

RESEARCH, DEVELOPMENT & INNOVATION

MARITIME INNOVATION

DAMEN



WELCOME TO DAMEN RESEARCH & DEVELOPMENT. WE HAVE A HISTORY THAT GOES BACK MORE THAN FOUR DECADES.

A COLLABORATIVE EFFORT

Innovation – finding and testing new ideas – is the way forward. We believe that innovation arises from cooperation. This is why we work closely with numerous research institutions, universities, maritime organisations and, of course, clients, not just in the Netherlands, but all over the world. The Sea Axe bow and the RSD tug are just a couple of examples of the results from such cooperative efforts.

THINK GLOBAL

Whilst much of our R&D work goes on at our headquarters in Gorinchem, the Netherlands, Damen operates on a global scale. In addition to the work taking place at headquarters, we have R&D teams at Damen Schelde Naval Shipbuilding (DSNS) in Vlissingen and Damen Dredging Equipment (DDE) in Nijkerk, both in the Netherlands, as well as in Ukraine.

Wherever we are, the results from all our R&D activities benefit the work of all the yards and subsidiaries of the Damen Shipyards Group

FINDING THE ANSWERS

Just like the entire vessel acquisition process from design to delivery, one thing is sure - our R&D activities are designed for, and around, the customer. This forms a common theme throughout all of our operations.

For example, in helping to answer the following questions:

- Is this design fit for purpose?
- How can we optimise the construction process?
- Can we predict and improve upon performance?
- How can we reduce downtime in the operational phase?



“ Our aims are to bring innovation to the maritime industry and to ensure the continual improvement of existing vessels in our portfolio, making them safe, sustainable and smart. Our work also involves the development of new designs, utilising state-of-the-art technologies dedicated to specific projects.”

PETER VAN TERWISGA
Director Group's Research
Damen Shipyards



AUTONOMOUS VESSELS

Damen works closely with partners, clients and suppliers towards applications which will help to make our solutions smarter, leading, in time, to autonomous vessels. Previously, we have developed remote monitoring of our vessels. At the current time, we are looking at the development of autonomous mooring, anti-collision detection capabilities, route planning and increased fuel efficiency.



WAAMPELLER

Together with a number of partners, Damen developed the WAAMPeller, the world's first Class-approved 3D printed ship's propeller. This ground-breaking project opened the eyes of the shipbuilding industry to the potential of additive manufacturing for large scale ship structures. Damen is actively working on developing innovative applications that can only be made by means of 3D printing techniques. Ship components that make use of the opportunities provided by 3D printing have increased vessel performance and reduced environmental impact.

