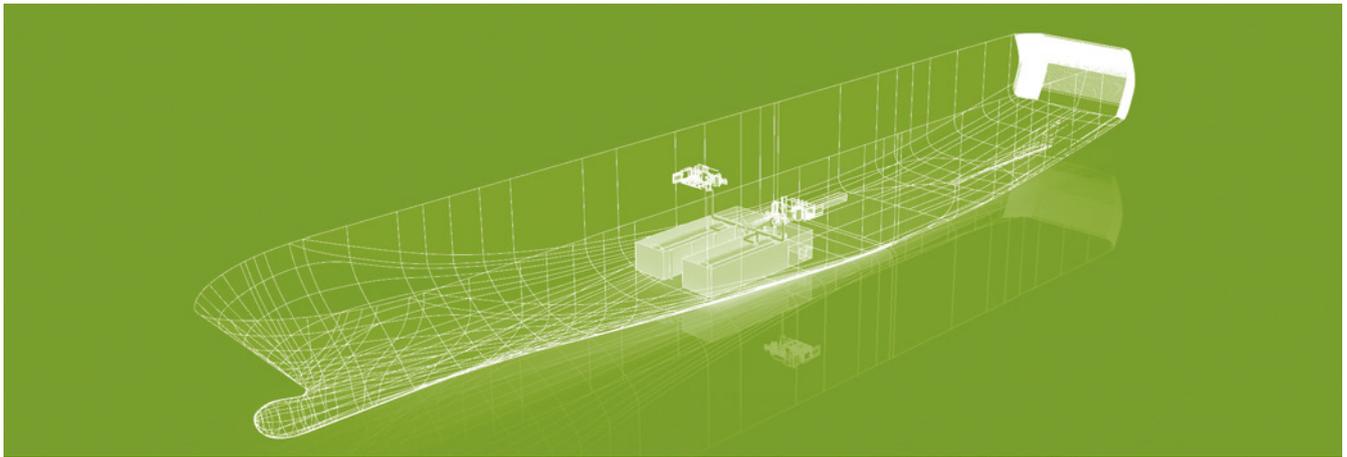
The construction of the Quantum of the Seas ushered in the future and heralded a new milestone of shipbuilding. This ship not only exceeds all previous cruise ship dimensions (length 348 metres, width 41.4 metres, 18 decks, and room for 4,180 passengers), but the luxury liner has revolutionised technology and energy efficiency.

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The cruise vessel is an innovative ship that sets new standards. The latest environmental technologies and improved energy efficiency make this holiday ship the first 'smart ship' in the world.

MEYER WERFT is building two further ships of this new class for its customer Royal Caribbean International (RCI). Its sister ship "Anthem of the Seas" has been delivered in 2015, while a third ship of this type will be completed in 2016.

# GASPAX PROJECT



For MEYER WERFT, it is not enough to wait for innovations to happen. It is part of the company's philosophy to be involved in the innovation process itself and the same applies to participating in projects of the future. The GasPax research project was one such activity, and its aim was to develop technical solutions and concepts for the use of alternative fuels: LNG (natural gas and biogas), LPG (propane/butane) and methanol. The research conglomerate consists of such renowned German shipyards as MEYER WERFT, Flensburger Schiffbaugesellschaft, Fr. Lürssen Werft (Bremen), Germanische Lloyd (Hamburg) and Tracetebel Engineering GDF Suez (Belgium). The aim is to deploy new fuel solutions on passenger ships, ferries and megayachts. MAN was also involved in the project as the engine builder.

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Particular attention was given in the GasPax project to liquefied natural gas (LNG) as a fuel for engines, turbines and fuel cells. When used in cruise ships, in the long term LNG results in a 26 percent improvement in energy efficiency in comparison to bunker oil. The aim of the participants was to develop a marketable gas-powered passenger ship and to secure a competitive advantage for the German shipbuilding industry. LNG is not only the most environmentally friendly but also the most commercially promising solution for the future.

In summer 2015 Carnival Corporation ordered a new ship generation pioneering a new era in the use of sustainable fuels. These ships will be the first in the cruise industry to use LNG in dual-powered hybrid engines.

The GasPax project was able to demonstrate that LNG is ready for use as a fuel for cruise ships, RoPax ferries and other passenger vessels. The shipbuilding industry has the necessary know-how and technologies at its disposal for restructuring its operations to accommodate gas-powered main engine systems. Now it is the customers who have to follow. In the research project completed in 2013, passenger ship models based on LNG were designed by the companies and examined for their marketability.

The cruise ship industry has reached an agreement to effect a gradual exit from the use of heavy oil as a fuel. The regulations of the International Maritime Organisation (IMO) are to be implemented in Europe by 2020 and worldwide by 2025. Several shipping companies are already re-equipping their fleets on the basis of the regulations in some European ports and in the USA and in the wake of the regulations for the North Sea and Baltic Sea. In the North Sea and Baltic Sea, for example, only the more environmentally friendly diesel fuel will be in use from 2015 instead of heavy oil.

## LNG – THE ALTERNATIVE FUEL

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Without a doubt, the future belongs to low-pollutant liquefied natural gas (LNG) – but there are so far only a few ships that actually run on this fuel. The combustion of LNG is sulfur- and soot-free. The size of the fleet running on LNG or with a dual-fuel propulsion is expanding. The maritime industry is forecasting that by 2020, around 100 ships will be sailing with LNG engines. The current figure is 45 or more. The majority of these are in use in Norway, since Scandinavia provides intensive financial support for such ships. They primarily comprise vehicle and passenger ferries plus offshore supply ships. It is in this segment in particular that experts predict growth. The USA is also providing intensive funding for LNG propulsion systems.

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### HEADING TOWARDS THE MARITIME FUTURE

One problem that remains with LNG is how to fuel the ships, since the infrastructure still needs to be developed. LNG tankers are only allowed to enter duly licensed LNG terminals, which are only located in certain ports. For this reason, in 2013, the European Commission declared its support for funding the construction of LNG bunker

stations in all sea and inland harbours with a connection to the trans-European transport network (TEN-T). This comprises a total of 139 ports, or around ten percent of all the ports in Europe. All TEN-T seaports should have an LNG terminal by 2020 while all inland ports should be equipped by 2025.

In 2012/2013, MEYER WERFT built the first LNG gas tanker “Coral Energy” for the Dutch shipping company Anthony Veder (Rotterdam). It is the first of a new generation of gas tankers to be equipped with a highly environmentally friendly dual-fuel engine. The shipyard is developing this propulsion technology with innovative components. The aim is that it will not just be used for gas tankers in future but also for passenger ships. For several decades, MEYER WERFT has been renowned as a specialist in the construction of gas tankers.

In 2014 the Borkum ferry “Ostfriesland” became the first German ferry operated by Emden Wattenreederei AG Ems to be refitted for operation with liquefied natural gas. The ferry should be in service in the north German mud flat area from summer 2015. This refitting represents a further impetus to the increased use of LNG in shipping.





Germany's biggest LNG-projects are being realized in Papenburg. In total the group of companies is currently building four ecofriendly cruise ship featuring 'LNG only' propulsion system.

#### SUPPLY CONCEPT WITH PROSPECTS

All that remains is the development of the necessary infrastructure: in Germany, Bomin Linde LNG is a leading company in the development of LNG terminals. Plans for the construction and operation of two terminals in Hamburg and Bremerhaven as LNG supply nodes on the German coast are being implemented. From 2015, the supply of clean LNG fuel should be available to ships in all German ports along the North Sea and Baltic Sea coasts. The decision to build an additional terminal in the deep-water harbour of Wilhelmshaven could be taken in 2017/18.

Of central importance currently is the development of environmentally compatible technologies and processes. For example the EU BunGas project is intended to support the development for gas tanks in cruise ships. MEYER WERFT's involvement in this research project is the design and construction of an LNG bunker barge.

The newly developed 104-metre-long LNG fuel station has a capacity of 5,000 cubic metres of liquid gas, stored in two tanks. The tank system works under low pressure and is installed on the upper deck. The barge works with an innovative, automatic hose system for transferring the LNG to another ship for fuelling. For a ship with a tank capacity of 2,000 cubic metres of liquid gas, the filling time from ship to ship is about six hours. The entire fuelling process can be monitored from the bridge. The "International Association of Oil and Gas Producers" (OGP) described the draft design as a forward-looking guideline for systems and installations for the supply of ships with LNG as fuel.

# LNG BARGES

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The ‚Hummel‘ freighter, which has been moored at a German port since October 2014, is the world’s first floating liquid gas power plant for cruise ships. The five generators and power output of 7.5 megawatts of the nearly 77-metre-long barge are earmarked to supply electricity to AIDA ships in the port of Hamburg from the 2015 season onwards. The ships can switch off their diesel generators and obtain electricity from environmentally friendly LNG. These generators are the first LNG caterpillar engines with marine certification to be supplied to customers. The LNG hybrid barge is a pilot project conducted by ship furnishers Becker Marine Systems and the shipping company AIDA Cruises.

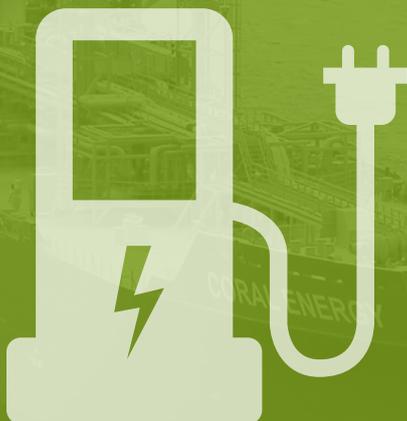
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It is also hoped that the use of the barge will further the decrease in environmental contamination in the harbour. Moreover, an offshore electricity supply for cruise ships should be completed in the Hamburg port before the end of 2015. The port of Hamburg is currently one of the first in Europe to offer an external, low-emission power supply for cruise ships.

## BIOMASS RESEARCH PROJECTS

In addition to liquid gas, biomass is another engine fuel that is gaining increasing attention. Research into the use of fossil and regenerative fuels for powering engines, including palm oil, soya oil, rapeseed oil, sunflower oil and spent grease, is currently being conducted. Partners from industry and science in 20 countries including China will be jointly investigating the possibilities offered by biofuels for shipping and power generation in the EU research “BioClean” project, which lasts until autumn 2015.

The BioClean studies of the MAN test engine show that the biofuels being investigated are fundamentally suitable for efficient combustion in big diesel engines. In comparison with heavy oil, the release of sulphurous emissions are negligible. Emissions of nitrogen oxides are not appreciably different to those from fossil fuels. The question of whether these fuels might lead to a reduction in CO<sub>2</sub> emissions and in turn to a reduction in the impact of ship’s emissions on the climate cannot yet be conclusively answered. Regarding the production of biogenic fuels, there are various parameters that must be taken into account, such as land use, cultivation, the processing and transport of biomass and the use of fossil energy sources and upstream chains such as fertiliser production.





## OTHER ENERGY SOURCES

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Another form of renewable energy that should be considered for use on ships is photovoltaic energy. In October 2008, MEYER WERFT delivered the first in a series of five ships featuring a particularly environmentally friendly design, in the form of the Celebrity Solstice class of cruise vessel.

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They were able to achieve an energy saving of 30 percent compared to previous ships with an on board photovoltaic system, optimised hydrodynamics and an advanced underwater surface coating. The Celebrity Reflection, the fifth ship in the Solstice class, was delivered in 2012; here too energy-efficiency activities included the installation of a photovoltaic system.



Wind energy and electric power are also being considered for use with power generation modules and propulsion systems. Besides cargo ships that are powered by wind energy, ferry traffic to the island of Föhr will in future include two new vessels with an electric propulsion system. The batteries are charged by climate-neutral wind turbines.

