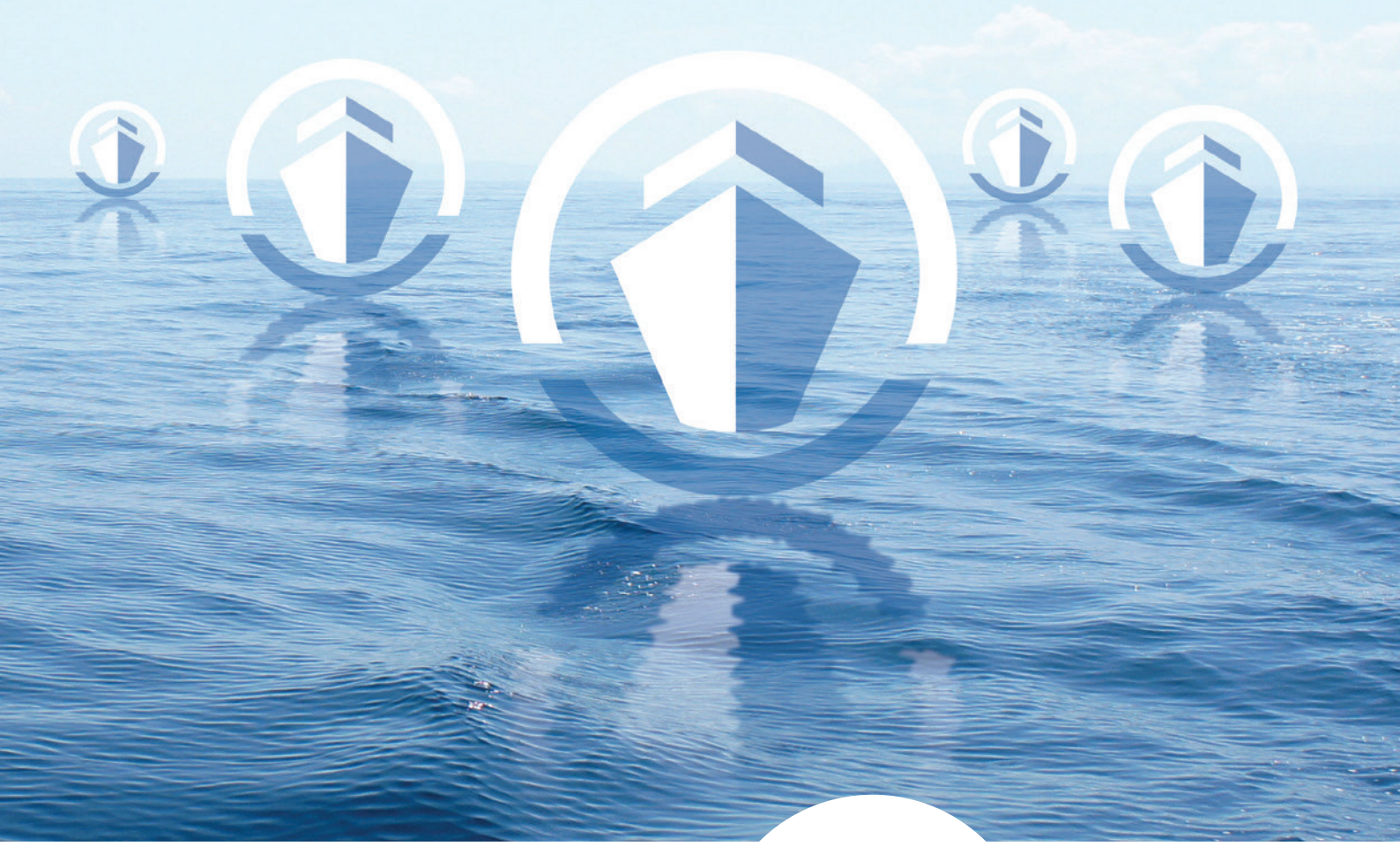
LeanShips

aims to demonstrate the effectiveness and reliability of energy saving and emission reduction technologies at full scale.



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Low Energy And
Near to zero emissions Ships

What is this European Innovation Project all about?

Target markets …

… are the small to midsized ships for intra-European waterborne transport, vessels for offshore operations and the leisure and cruise market.

Demonstrators will be carried out …

… combining technologies for improved efficiency and pollution reduction, in line with end-users' needs and requirements.