THE DAMEN STANDARD

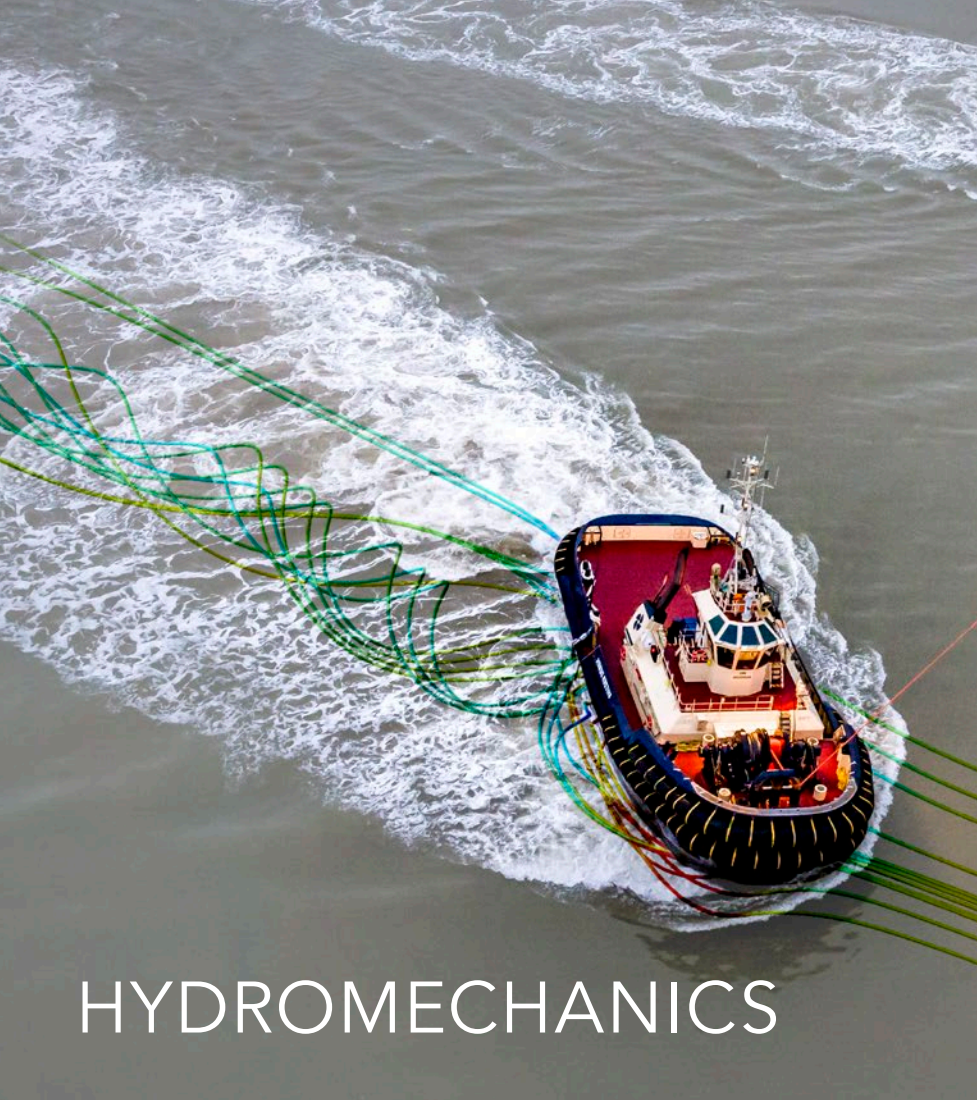
RESEARCH, DEVELOPMENT & INNOVATION

Damen is renowned for its standardised shipbuilding concept. Fast deliveries, competitive pricing, tried and tested technologies and assured performance are just a few of the advantages associated with this strategy. The implications go further though; the unique philosophy of standardised shipbuilding in series delivers a unique approach to R&D. As a result, Damen has developed an extensive R&D programme, itself proven over many years. Coupled with a listening ear towards the client, the advantages of standardisation from a research perspective include:

- Successive research into sequential generations of vessels in-series
- Extreme relevancy for research findings with subsequent implication for series development
- An opportunity to turn clients' feedback into tangible development on same or similar vessel types

- A platform for collaboration with leading research institutes seeking a consistent proving ground for the demonstration of scientific theory
- Constant variables on which to conduct research on a wide range of factors, including hydromechanics, structures & materials, mechanics & systems, electrics & automation, noise & vibration and industrial design & human factors
- Continual evolution of the product portfolio
- An unparalleled data set of model and full-scale measurements and other information.

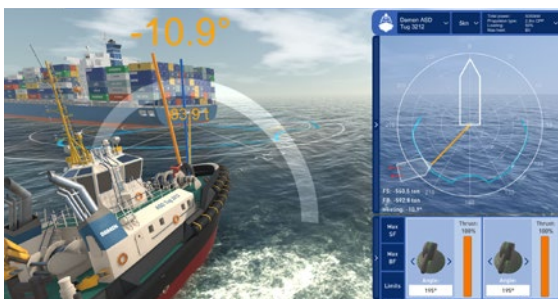
Throughout our many years of operation we have collected data measurements from the more than 6,000 vessels we have built. Since we started, collection methods have improved considerably. Today, we are able to gather all the details required from our series production to facilitate the continual improvement of our designs required by our ever-changing industry.