# FUEL CELLS AND PHOTOVOLTAICS

Experts at MEYER WERFT believe that ship's propulsion systems powered by hydrogen will increase in use over the next ten years. Fuel cells in particular are set to usher in a more environmentally friendly age. Research in this field is continuing until 2016 in the form of the flagship "e4-Ships" project. The project partners cooperating with the company include renowned German shipyards and shipping companies, leading fuel cell manufacturers and classification societies. The aim of the e4-Ships project is to vastly improve the supply of energy on board large vessels. It is envisaged that high-temperature and PEM fuel cells will be employed, as they are able to fulfil the demands for significantly reducing emissions and fuel consumption. The research project is being supervised by the National Organisation for Hydrogen and Fuel Cell Technology (NOW) and supported by the Federal Ministry of Transport and Digital Infrastructure.

e4-Ships consists of three demo projects and one umbrella project. In each component, concepts are developed, implemented and tested, after which the ecological, technical and economic aspects of fuel cells on ships will be assessed. MEYER WERFT is playing a leading role in the Pa-X-ell project. This project component is testing the use of high-temperature PEM fuel cells for supplying decentralised energy on board a passenger ship. The idea is to use standardised units that have a modular construction and can be connected together to create any required scale of performance. The objective of the development is to enable the safe, environmentally friendly and economical supply of power on passenger ships and, in turn, to secure a reduction in emissions and generate increased efficiency. Field tests have added valuable findings to the development that will help in the optimisation of new modules. Therefore, in early 2015, the shipyard will begin producing a new module generation.

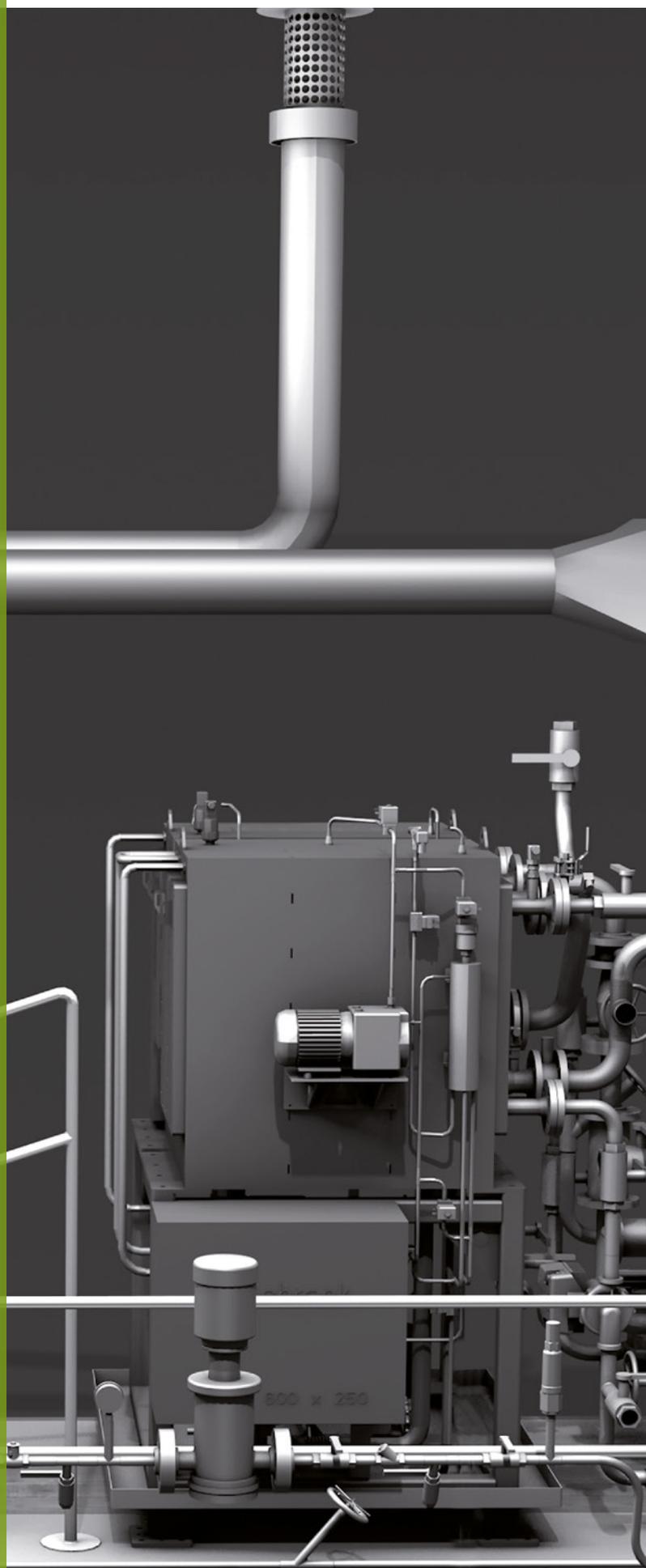
At the moment, the fuel cell system for cruise ships is still being developed. In November 2014, the world's first power-to-liquidity pilot system was put into operation. Unlike conventional engines, fuel cells work according to the principle of cold combustion, an electrochemical process that is characterised by high efficiency and that takes place without placing any mechanical strain on the components. Fuel cells are capable of substituting both conventional ship's engines as well as the auxiliary units used for supplying secondary power loads. If the hydrogen used comes from renewable sources, the fuel cells will operate largely emission free; only water vapour is emitted.

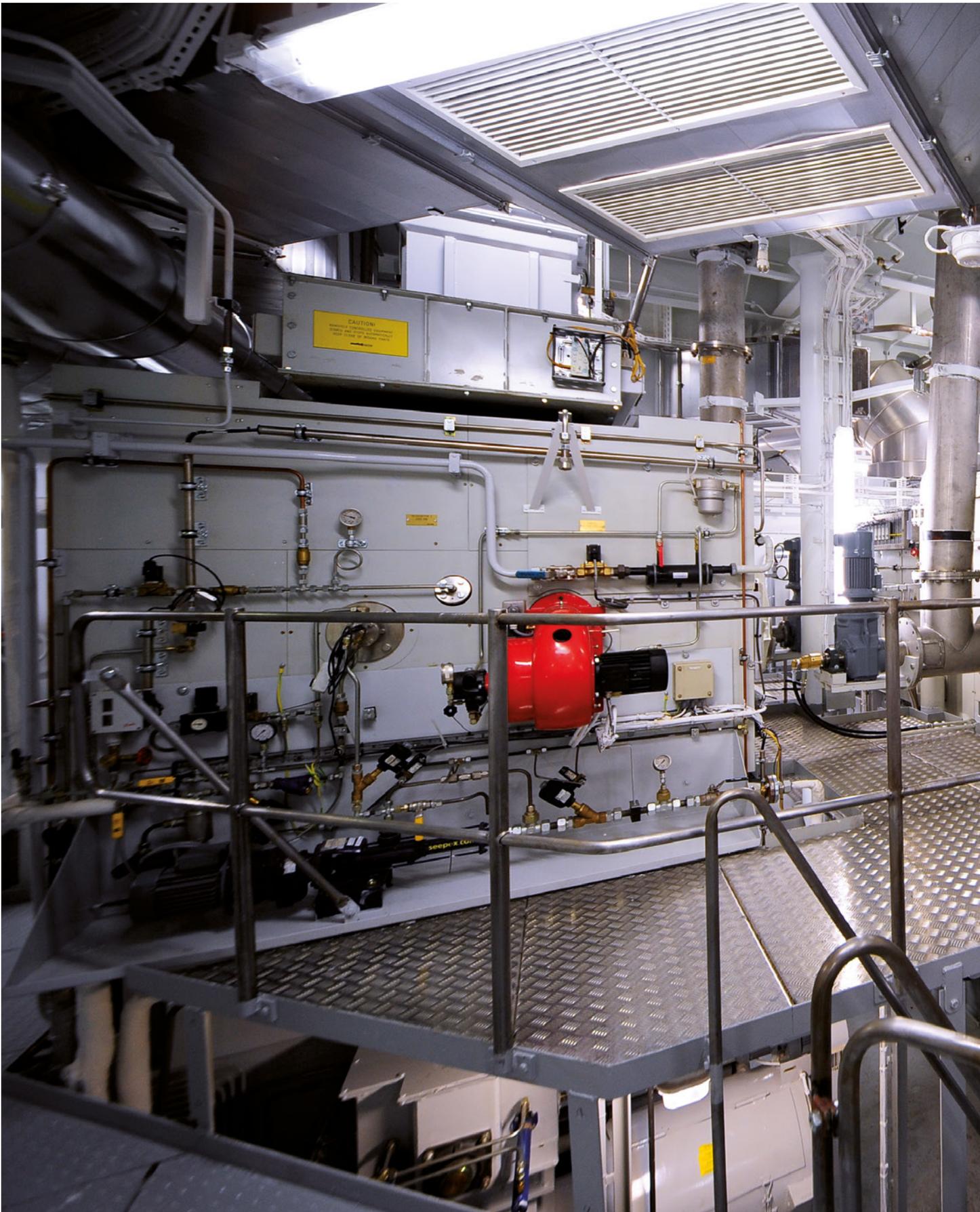
If methane or natural gas is used as a fuel, it will be possible to reduce the level of emissions considerably, on the one hand due to the higher efficiency of the system compared to conventional propulsion systems and on the other because of the more favourable emission balance.

Fuel cells can be deployed on many types of ships in line with the respective performance requirements. High-temperature fuel cells with a future power output of up to 1 MW are recommended for use in supplying on-board power on large ships such as cruise vessels or container ships. The convenience of low noise levels also makes them suitable for use on megayachts. Smaller passenger ferries or excursion craft in the power class up to 300 kW for instance can obtain their entire propulsion power from low-temperature fuel cells.

Fuel cells in general are characterised by efficiency and low levels of pollutant emissions. This is good for the environment and reduces long-term costs. The supply of heat or refrigeration by means of cogeneration is particularly advantageous on board ships that have a high level of requirements in this area, such as container ships, cruise vessels or megayachts. The latter moreover benefit from fuel cells' quiet and low-vibration operation. Ferries powered by fuel cells can sail with zero emissions, which allows them to enter sensitive sea regions, such as shallows and mud flats.

The integration of this technology in shipping is still a new field. The increased use of fuel cells in ships is not expected before 2020.