HYDROMECHANICS

Damen is constantly seeking innovative solutions and new technologies to increase the performance, operability, safety and efficiency of our ship designs. In order to be able to do this, we conduct research in the field of hydromechanics. The classical themes are resistance and propulsion, seakeeping and manoeuvring, but dynamic positioning and escort performance of tugs and workboats are also part of our focus.

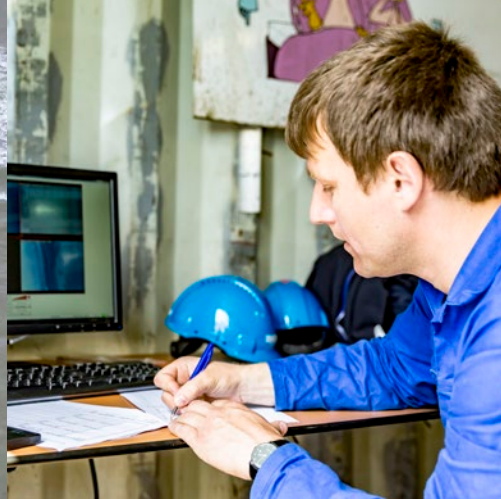
In addition to traditional model testing, we utilise computational fluid dynamics (CFD) for the design and evaluation of new ship types and concepts. CFD is becoming a more widespread technology. We research these and other technological developments so that the application and accuracy of groundbreaking technologies will increase, resulting in reduced margins of error and better performing ships.



ESCORT PERFORMANCE

TugSim is a simulation programme that calculates the effective pull of our tugs. With a flexible and modular approach, this method can simulate any towing configuration involving various important tug design characteristics.

The tool is validated with model test and full scale measurements and fully Class approved as an alternative for full scale or model tests to achieve an Escort Notation.



AIR LUBRICATION

Damen has been looking at ways to promote sustainable shipping for years. Reducing the frictional resistance of the ship's hull by means of air lubrication showed to be a promising way. Model scale and full scale investigations demonstrated that overall fuel-savings up to 15% are possible.

Damen participated in successful Dutch and European funded research projects and recently commissioned a new type of air lubricated inland ship called the Ecoliner. This vessel is equipped with air chambers. This concept is patented by Damen.

Current research is looking into the practical and economic feasibility of an alternative system based on an air cavity concept. This concept is patented by the Technological University of Delft, the Netherlands. Fundamental research showed good results and this system allows for a wider application, being less sensitive to ship motions and with less impact on the hull geometry. This makes it possible to refit existing vessels with the air cavity concept.



The Bibby WaveMaster 1, a Damen ASV 9020. Good seakeeping behaviour was an essential design goal for this vessel, which provides a comfortable working environment for offshore personnel.



THE QUEST FOR UNDERSTANDING

Whether it is predicting fatigue or strength testing new materials, our research into shipbuilding structures focuses on understanding various phenomena and gaining knowledge. The knowledge we gain enables us to build light, fatigue-resistant structures.

STRUCTURES

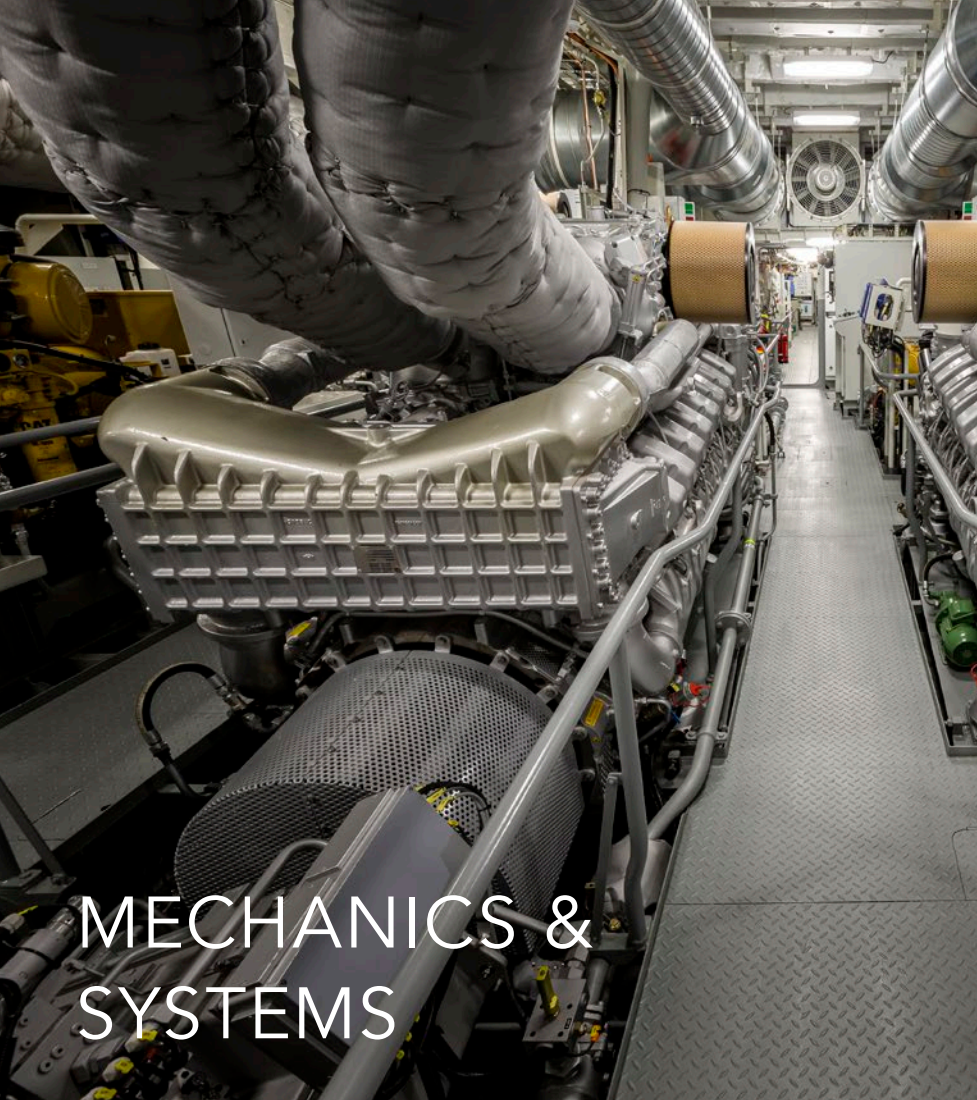
COMPOSITE VESSELS

As part of the FLIGHT (Fast LIGHT Hull Technology) consortium, we investigate the use of carbon-reinforced composites in shipbuilding. In some cases, such materials have the potential to replace steel and aluminium. The benefits are reduced weight and less corrosion. Looking at a material's hydro-elastic properties can also help to predict its static and dynamic behaviour. In the EU Horizon 2020 project RAMSES we will look into the use of composites for vessels up to 70 metres in length.

ADHESIVE BONDING

Our research on the subject of adhesive bonding involves steel, aluminium, glass and composites, for non-structural components. The reduced use of nuts and other fixed parts not only facilitates reduced levels of corrosion and improved sound insulation, it also significantly saves on time during outfitting.





MECHANICS & SYSTEMS

CASE STUDY: COOLING SYSTEMS

Systems on board vessels produce concentrated heat. This heat needs to be dissipated to keep all systems functioning optimally. Using special propeller nozzles as a cooling system, for instance, is a highly efficient method of heat transfer into water. Our research optimises existing cooling concepts using cooling channels and box coolers to meet the cooling demands of the future, where designs will become ever more compact.