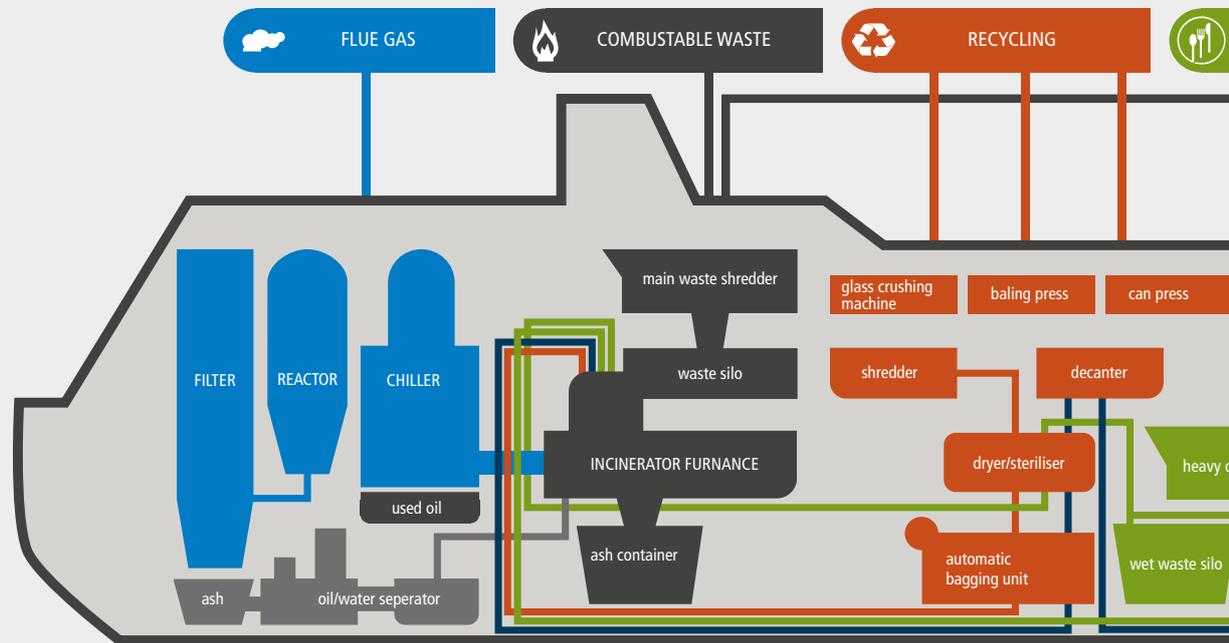


# ON BOARD ENVIRONMENTAL PROTECTION

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Sustainable supply and disposal activities are of central importance on board ships. Conscious environmental management on increasingly large cruise ships is of top priority – the gigantic luxury liners built by MEYER WERFT are frequently described as floating cities. The Papenburg shipyard has been building cruise ships since 1985. It is not just the technological and logistical challenges of these large-scale projects that have grown but also the demands placed on environmental protection. There are many options for intelligent environmental protection available on board a cruise ship that serve to minimise the impact on the environment, such as sewage treatment, refuse disposal and energy saving measures.

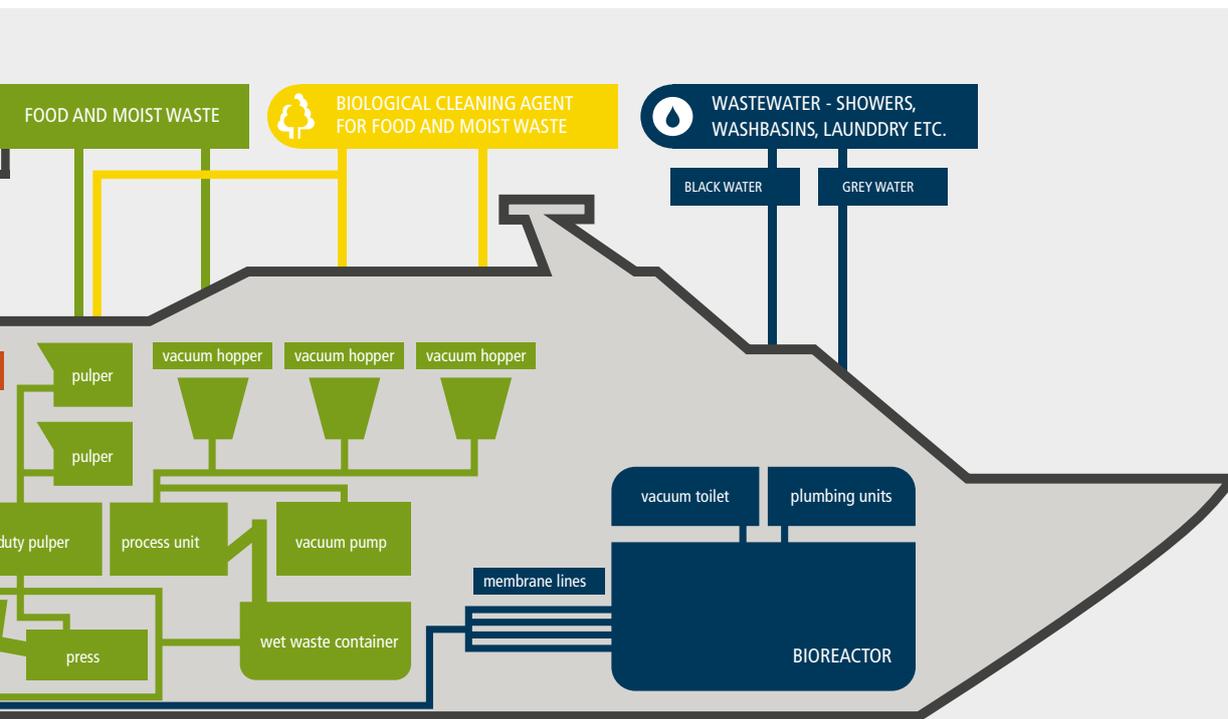
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## SEWAGE TREATMENT AND REFUSE DISPOSAL ON BOARD

There is always plenty to throw away after a party, and on a cruise ship with often several thousand passengers, considerably volumes of refuse build up every day. According to international regulations, waste must be separated and disposed of in an integrated waste disposal system on board the ship. It is as if these gigantic passenger ships had their own utility companies right there; incinerators, wet refuse stores, balers, vacuum pumps and bioreactors ensure modern waste disposal on the high seas.

Statistically, every cruise passenger produces 2.5 kilograms of food leftovers, 1.8 kilograms of packaging waste and around one kilogram of glass and cans per day. The latest cruise ships made by MEYER WERFT are fitted with around 400 kilometres of pipes for waste disposal. All cruise ships are equipped with the latest waste water treatment technology. The daily volume of waste water on a ship attributable to showers, washrooms, toilets and galleys is enormous. The first ship in the new Quantum class, which was handed over to Royal Caribbean International in November 2014, can hold up to 4,100 passengers. In the interests of both nature reserves and drinking water resources, waste water on board a cruise ship undergoes purification treatment before it is pumped into the sea.



Waste water treatment is performed by a bioreactor. Organic substances in the waste water are subjected to a biological breakdown process brought about with the aid of microorganisms. Just as people do, microorganisms require nutrients and oxygen to survive and multiply. Oxygen is supplied from an external ventilator in the bioreactor. The pollutants present in the waste water are the nutrients. They are consumed by the microorganisms and, again as with people, carbon dioxide is released and new cells built up. Using modern membrane technology, the microorganisms are separated from the water phase in a subsequent process. The membranes are extremely finely meshed filters that are able to hold back even bacteria and viruses.

In the next step, the filtered waste water is then subjected to disinfection. After this treatment, the waste water is virtually of drinking water quality and can be pumped into the sea with no danger. The process complies with all stringent international criteria.

Membrane filtration generally consumes a lot of energy. Environmental protection on board the new Solstice class of ships, built for Celebrity Cruises, has been furthered by the use of new, energy-efficient technical systems that have set a new standard for ships to come. One aspect of this is that the membranes in the bioreactor are submerged and the water is sucked from the bioreactor through the membranes by the effect of low pressure. >>

## A zero discharge policy applies on board cruise ships: no untreated waste water or refuse goes overboard.

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>> Compared with other methods, the generation of negative pressure requires little energy. This technology alone saves 2,500 tonnes of CO<sub>2</sub> per year. In autumn 2012, MEYER WERFT delivered the fifth ship of this type to the shipping company and built a particularly environmentally friendly cruise ship in the process. In the subsequent Quantum class of ships, climate protection efforts continue to be intensified and modified to take into account technological innovations.

A zero discharge policy applies on cruise ships, which means that no untreated waste water or refuse may be discharged into the sea. The waste water is treated in Sphinx-class biological membrane sewage systems. To improve the system, AIDA Cruises, for example initiated a project in 2011, together with the Testing Institute for Waste Water Technology (PIA) in Aachen. Technical possibilities of optimising the treatment efficiency were investigated in an attempt to attain the new HELCOM limit values for nitrogen and phosphorus, long before they become legally binding.

All waste created on the ships is separated according to its material and disposed of in an integrated waste disposal system, in compliance with international regulations. Recyclable waste materials such as glass, soft plastics, drink and food cans, and paper are compacted and handed over as raw materials to the respective disposal firms on land. Waste wood and plastic is ground down directly on board and fed into modern refuse incineration plants for thermal recycling directly on board. All Marpol requirements are complied with in terms of emissions and pollutants. Ash from the incinerators is collected in special containers and professionally disposed of on land or even recycled – for example in road building. From 15,000 kilograms of waste, about 400 kilograms of ash remain following incineration.

There is a separate pipe system for galley waste on the cruise ships, which transports the waste by vacuum to be dewatered along with the sewage sludge in the waste water treatment facility; from here it passes to the steam-driven drier.

The sludge produced in waste water treatment first enters a decanter for dewatering. There is also a separate collection and recycling system on board for food residues. Food leftovers are transported to the incinerator using a collection system that runs using negative pressure, where it is ground down and subsequently dewatered in mechanical presses. After dewatering, the sludge and food residues enter a drier. The components are flammable and can be subjected to thermal recycling. Black water (faeces) and grey water (water from shower drains, galleys etc.) are treated in the on board sewage treatment system.

### ENERGY SAVING THROUGH HEAT RECOVERY

Until a few years ago, the power requirements of these driers were covered by an external steam feed. A specially developed method in the new cruise ship generations allows heat released in the incineration of refuse to be used to operate the driers. Waste heat recycling of this type leads to further energy savings while also relieving the strain on the environment.

The possibilities for transforming, by means of a gasification system, the large quantities of waste produced on board cruise ships into natural gas, which is in turn available for generating electrical power on board the ship, have recently been investigated within the shipbuilding industry.



# ENERGY SAVING

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Show stages, heated swimming pools, wellness centres, observation pods, film palaces or virtual balconies for interior cabins: sailing in maximum comfort requires a sophisticated energy supply infrastructure. For MEYER WERFT, all efforts focus on creating sustainably improved energy efficiency and orienting energy requirements on board towards the latest technology. An air-conditioner, for example, that circulates several million cubic metres of air an hour guarantees constant room conditions even under highly varying outdoor temperatures. By employing innovative technology, it is possible to save at least 30 percent of the energy needed. This is the equivalent of an annual reduction of 19,000 tonnes of carbon dioxide emissions. Compared with earlier ships, this volume corresponds with that of around 7,500 cars.

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In the context of energy consumption, a lot has been achieved. For instance, innovative extractor hoods have been installed in the galleys. Energy from exhaust fumes produced by the refuse incineration plant is used for preliminary drying of moist refuse. Not only that, but (hot) air emitted by air conditioners is fed through pipelines along which (cold) fresh air from the outside passes. The heat energy is then transferred to the surrounding fresh air, this benefits heating (or cooling) requirements, according to the local conditions. Heat recovery systems ensure a fresh supply to cabins and other rooms in the ship. In public spaces, the fresh air supply can be controlled by intelligent systems, depending on the amount of carbon dioxide in the breathable air. Thanks to this regulatory circuit, the climatic conditions in the ship are not unduly affected by the environment, and air-conditioner compressors enable great energy savings. On board photovoltaic systems, the utilisation of outgoing heat from the propulsion systems, and low-energy LED lighting systems also help to save valuable energy.

MEYER WERFT recently achieved great success with the installation of new air curtain system technology. To avoid the loss of room air that has undergone complex air conditioning each time a door is opened on the ship, not to mention the inflow of humid tropical air from the outside, E series air-curtains with nozzle fittings from Teddington have been installed. This system requires up to 80 percent less energy than conventional systems for the same screening performance. In this patented system, the air current in the pressure chamber is compressed and distributed evenly by the nozzles over the entire outlet width. This requires considerably less air and energy to obtain the same effect. The use of air curtains is also highly effective in other areas of the ship, for example it can be used to screen the cool area in the galley. Here too, pressure chamber nozzle technology has proven to be highly effective.



Without water, nothing would be able to function on a ship. The amount of water consumed on board a modern cruise ship is around one million litres per day. The main consumers of water are the galleys, the laundry and the cabin toilets. Shipbuilders are therefore constantly on the lookout for solutions affording them the most economical use of the valuable resource of water.