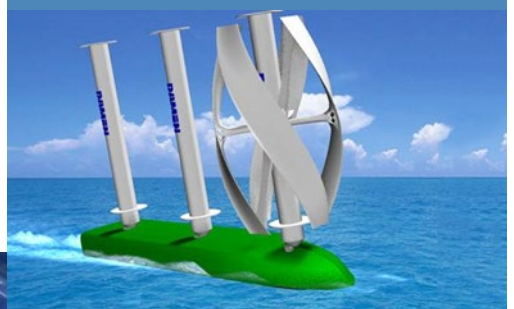
DAMEN PAYS CLOSE ATTENTION TO THE WAYS IN WHICH THE COMPONENTS AND SYSTEMS IT EMPLOYS ON ITS VESSELS INTERACT WITH EACH OTHER. IN THIS WAY, WE ARE ABLE TO ENSURE THE BEST POSSIBLE INTEGRATION AND CONFIGURATION, RESULTING IN OPTIMAL PERFORMANCE.

JOULES

Within JOULES, we studied novel technologies to reduce fuel consumption and emissions from ships, in collaboration with major players from the marine industry.

Advanced time-domain simulations are developed to support future ship designs with ongoing electrification. Think of hybrid and full electric propulsion. These tools enable us to optimise the sizing of the power and propulsion equipment and energy management strategy.

In addition, alternative technologies and fuels are evaluated to develop zero emission concepts such as fuel cells and wind propulsion. This project resulted in six future ship concepts and, for three of which, a near future and advanced design concept. The solution was a fit based on ship operation and timeline.



DAMEN DIGITAL

Damen is developing a unique platform – Damen Digital – which will bring all of its in-house digital initiatives under one roof.

The launch of Damen Digital means that the many innovations and developments can be brought together, enabling the company to take a more cohesive approach to digitalisation. This in turn leads to product improvements and cost savings for customers.



NUMEROUS ADVANCES

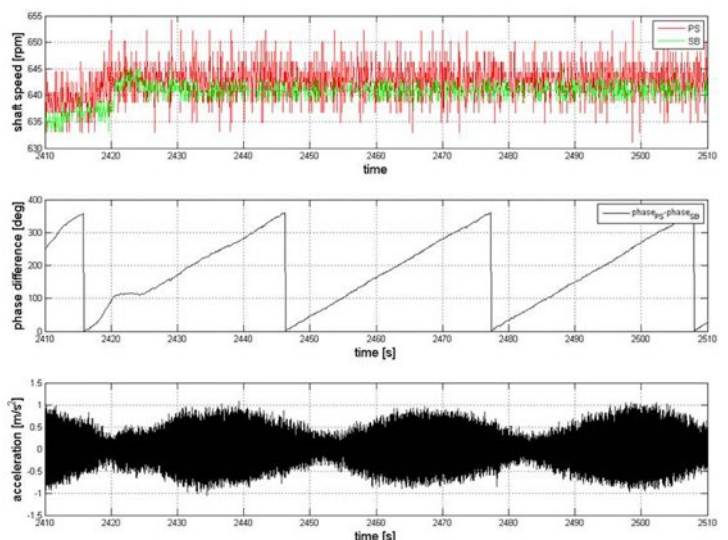
As a result of our research on electrical and automation systems onboard, Damen has made numerous advances on its vessels. This includes hybrid propulsion, DC grids and advanced control systems. These have made our ships lighter, more reliable and more efficient, laying the groundwork for fully-electric vessels, sailing towards tomorrow's autonomous operations.

ELECTRICS & AUTOMATION

HARDWARE IN THE LOOP (HIL)

Combining the embedded systems of the vessel with a range of sophisticated software emulations, Damen is able to assess and improve the cooperation between on board systems and fine-tune the interaction in simulated real-life conditions.

This branch of research has quickly demonstrated its benefits to clients, giving them confidence in our products' ability to perform according to stated capabilities. An example of this is the recent analysis of the interaction between the DP system and motion-compensated access walkway in the Accommodation Support Vessel (ASV).



CASE STUDY: PROPELLER PHASE SYNCHRONISATION

The findings of our studies of the synchronisation of prop shaft revolutions reduce differences in so-called beat phenomena. This can be controlled by engine regulation – noise and vibrations will be reduced when propeller shaft revolutions are in counterphase.

THE MINIMISATION OF NOISE AND VIBRATION IS CRITICAL FOR DEVELOPING VESSELS THAT OFFER THE SAFETY, COMFORT AND ENVIRONMENTAL PROTECTION STANDARDS DEMANDED BY TODAY'S MARITIME INDUSTRY.