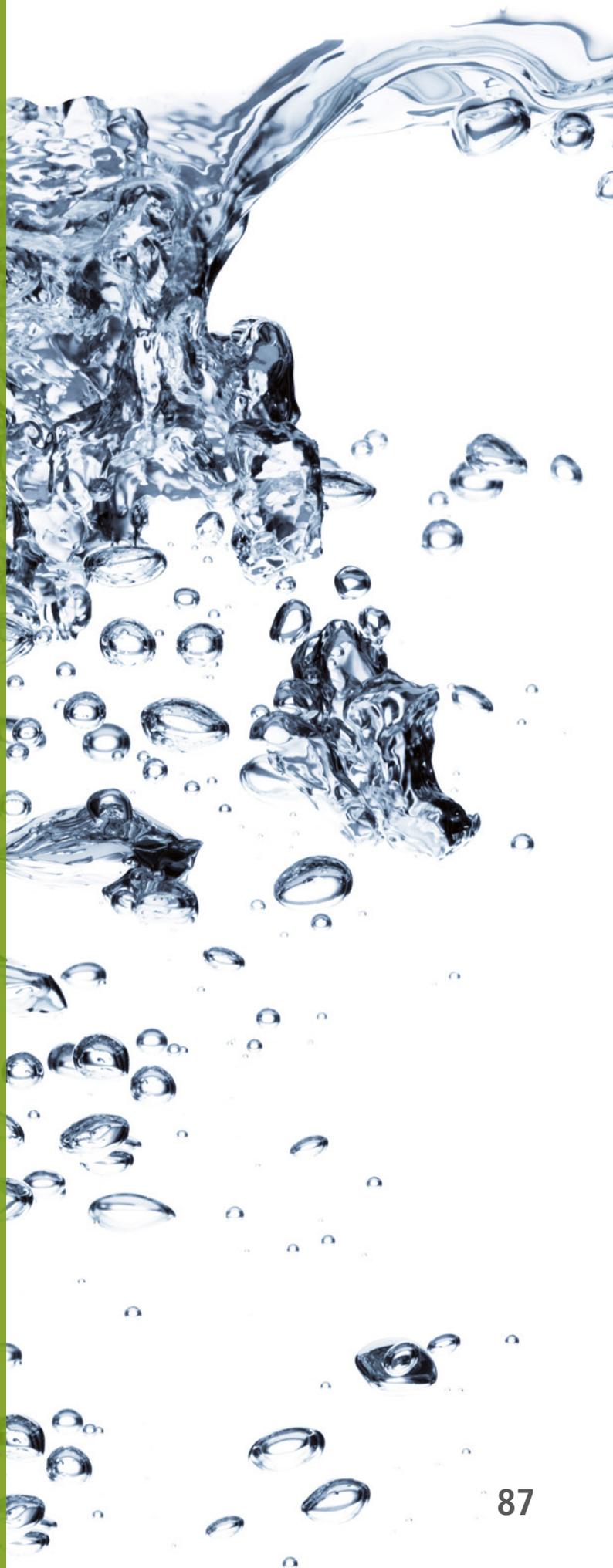
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## FRESH WATER SUPPLY

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One possibility is to use water-saving devices such as special shower heads, flow limiters in sinks and showers, timers and infrared controllers in the sanitary installations.

AIDA Cruises has committed itself to having the lowest consumption levels of fresh water in the entire cruise ship industry. The aim is to effect annual reductions in water consumption per day and per passenger. This goal calls for effective systems. Vacuum-food waste systems are being installed on new ships, which consume considerably less water than conventional systems. Instead of flushing waste through pipelines using water, it is transported via a vacuum suction system into a dedicated storage tank. Toilets are also fitted with a vacuum system, to reduce water consumption each time the toilet is flushed. This reduces water consumption each time the toilet is flushed from six litres for a gravity toilet to only 1.5 litres. Particularly economical systems have meanwhile attained a value of one litre per toilet flush.



# EVAPORATION AND OSMOSIS PLANTS

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No matter how economical they are, it will never be possible to bunker the water in harbours in the volumes in which they are needed. Which is why modern cruise vessels have evaporators and osmosis plants on board for making fresh water from seawater. Out at sea, water is supplied by evaporating seawater in specially developed fresh water generators. The steam is condensed, treated and fed to the consumers. Salt dissolved in the seawater remains in the brine following the evaporation process.

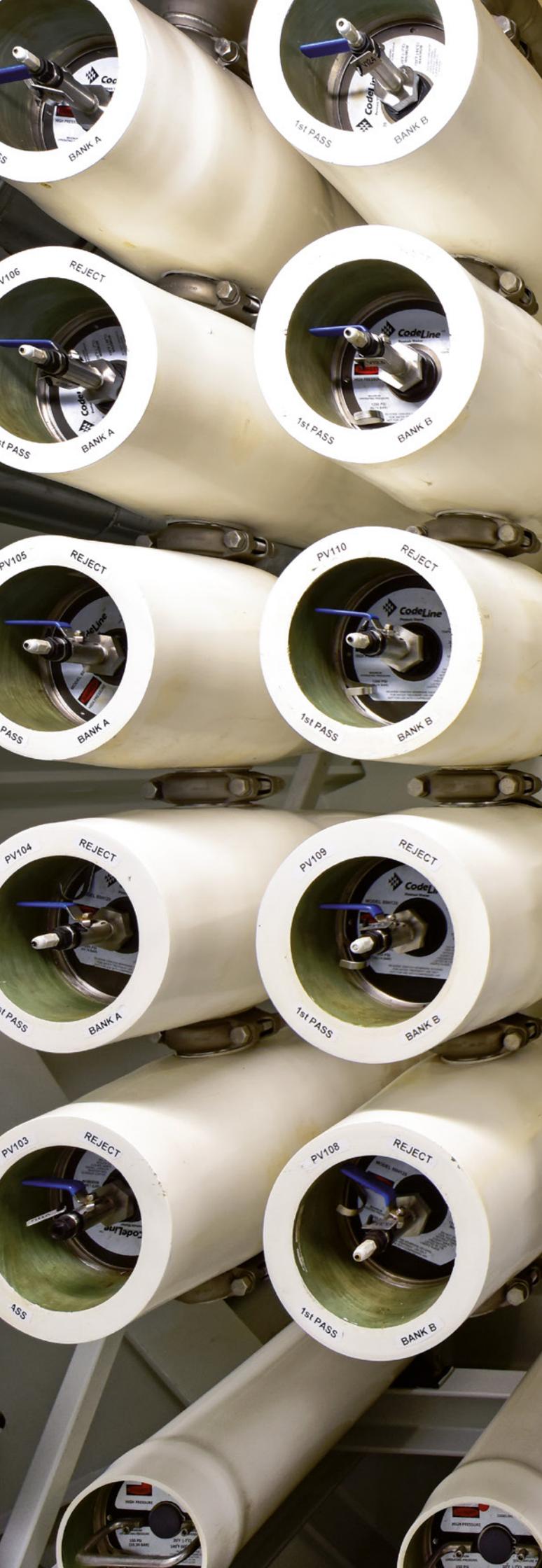
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Fresh water generators installed by MEYER WERFT attain a high level of energy efficiency thanks to the effective interplay of several factors. One of these is that the energy requirements of the evaporation plants are largely covered by heat from the main engines. The environmentally friendly process of fresh water generation includes heat recovery processes, the utilisation of condensation heat and the connection of eight flash evaporators in series, which run on negative pressure and at their maximum level are able to bring seawater to the boil at temperatures of less than 40 degrees.

The process involves taking in seawater and mixing it with non-evaporated water in the fresh water generator. This recovers the heat energy of the brine. The mixture subsequently runs through heat exchangers installed in the fresh water for the purpose of dissipating the condensation heat. The seawater in the heat exchangers absorbs the condensation heat, which increases its temperature still further. Additional heat exchangers and flash evaporators are connected in series.

With several thousand passengers on board, drinking water consumption is high. Reverse osmosis plants are also used in addition to evaporation systems. These devices use membrane filters that are able to hold back viruses and salt molecules from the seawater. In this process, the seawater is pumped into the filter at a pressure of 60 bars by a high-pressure pump. By using increased pressure, water molecules are forced through the membrane such that the water is subsequently suitable for use as fresh water. Dissolved salts, organic components and microorganisms are held back. The concentrate is discharged overboard.

The pressure energy in the concentrate was rendered usable for the first time a few years ago, using a concept specially developed for the Celebrity Cruises shipping company. An impeller was installed in the concentrate discharger of the reverse osmosis system, which was driven by the concentrate. The impeller was connected to another one in the feed of the system. The energy remaining in the concentrate was transferred to the seawater in the feed, allowing the pump power to be reduced. Recycling resulted in a 65 percent reduction in the energy required by this type of reverse osmosis plant.



# OIL EXTRACTION

Seawater

Heavy oil

Oil

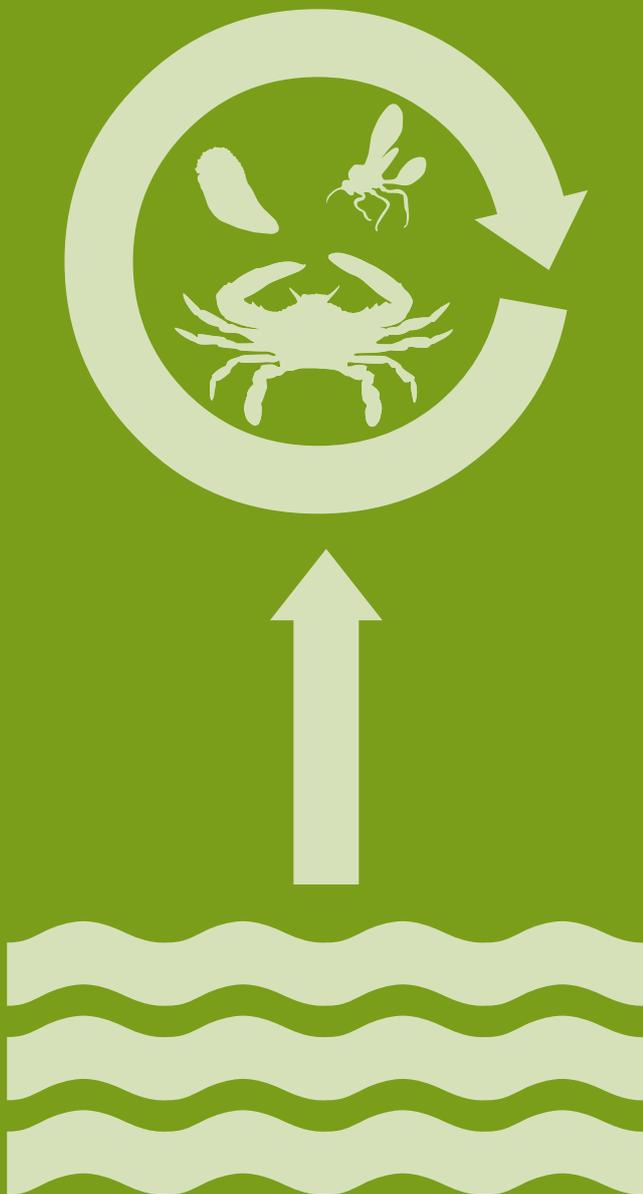
Cold cleaner

Dirt

As a result of maintenance work, tank dewatering and various necessary purification processes, a waste water product builds up inside ships that gathers in the so-called "bilge" in the bottom of the ship's hull. It is a mixture of seawater, heavy oil, lubricating oil, cold cleaner emulsion and dirt.

Using the latest technology, this bilge water can now be treated such that it no longer forms a risk to the environment. Residual oil contents of 15 ppm in the waste water can now be achieved using modern technology.

# BALLAST WATER TREATMENT



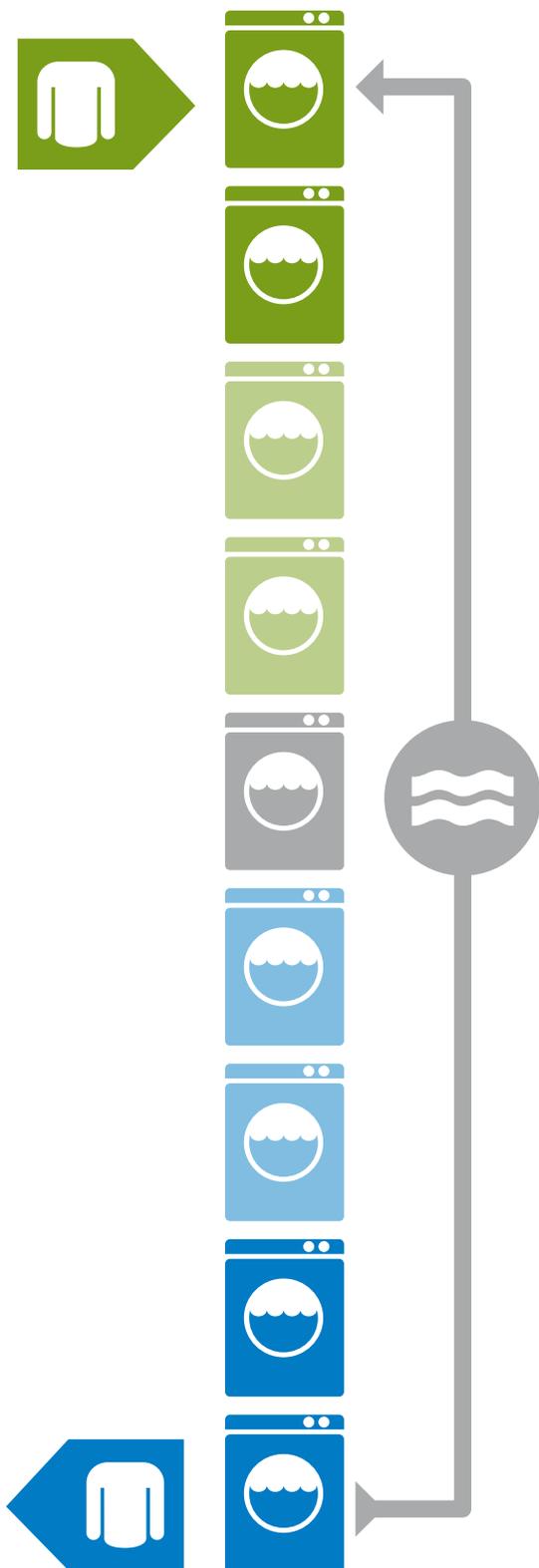
Cruise ships need so-called “ballast water” to ensure a stable floating position. This is seawater that is pumped into tanks or back into the sea, as needed. Ballast water has been a problem for shipping for more than 100 years because it causes minute marine animals, eggs and larvae to be transported from one continent to another. Wherever ballast water is returned to the sea, these “stowaways” can cause sustained damage to the ecosystem as a result of enormous reproduction rates. For several years, research has been carried out into treatment solutions, which for example enable disinfection of the ballast water by a physical process using a combination of filtration and ultraviolet radiation when extracted from and before being returned to the sea.

The first such system for purifying ballast water was installed on the AIDAstella, which was delivered by MEYER WERFT in 2013. The purification system subjects the ballast water to both mechanical treatment and UV radiation. In general, the ballast water is not only treated when the seawater is first taken in but the process is repeated approximately every two weeks to filter out any residual organisms that may have multiplied in the meantime.

All other ships in the AIDA fleet have been gradually retrofitted with such a system. Environmentally friendly procedures are needed to protect the waters.

Back in 2004, the IMO passed a ballast water agreement, which codifies the management of ballast water as well as its performance and monitoring. However it is currently not possible to say when the agreement will be enforced under international law. So far, 38 states have made a binding declaration at the subsidiary organisation of the United Nations. Germany deposited a ratification certificate with the secretary general of the IMO in summer 2013.

# LAUNDRY



Fresh towels, fresh bed linen and fresh tablecloths: just like in any other hotel, a well-performing laundry is vital on a cruise ship. MEYER WERFT employs the latest technologies available in the ship's large laundries. For example, the laundry uses condensation water from the air conditioning system, which has reduced the consumption of fresh water. Depending on the current geographical area, the daily volume of condensation water can be between 60 and 80 cubic metres.

The Celebrity Solstice of Celebrity Cruises was delivered in 2008 and is the first cruise vessel built in Papenburg to incorporate a new type of integrated laundry line facility complete with drier and mangle lines. An essential factor here was to ensure a high level of automation. With the installation of the laundry line, which comprises nine washing units, water consumption could be reduced to between 5 and 6 litres per kilogram of laundry. In conventional spinning machines, water consumption is between 15 and 18 litres per kilogram of laundry, or 11 litres in systems using water recovery. The laundry line system involves circulating wash water; after the washing process in the final chamber has been completed, the water is pumped off, new washing detergent is added, and the water re-enters the first chamber to begin a new washing sequence. This method has resulted in a reduction in the consumption of water and energy as well as washing additives.

The subsequent laundry drying procedure is performed as energy efficiently as possible, in driers that function with internal heat recovery. As a result, the energy requirements of the driers have been reduced by 25 percent.

# 4.

## EDUCATION, HEALTH & SOCIAL MATTERS






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**MEYER WERFT is one of the biggest employers in the north west of Germany. The family-run company is known for its modern and progressive attitude to shipbuilding. The central factor of the shipyard's success are its employees, and its corporate culture is rooted in securing the future of the shipyard and its jobs. In 2013 the company further intensified its profile by laying down requirements concerning conditions in the workplace and the social rights of employees within a formal framework of exemplary character. This led to the formulation and implementation of the social charter, a code of conduct for suppliers and employees, and an in-house wage agreement for service-contract employees.**

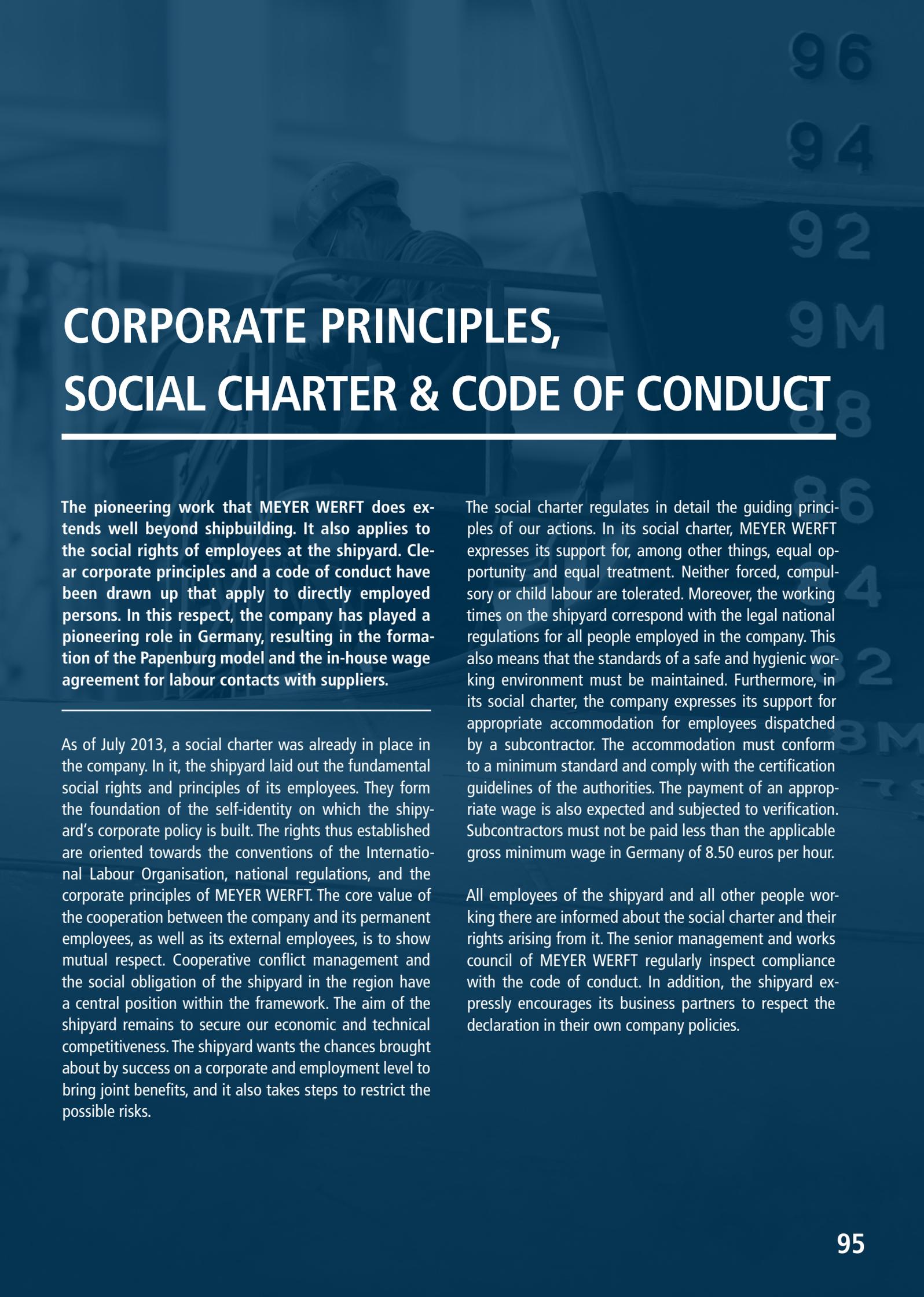
## THE SHIPYARD AS A SOCIAL NETWORK

As part of its overall social responsibility, the company sees it as its obligation to care for its more than 3,300 employees and to provide them with support and encouragement whenever needed. At MEYER WERFT, we are convinced that a healthy, motivated workforce that also shows a willingness to learn is absolutely essential for the long-term financial success of our shipbuilding enterprise. That the well-being of employees is a key factor is visible not only directly at the workplace but also beyond. A well-functioning family environment also plays a major role. Several years ago, the shipyard began offering its own advisory activities, along with additional services offered in cooperation with public institutions in the surrounding cities, to give employees the best possible support in all the challenges facing them on a personal level. This includes a wide range of health measures as well as support in looking after family members in need, applying for housing benefit or contacting social and psychiatric services. A major step in improving the compatibility of working life with family life was the opening of an in-house company kindergarten in spring 2013.

Traditional and modern aspects come together on many levels within the company. Qualified employees are considered as high-value goods at MEYER WERFT. Ongoing training, lifelong learning and innovative spirit are actively supported. We at the shipyard are convinced that education constitutes a decisive competitive advantage and one that needs to be utilised and expanded continually to ensure that we remain able to respond to continually changing requirements. The MEYER WERFT academy offers its employees a wide range of possibilities for taking part in training and further training activities. The MEYER WERFT has a long tradition of offering vocational training and invests in the future of young people every year. Young trainees receive professionally sound and, above all, practical training in 12 different vocations. The MEYER WERFT also offers the practical placement programmes for doing a sandwich course degree in various different subjects. As one of the largest training companies in the region, we also live up to our responsibility for working together with regional training and educational institutions. Through various cooperation measures, e.g. with the „Johannesburg“ training centre, we contribute to helping underprivileged youngsters and those with learning difficulties together with people who have been unemployed for a long time and currently also refugees from the various crisis areas, offering them a chance to obtain vocational qualifications and thus to become integrated in our society.