We carry out vibration studies on all aspects of a vessel's construction, for example incorporating floating floor analyses and consideration of sources of vibration. We consider noise levels, not only on board, but also outside the vessel. Damen is one of only a few shipbuilding companies to carry out research into underwater radiated noise (URN) and also perform validation measurements with its own DNV compatible measurement system.



PURSUIT: UNDERWATER NOISE

Underwater noise, or rather the lack of it, is an important element in a naval ship's operational performance. The quieter the ship carries out its missions, the smaller the chance of being detected. Like with naval ships, these properties are also important to research and hydrographic ships, as underwater noise could interfere with the vessel's acoustic sensors.

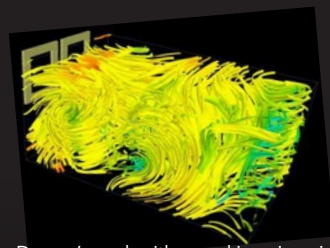
NOISE & VIBRATION

SEA

The Statistical Energy Analysis (SEA) calculates the movement of energy through a vessel to ascertain noise and vibration levels in different sections.

OTPA

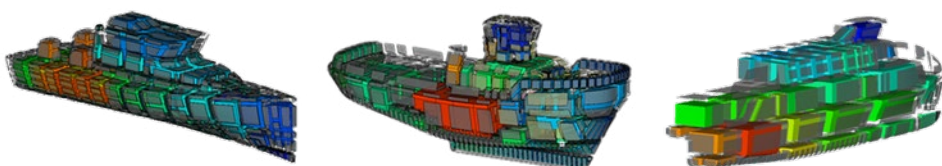
The Operational Transfer Path (OTPA) establishes the validity of calculations. We place sensors throughout the vessel in places known to generate noise and vibration. Microphones catch the sound and sophisticated software is then able to unravel the measured noise into its source components.



Damen's work with sound imaging aims to deliver a better understanding of how sound travels throughout a vessel in order to optimise comfort on board.

For commercial ships too, underwater noise is gaining in relevance, as it is increasingly seen as an undesired emission that disturbs marine life and mammals in particular. As a result, various organisations are developing noise contour regulations that future ships will need to adhere to.

Pursuit aims to develop accurate methods to predict underwater noise generated by a ship's onboard machinery and its propeller. These prediction methods will help Damen to cost-effectively develop ships with low noise levels.





DAMEN HYBRID TUGS - REDUCED FUEL CONSUMPTION AND EMISSIONS

A reduction of fuel consumption up to 30% was calculated with a true operational profile of a hybrid tug, in comparison to a benchmark vessel - a standard ASD Tug 2810, the Smit Elbe, operating in the Port of Rotterdam. The Hybrid also saw reductions of up to 40% in NO_x , HC, CO and up to a 30% reduction in PM, CO_2 and SO_x , compared to the standard vessel.

SUSTAINABILITY

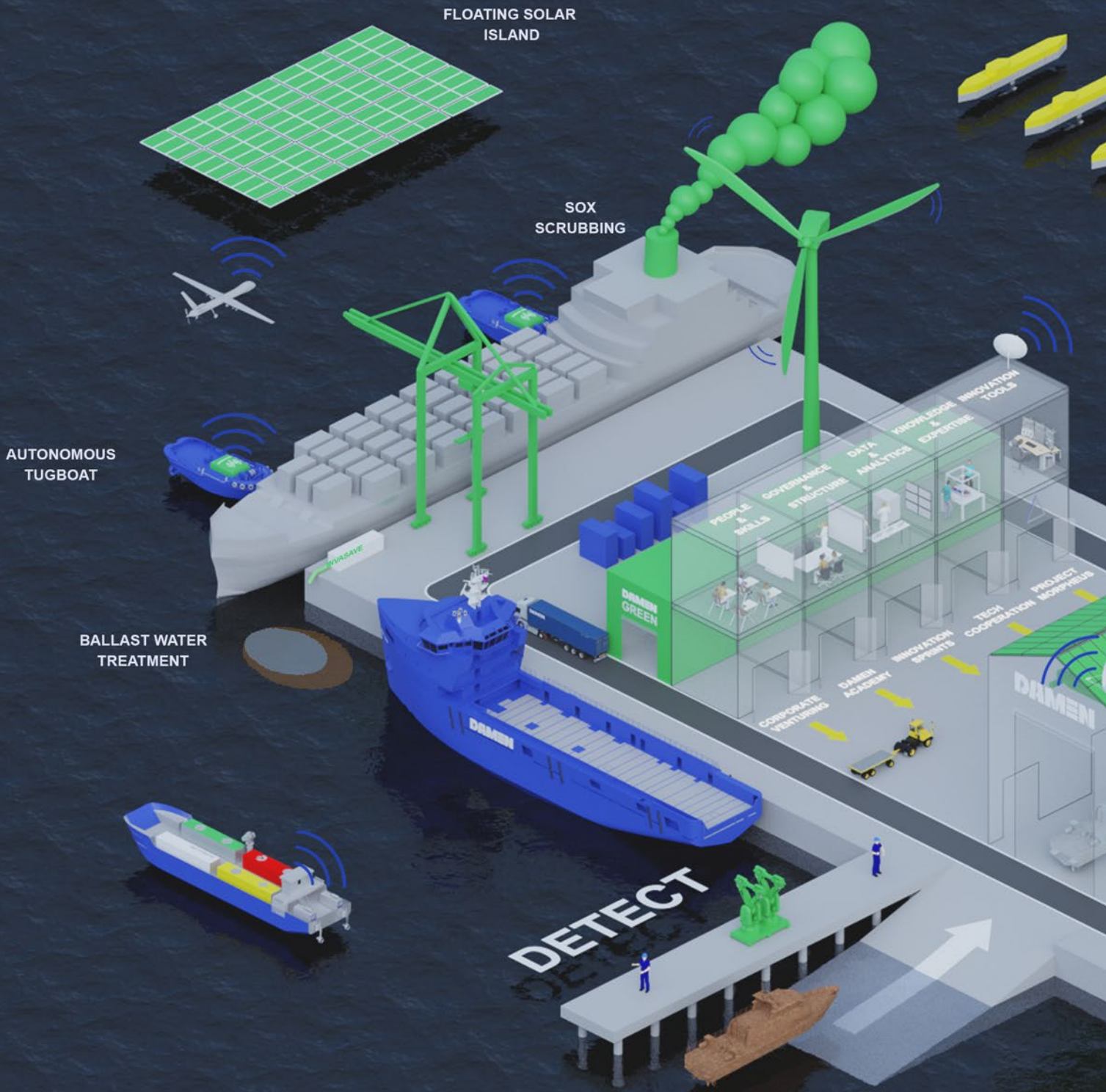
SUSTAINABILITY

Sustainability is growing in relevance across all industries and shipbuilding is no exception. Regulations are becoming increasingly stringent as governments and industry bodies seek to bring the maritime world into alignment with environmental targets.