Once people are established with the company, opportunities are available to obtain additional qualifications and to further their career in the firm. These include flexible additional training possibilities as well as long-term training courses. The strategic employee development concept at the MEYER WERFT stands for future-oriented, life-long learning. Funding programmes and also grants are made available to employees who are interested and willing to keep learning. We became aware at an early stage that we can only be competitive by discovering, developing and reinforcing our strengths and advantages.

Finding, training and retaining specialist employees is as elementary as reinforcing their bond with the company. At the shipyard, we promote and foster long-term bonds with the company, something that has become a rarity nowadays. These remain from the training phase right up until (pre-)retirement age and beyond. Part of this concept is the pensioners association, MEYER WERFT e.V., founded in 2007, which today has 350 members.



# CORPORATE PRINCIPLES, SOCIAL CHARTER & CODE OF CONDUCT

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The pioneering work that MEYER WERFT does extends well beyond shipbuilding. It also applies to the social rights of employees at the shipyard. Clear corporate principles and a code of conduct have been drawn up that apply to directly employed persons. In this respect, the company has played a pioneering role in Germany, resulting in the formation of the Papenburg model and the in-house wage agreement for labour contacts with suppliers.

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As of July 2013, a social charter was already in place in the company. In it, the shipyard laid out the fundamental social rights and principles of its employees. They form the foundation of the self-identity on which the shipyard's corporate policy is built. The rights thus established are oriented towards the conventions of the International Labour Organisation, national regulations, and the corporate principles of MEYER WERFT. The core value of the cooperation between the company and its permanent employees, as well as its external employees, is to show mutual respect. Cooperative conflict management and the social obligation of the shipyard in the region have a central position within the framework. The aim of the shipyard remains to secure our economic and technical competitiveness. The shipyard wants the chances brought about by success on a corporate and employment level to bring joint benefits, and it also takes steps to restrict the possible risks.

The social charter regulates in detail the guiding principles of our actions. In its social charter, MEYER WERFT expresses its support for, among other things, equal opportunity and equal treatment. Neither forced, compulsory or child labour are tolerated. Moreover, the working times on the shipyard correspond with the legal national regulations for all people employed in the company. This also means that the standards of a safe and hygienic working environment must be maintained. Furthermore, in its social charter, the company expresses its support for appropriate accommodation for employees dispatched by a subcontractor. The accommodation must conform to a minimum standard and comply with the certification guidelines of the authorities. The payment of an appropriate wage is also expected and subjected to verification. Subcontractors must not be paid less than the applicable gross minimum wage in Germany of 8.50 euros per hour.

All employees of the shipyard and all other people working there are informed about the social charter and their rights arising from it. The senior management and works council of MEYER WERFT regularly inspect compliance with the code of conduct. In addition, the shipyard expressly encourages its business partners to respect the declaration in their own company policies.



## THE PAPENBURG MODEL

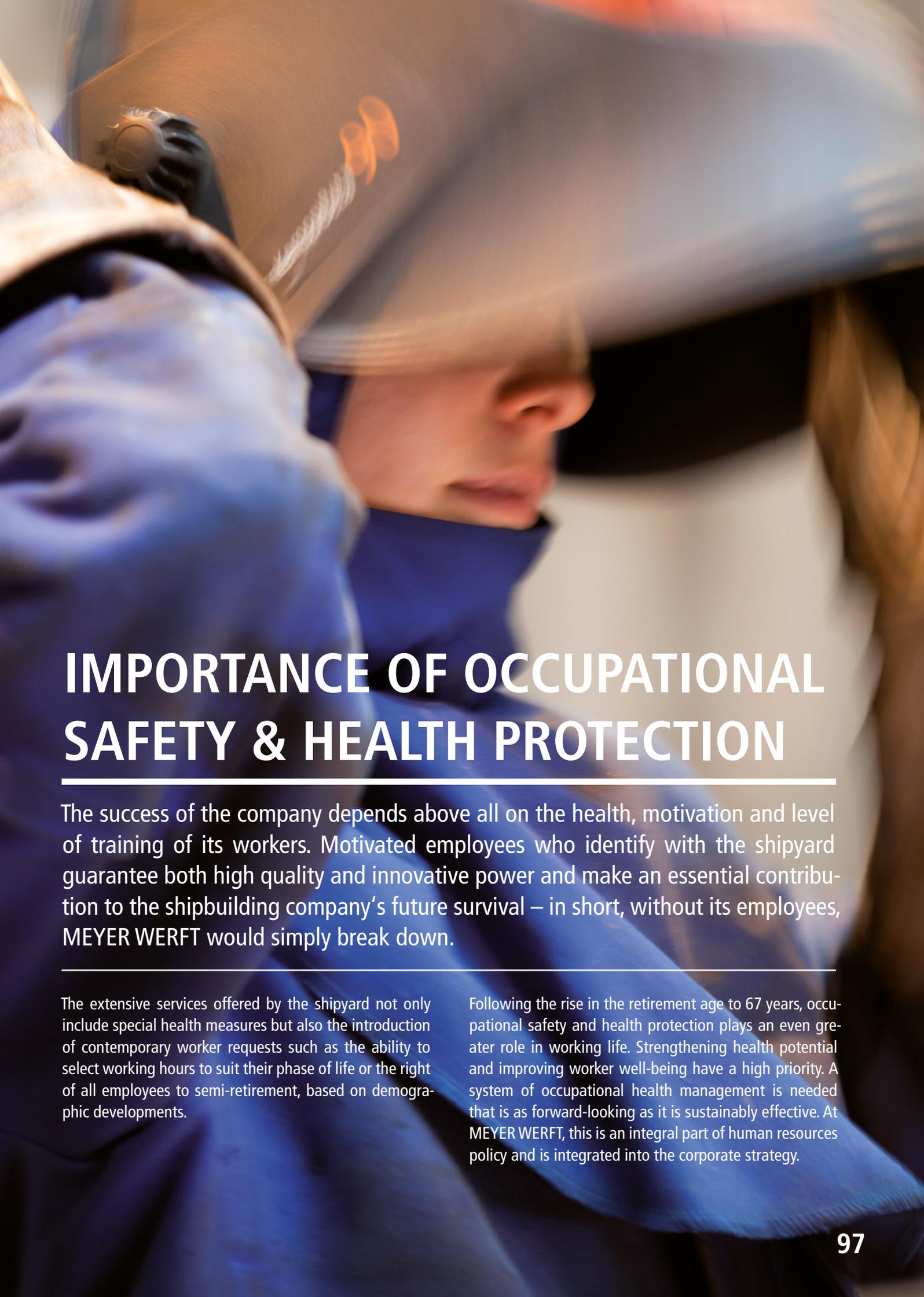
MEYER WERFT has an enduring commitment to upholding good working conditions at the shipyard. In addition to its social charter and its code of conduct for suppliers, it has also drawn up an in-house wage agreement for labour contracts, which has been in force since October 2013.

The contract is exemplary in Germany and was devised in intensive negotiations with the union IG Metall Küste and the works council. Together with the Pact for Work and Innovation (February 2013) and the Location Safeguarding and Future Wage Agreement (October 2012), the regulations concerning labour contracts form what is known as the Papenburg Model.

The in-house wage agreement is an important instrument for improving the living conditions of labour contract employees. Together with the accompanying measures taken by the districts and surrounding cities and municipalities, the contract sets out important prerequisites for appropriate working and living conditions. Anyone working for longer than a month at MEYER WERFT in Papenburg is subject to the regulations of the in-house wage agreement.

The core of the agreement is that the shipyard will oblige all subcontractors with contracts to maintain minimum standards of working hours, occupational safety & health protection, accommodation and wages. The right of complaint in the event of non-compliance with standards is expressly stated.

The company's overriding goal of securing the future of the shipyard and, in turn, the jobs there forms the guiding principle of all measures. MEYER WERFT considers it important that its future ship production continues to be based on labour contracts. Labour contracts form an indispensable and integral factor in cruise ship construction. Wage negotiators and in-company parties work together intensively to position the shipyard in the global field of competition such that it can master all the challenges it is faced with, both now and in the future.



# IMPORTANCE OF OCCUPATIONAL SAFETY & HEALTH PROTECTION

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The success of the company depends above all on the health, motivation and level of training of its workers. Motivated employees who identify with the shipyard guarantee both high quality and innovative power and make an essential contribution to the shipbuilding company's future survival – in short, without its employees, MEYER WERFT would simply break down.

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The extensive services offered by the shipyard not only include special health measures but also the introduction of contemporary worker requests such as the ability to select working hours to suit their phase of life or the right of all employees to semi-retirement, based on demographic developments.

Following the rise in the retirement age to 67 years, occupational safety and health protection plays an even greater role in working life. Strengthening health potential and improving worker well-being have a high priority. A system of occupational health management is needed that is as forward-looking as it is sustainably effective. At MEYER WERFT, this is an integral part of human resources policy and is integrated into the corporate strategy.

# OCCUPATIONAL SAFETY AND HEALTH PROTECTION – THERE FROM THE START

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At MEYER WERFT, employee health and safety enjoys the utmost priority – and always has done. The shipyard has developed a successful occupational safety programme for trainees, the purpose of which is to minimise the risk of accident to career newcomers, by familiarising them at an early stage with the processes at the shipyard. Statistically, the 17-24 year-old age group is subject to a particularly high risk of accident. For this reason, the occupational safety and training departments have devised a joint plan, in which young career starters are assigned an experienced mentor for support. Moreover, all trainees at MEYER WERFT go through an internal training programme. The field of occupational safety is covered in its entire breadth over five training modules, using methods that are at times unconventional and innovative, such as the interactive theatre piece designed to familiarise them with the theme of road safety. A central feature of the training programme are the practical exercises, which are designed to expand on the theoretical knowledge. The programme also includes a special seminar for trainees at the “Metall-Genossenschaft”, which covers the specific concerns and interests of the shipyard. Each year, selected safety officers are also involved in the training courses.

## ABSOLUTELY VITAL: PROTECTION MEASURES

In a production company protective helmets, shoes and clothing are an absolute must. Protective goggles are anything but an accessory at MEYER WERFT; in the presence of splinters, UV radiation, solvents and heat, protection of the eyes and ears is essential. The goggles distributed at the shipyard are individually fitted. Not only is it important to have the right protective clothing but also to have an awareness of the processes that are involved in shipbuilding: in the campaign “Tread Safely”, initiated by the occupational safety department, both shipyard employees and members of partner firms simulate typical accident scenarios such as tripping, slipping and falling, complete with on board inspections.



# RISK ASSESSMENT – TAKING RESPONSIBILITY

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The objectives of occupational safety are laid down in official guidelines contained in the occupational safety law – the elaboration and implementation of the risk assessment is, however, increasingly the responsibility of the company itself. MEYER WERFT has used this responsibility as an opportunity to develop a process-integrated and sustainable risk assessment. In the shipbuilding company, it is not only the industrial safety experts and occupational safety officers who are involved in the risk assessment, which plays a central role in ensuring the smooth flow of work, but also managers and employees on site. By directly integrating all employees in the process, occupational safety can be sustainably incorporated in the core processes of the company.



The workplace must be made as safe as possible. This is a basic principle, for which MEYER WERFT has developed and implemented appropriate protection measures in its risk assessment. The company has conducted a detailed and systematic screening of all activities and departments with individual risk assessment teams. Work protection and occupational safety goals have been defined and codified in a measures sheet. Senior staff, employees and safety officers of a department search together for the best and safest solution. Central to this process are such aspects as transparency, continual improvement of workflows and consistency.

The demands of work protection and occupational safety will rise even further in the future. MEYER WERFT is sustainably involved in this area right now. In addition to compiling its own risk assessment, construction foremen are trained by trade associations and suppliers assessed by occupational safety officers. Certification of partner firms with respect to their occupational safety is also envisaged for the future.