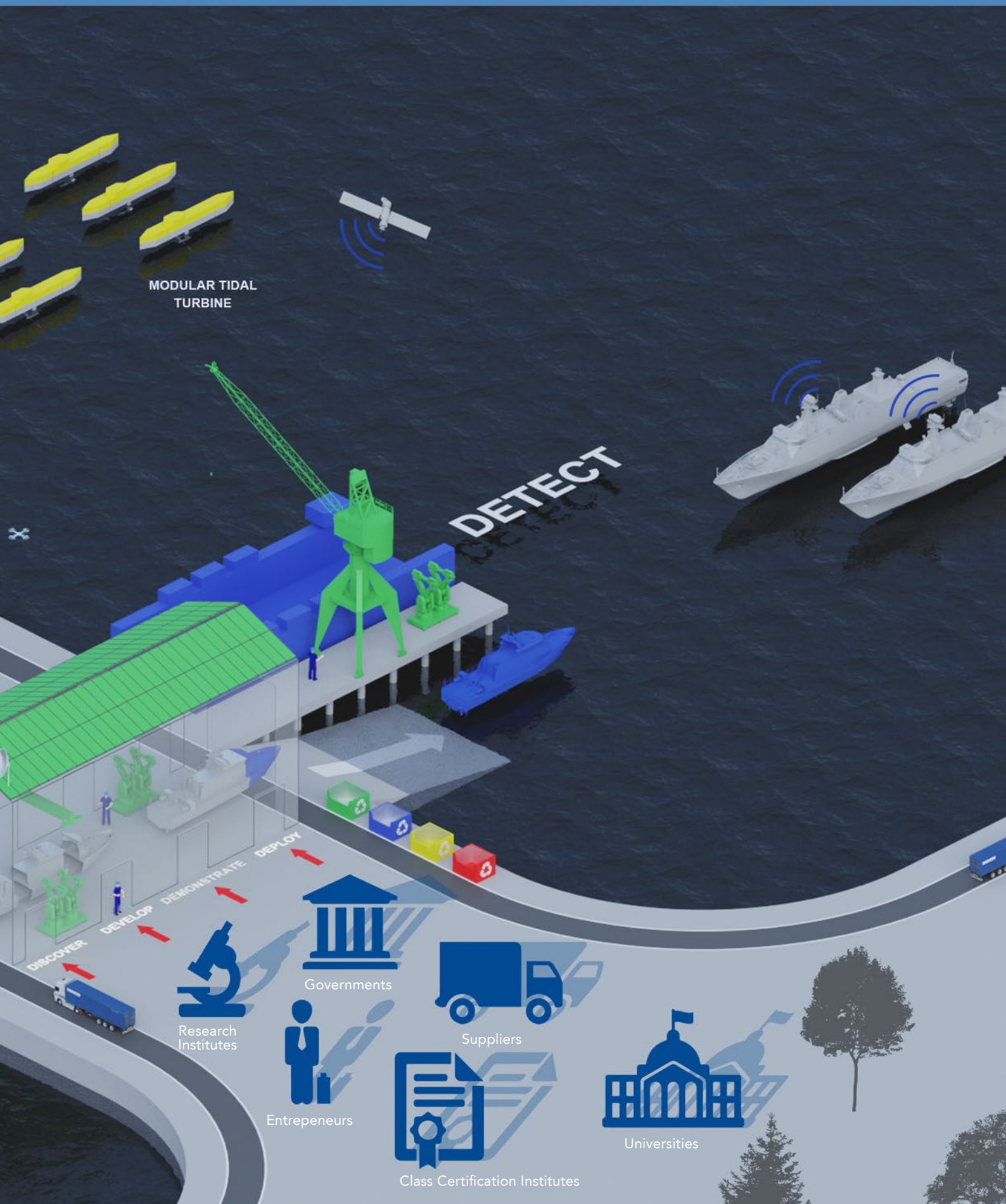
Damen is committed to ensuring continuous improvement of its products and production methods, with the objective of reducing our environmental impact. Included in our approach is a focus on design optimisation, a continual drive towards ever-more environmentally relevant production methods and bringing environmental awareness to our employees in relation to everyday activities.



THE INNOVATION YARD



At Damen, innovation is engrained in everything we do. And, like the physical shipbuilding process, our RD&I efforts extend beyond the slipways and shipyard gates. We distinguish short, medium and long term strategic projects and explore new technologies and markets in dedicated ideation campaigns and innovation sprints.



We collaborate intimately with our eco-system of research institutes, universities and suppliers. This mindset has driven us into an ever-expanding set of markets delivering innovative solutions everywhere we go.



Damen has developed extensive R&D programmes leading to multiple ground-breaking innovations. We are committed to the continuous improvement of our products and production methods with the objective of reducing the environmental impact of the product lifecycle. Damen R&D also contributes greatly to the digitisation of Damen products and services by supporting vessel connectivity.

DAMEN

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