## SUSTAINABILITY IN PURCHASING AND WITH INTERNATIONAL CONTACTS

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MEYER WERFT primarily relies on a regional supplier network for its cooperations. This takes in a radius of about 150 kilometres around the shipyard sites in Papenburg or Rostock, respectively.

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The yardsticks of cooperation with suppliers are transparency and good communication. The company has created an Internet application known as the MEYER NEPTUN PORTAL, in which MEYER WERFT and NEPTUN WERFT can communicate with external partners directly and without barriers. In the Material Management/Purchasing area of the portal, it is now possible to view a database containing data provided voluntarily by existing and potential suppliers, while companies can present themselves in a regional network. To simplify exchanges, there is also a market place, organised like a notice board. In future, it will also be possible to perform procurement activities through the Internet portal.

MEYER WERFT works with its suppliers in a spirit of trust. Its regular supplier evaluation has proven to be a useful corporate instrument. The title of Partner of the Year has been awarded to selected suppliers since 2005. Moreover, the shipyard organises a “Day of Possibilities” as a platform for entering into direct talks with new suppliers. Dialogues with suppliers and transparency of shipyard activities are matters of great importance to the company. The shipyard publishes its own information magazine, “Im Dialog”, in which it reports news from its suppliers in the fields of purchasing and material management. Companies interested in working together with MEYER WERT can register to use the portal.

The code of conduct at MEYER WERFT obliges all the shipyard's suppliers to comply with social standards.



## CODE OF CONDUCT WITH RESPECT TO SUPPLIERS AND EMPLOYEES

More than 800 partner companies are involved in the building of a cruise ship. The current subcontracting share of around 75 percent per cruise ship is a clear indication of how important MEYER WERFT considers a good level of cooperation between itself and its suppliers.

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In line with its social charter, the shipyard devised a code of conduct in summer 2013, which now forms an integral part of contracts concluded with suppliers. Upon concluding the contract with MEYER WERFT, all suppliers undertake all measures necessary to ensure implementation of the code of conduct and compliance with the defined social standards. These include working hours, working conditions and wage payments.

# SUSTAINABILITY IN EVERYDAY COMPANY LIFE







## SUSTAINABILITY IN EMPLOYEE CARE

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Food and drink hold the body and soul together. A balanced diet is essential for a fit and healthy life. This is particularly true at the workplace. Every day, the Papenburg company Menü 2000 Catering provides a selection of dishes at the works restaurant at MEYER WERFT. The focus is on short distances, fresh and healthy ingredients and concentration on the region.

Dishes are freshly prepared on the premises in the works restaurant every single day. The catering company attaches great importance to freshness and does not serve reheated food. All dishes are prepared in line with the latest nutritional research.

According to its own information, Menü 2000 is the largest owner-managed corporate catering business in Germany. The food quality is TÜV-tested and the company even has ISO 9001 certification.



## TRANSPARENCY AND INTERNAL COMMUNICATION

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MEYER WERFT maintains a culture of exchange, transparency and open communication. Employees, suppliers and the public alike are regularly kept up to date about the activities at the shipyard. The shipyard's visitor centre and its guided tours are open to anyone who would like to view the shipbuilding process up close. It is operated jointly with Papenburg Tourismus GmbH. It was re-opened in spring 2015 after a complete reattraction and refurbishment.

The employee magazine "kiek.ut" and the press ticker "Neues von der Werft" are two essential information channels within the internal communication structure. For example, the printed magazine publishes various reports covering new projects, technological innovations and co-operations. This puts all employees and suppliers on the same level of information and ensures they are always notified about activities at the shipyard. However, MEYER WERFT regards the Internet as a central modern information source. News is published on the shipyard's website on the Internet, and the company also uses the medium as a driver of knowledge management. The Wikipedia online encyclopaedia is an important tool, as is the company's presence in social media like Facebook and Youtube.

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Link to the Internet site:

[www.meyerwerft.de/en/meyerwerft\\_de/besucher/besucherzentrum/besucherzentrum.jsp](http://www.meyerwerft.de/en/meyerwerft_de/besucher/besucherzentrum/besucherzentrum.jsp)

[http://en.wikipedia.org/wiki/Meyer\\_Werft](http://en.wikipedia.org/wiki/Meyer_Werft)

# HEALTH MANAGEMENT 2015

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More exercise, a healthier diet and all-round health care: MEYER WERFT has a great interest in promoting the health and motivation of its employees. A modern health-management system with sustainably effective service offers is essential. As a result of the demographic shift and the increase in the retirement age to 67, the subject of health at work has taken on increasing significance in everyday company life. Keeping fit into old age is an important matter, both for the shipyard and for its employees. The company has undertaken to make working conditions as pleasant as possible for its employees and to provide leisure activities as a balance for working activities.

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One of the central aspects of the shipyard is its occupational health management, which complements personnel and organisational development and forms an essential component of company policy. The aim of health management is to develop and implement sustainable measures for maintaining the workforce's health. Special attention is given to the themes of ergonomics, stress, psychological stress and diet.

Thanks to a cooperation with Hansefit, an amalgam of several regional fitness studios and physiotherapy practices, employees at the shipyard are able to select from fitness and wellness services offered by a range of suppliers in northern Germany. The programme includes custom training opportunities, professional support and advice, long opening times and childcare.

A range of courses are also offered through the occupational health management service, covering subjects such as coping with stress, nutrition, yoga, muscle relaxation, cardiovascular training and giving up smoking. Help and advice for employees are also available from the works doctor, medics and health advisers. They give support and motivation in the event of illness and initiate health-promoting measures such as ensuring an optimum workplace design. Addiction counsellors provide information and offer methods of treatment to help addicts or those at risk of addiction.



# INTEGRATION MANAGEMENT / BEM

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Integration is another important theme for companies. The works integration management controls measures that are designed to give employees with health problems or disabilities a permanent deployment at a suitable workplace. This applies not only to employees with a disability but to all employees at the shipyard.

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The shipyard's health officers support employees in installing step-by-step plans and help programmes and in implementing measures for creating optimum, health-promoting workplaces. MEYER WERFT upholds its undertaking to employ people with disabilities. Furthermore, the company works closely with a workshop for handicapped persons.





# FAMILY AND SOCIAL MATTERS

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**MEYER WERFT is a family-friendly workplace and was even awarded the official quality seal – in 2011 the shipyard won the Family Friendliness Award from the “Family and Work” foundation. For MEYER WERFT, family friendliness is more than just a modern slogan, it is part of a longterm strategy.**

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Anyone advertising for qualified employees with a desire to expand his competitiveness must do more than just list a few powerful arguments in a job advertisement. So-called “soft facts” play an increasingly important role in the decision-making process. Education, culture and sports activities are also meaningful, as is a good and reliable child care service. In March 2013, MEYER WERFT opened “Nautilus”, its works kindergarten, in cooperation with the Emsland district group of the German Red Cross (DRK), in so doing breaking into new territory.

There are now two day nurseries and two kindergartens housed in the new building at Gate 2. Children can be looked after as required between the hours of 7 am and 5 pm. Two thirds of the places are reserved for children of people working at the shipyard, while parents from the surrounding industrial area and the city region of Papenburg can apply for the remaining third of available places. In providing this service, the shipbuilding company is a pioneer in the region.

The world of work is increasingly characterised by flexibility and mobility. It is necessary to work for change and to create a society that is more friendly to children and families. It remains the aim of MEYER WERFT to create an employee-oriented corporate culture, which makes it possible to harmonise employees’ working and private lives as much as possible. A positive work-life balance not only benefits employees but the company too. This also includes letting employees coordinate their working times as they see fit and enabling them to care for family members.

In addition to its own services, MEYER WERFT cooperates with family advice centres in Papenburg and Leer, who advise people with problems related to child upbringing, separation, pregnancy or relationships. It also operates a cooperation with a social-psychiatric service, which offers house visits, private consultations and group activities designed to help employees cope with any problems they may have.





# A VISIT TO NAUTILUS

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**A fragrant air blows from the “coral reef” through the bright corridor, which is decorated with fish, anchors and coral as far as the eye can see. It gradually merges with the aroma of freshly baked apple crumble. Nicole Lammers, whose door bears the legend “Captain” written in colourful letters, smiles and will soon be sampling this delicious dessert. Baking is a popular activity at the Nautilus day-care centre. There is even a special little children’s cooker installed at children’s height. The three-to-six-year olds are very involved in the activities and great emphasis is placed on joining in.**

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Loads of little rucksacks, a flood of Wellington boots and colourful jackets populate the elongated cloakroom on the ground floor of the cheerfully decorated yellow and orange building. There is plenty going on in the building right alongside Gate 2, which was opened in 2013. What started out as a single group has grown to four within only one year: two kindergarten groups and two day nurseries. Nautilus has more than 80 children, along with 16 staff plus a kitchen assistant – and yet right now there is a ghostly silence. Where is everybody? Well, over in the “Coral Reef”, the children are proudly sampling the cake they made themselves, while others are making and building things and playing with dolls in the “Treasure Chest” next door. Janis, Thore, Olga and their friends are in their element. “Don’t worry, it isn’t always like this”, laughs the head of the kindergarten, as she trots energetically up the stairs to the top floor, puts the blue protectors on her shoes and opens the door to the crèche area. Melissa winks at her happily from the colourful climbing boat. Mats is working on his football career and kicks a ball around slightly unsteadily. The big corridor is also an indoor playground for the youngest ones. Next door to their group rooms, known as the “Seagulls’ Nest” and the “Shell Basket” is the “Island of Calm”. After lunch, small beds await the children here, along with their favourite teddies and blankets brought from home. “It is very important that they have something with them that they are familiar with,” stresses the boss of the day centre.

As you would expect on board a ship, all the doors in the Nautilus have a porthole. Lammers looks through one of them towards the new “Klabauter Cave”. „Our new sports hall“, she says proudly. Since November 2014, the day centre with the bright and inviting room has yet another highlight on offer. Because no matter how much young and old sometimes appreciate the benefits of a quiet atmosphere, children often want to run about and play and they should be encouraged to do so. Here they have a climbing wall, rings, swings, balls and mats, where they can run around and play as much as they like. “Hey, look at me, I’m a lion”, growls Tristan, darting round a corner. Nicole Lammers pretends to be afraid and the boy smiles with joy. The spontaneous gestures underline the principle set out on the metal plate in her office. “Playing required! Laughter and frolicking permitted for children and adults.” Being in contact with children is a wonderful and enriching experience for her, even after so many years in her profession.

“We are very lucky to have one of the most modern kindergartens that we could possibly have”, says Nicole Lammers. In addition to several routine activities, children learn a wide variety of other things. Exercising, playful music lessons, plus special activities for pre-school children and for children with a thirst for knowledge and experimenting. But the focus is always on having plenty of space to play and try things out until their mummies and daddies come from work to pick them up. The best place for running round is the big outdoor area where they can capture the real “Nautilus”. The yellow red and blue play-ship, built by trainees on the shipyard, is a real eye catcher.

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Link to the Internet site:

[www.meyerwerft.de/en/meyerwerft\\_de/werft/umwelt\\_und\\_soiales/soziale\\_verantwortung/kita\\_nautilus/kita\\_nautilus\\_1.jsp](http://www.meyerwerft.de/en/meyerwerft_de/werft/umwelt_und_soiales/soziale_verantwortung/kita_nautilus/kita_nautilus_1.jsp)



## SOMETHING COMPLETELY NEW!

Short interview with Nicole Lammers, head of the Nautilus kindergarten

### What is special about this children's day centre?

**Nicole Lammers:** It is the first ever works day centre for children in this region. We are in the very fortunate position of being able to work closely with the children in an all day schedule and we do this at a high educational level, in accordance with the latest standards. Moreover, the day centre is a place of encounter. Children of staff employed in all fields of work, from machine fitters to managers, meet here. This encourages a sense of community. Furthermore, the shipyard as our partner has placed its complete faith in our expertise, which gives us the perfect space to put our skills to their best use.

### You had to enlarge the day centre rather quickly. Were you surprised by its success?

**Nicole Lammers:** No, not really. A works kindergarten offers great benefits to a company. Apart from giving it a clear competitive advantage, it affords parents great flexibility. They can go to work with peace of mind and concentrate on their jobs, without the stress from long times spent in traffic. This in turn benefits the company. By providing an all-day service, we also enhance parents' flexibility. They can pick up the children whenever it suits them, and they make increasing use of our all-day availability. The new kindergarten enjoys great acceptance and this is something we wish to build on.



### What do kindergartens today need to offer?

**Nicole Lammers:** Clearly, kindergartens need to sharpen their profile and do more to accommodate the requirements of families. Quality will assert itself in future ahead of the mere convenience of having a place close to home. This is something I am convinced of. We are already trying to get a lot of things moving, for example through our programmes for language training and violence prevention as well as through scientific research. A further goal is to obtain certification for the kindergarten. The important thing is that we are able to give the children a good start.

**Thank you for the interview.**

## OTHER SERVICES FOR EMPLOYEES

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MEYER WERFT's social responsibility extends beyond health promotion and family friendly services and also includes an internal mobbing advice centre and debt counselling. The latter is designed to assist individuals and families who are in debt in paying off what they owe, helps them get to grips with their financial problems and enables them to look to the future with confidence.

There is also a relief fund operating at the shipyard, to which all employees or their relatives who are in need are entitled. The relief fund is financed by donations from shipping companies as well as by the employees themselves. MEYER WERFT employees also enjoy further internal benefits, such as a pension fund and a direct insurance policy with the MetallRente pension fund.

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Link to the Internet site:  
[www.metallrente.de](http://www.metallrente.de)



## REPRESENTATION FOR SEVERELY HANDICAPPED EMPLOYEES

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The representative body for disabled employees is an elected interest group that looks after the needs of MEYER WERFT employees who are severely handicapped or have equivalent status. They are the people to whom employees can go to with problems, and they also monitor adherence to any regulations affecting severely handicapped people as well as the implementation of required measures. The representation for severely handicapped employees also supports disabled employees in placing applications with integration offices for recognition of disabilities or equivalent status.



# EMPLOYEE REPRESENTATION

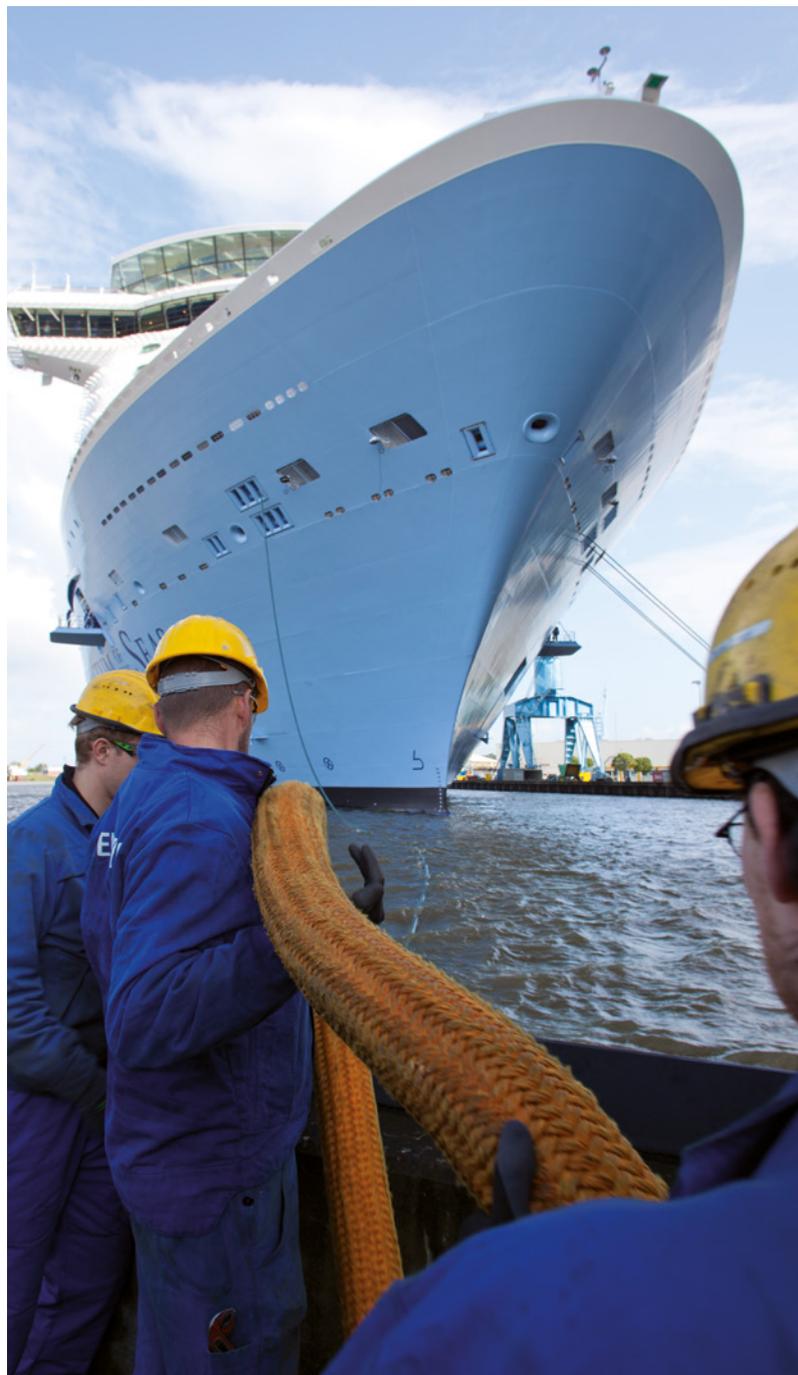
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For 90 years now, there has been an employee representative body at the shipyard that campaigns forcefully for the interests of its employees. The works council at MEYER WERFT held its first meeting in July 1924. The negotiations with the management at that time concerned wages, potato money and new rents for works accommodation.

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Over the decades, the themes may have changed but the commitment is the same. Now, as much as in the past, the shipyard works council represents the interests of employees at the shipyard. Its central tasks include checking that laws, ordinances, wage agreements and works agreements are being adhered to in favour of employees. Today, the shipyard works council has twentyfive members, five of whom are released from their regular activities, as provided for in the legal regulations, to allow them to concentrate on their duties for the works council.

In general the MEYER WERFT management maintains a constructive exchange with the works council. For many decades, the works council has sustainably committed itself together with the management to the preservation of the shipyard at the Papenburg site. There have been many discussions with environmental groups centring on relocating the shipyard due to the deepening of the river course, to enable the passage of increasingly large craft along the Ems. After weighing up all the relevant aspects in this matter, the works council has always supported the development of the infrastructure on the Ems as well as the creation of new jobs, to preserve the region's economic leverage.



# COMPLIANCE

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MEYER WERFT stands for clear fundamental ethical values and precepts that are defined in the corporate principles and codes of conduct. Regulations pertaining to compliance and anti-corruption are thus an integral part of the corporate culture. They are an important element and guideline for our daily cooperation within our shipyard and its subsidiaries. The group of companies has a central business unit that attends to compliance with the rules and the on-going development of the regulations.

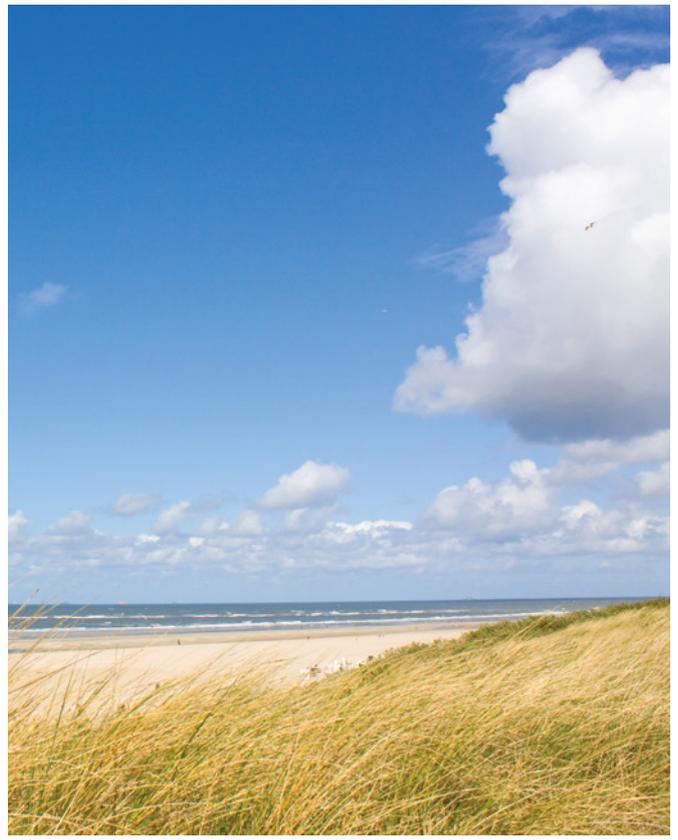
The central aim of our companies is to continue being successful and generating profits over the years ahead. One major prerequisite in this respect is that we fulfil the expectations made of us. This means that we live up to both customer expectations and the requirements made by society, our suppliers, employees and owners. Here our aim is to be convincing through our honest services and products.

The requirements made of us are expressed in laws and state regulations as well as internal stipulations and guidelines. Fulfilling the expectations made of us serves in the end to secure the continued existence of our company. The corporate principles and codes of conduct constitute the demands we make of ourselves and our partners to live up to these expectations.

Each and every one of us is obliged to heed and comply with laws, regulations and internal rules. We therefore expect that in working for our company, every individual fulfils the strictest standards of law-abiding behaviour, fairness, honesty, integrity and correct conduct. The company management and senior executives act as role models in this respect and are responsible in particular for active implementation of the compliance culture.

Our regulations do not currently describe every single case and cannot provide an answer to every single question. But they define the principles by which we judge correct conduct. More specific rules and regulations are stipulated in corresponding guidelines and instructions for each specific business unit.

Every single one of our senior executives, employees and partners is required to make an active contribution to the development and compliance with these stipulations.



# OUTLOOK

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MEYER WERFT is well equipped to face the future. The order books are full of orders for complex new designs, which will keep us busy for several years to come. Following the acquisition of a shipyard in Finland in 2014/2015, the company has extended the range of its business and increased its flexibility. As a result, it is now able to produce at three locations – in Papenburg, in Rostock and in Turku.

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The company is consistently furthering the use of innovative technologies in highly modern shipbuilding, with the aim of developing and testing new systems and establishing them as standards and in so doing giving due consideration to precepts of sustainability and environmental friendliness. These are the factors with which the shipyard is constantly concerned.

It is impossible to imagine the present international shipbuilding scene without our company's presence. In January 2015, the shipyard signed a fifteen-year site-continuation agreement with the state of Lower Saxony. A concession that not only the company and the region but also the thousands of people employed in the supply industry are set to sustainably profit from.

MEYER WERFT is deeply committed to the region and its people. For more than two centuries, commitment to the company's continued existence has gone hand in hand with the well-being of the people and the environment. We are dedicated to the responsible treatment of resources and, in particular, to ensuring that our actions are always in harmony with the Ems and the people who live near it. In all that we do, our focus is always on maintaining the high quality of life in our local region.

Not only today but also in the future.





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