Main objectives …

CO_2 reduction of at least 25 %
Estimated fuel saving of up to 25 %
Expected decrease of SOx / NOx / PM air pollutants by up to 100 %

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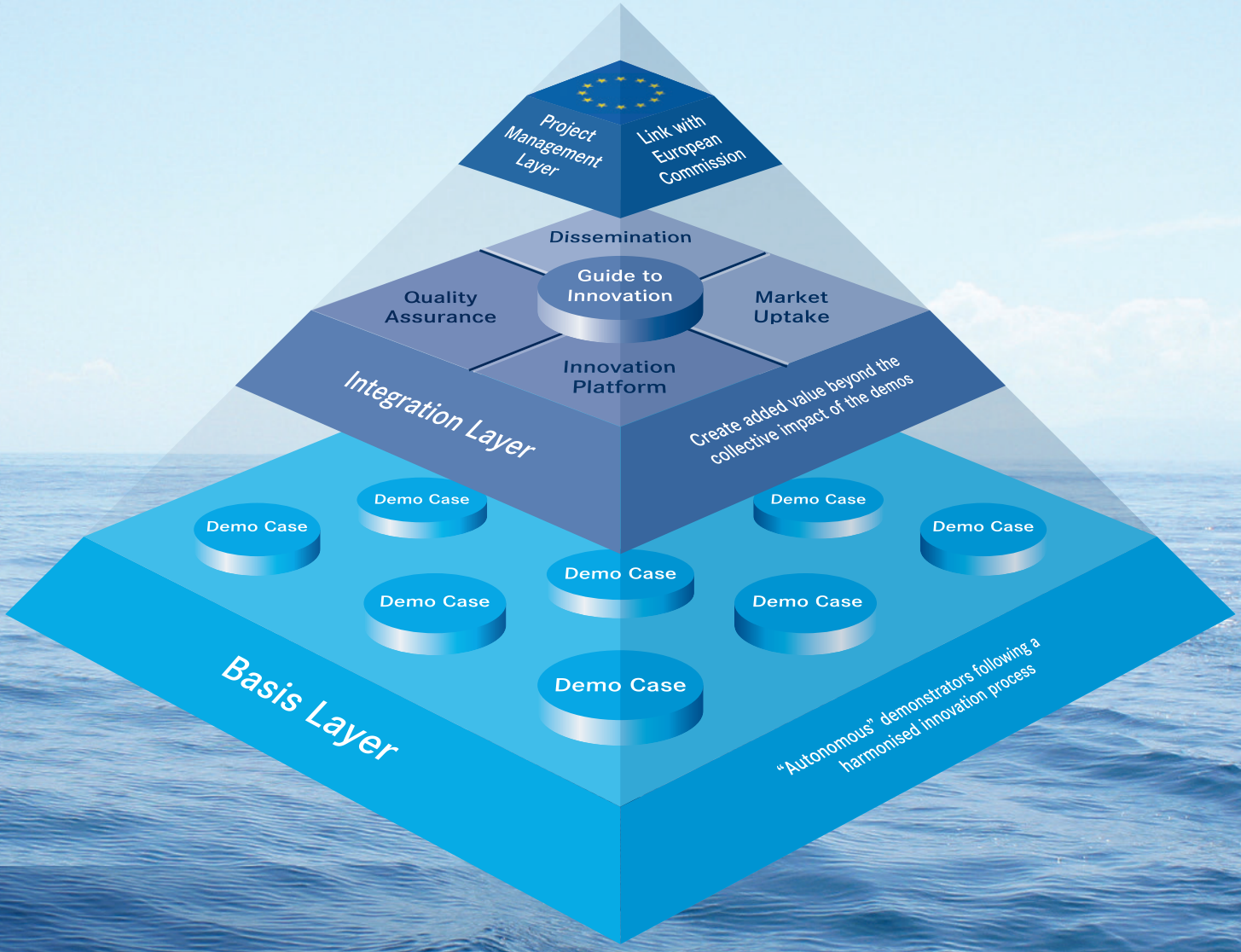

LeanShips

has a layered project structure and integrates
the experiences from the Demo Cases into a web-based "Guide to Innovation".

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Project Management Team
Damen Shipyards Gorinchem, Netherlands Maritime Technology,
Center of Maritime Technologies e.V., CETENA S.p.A.

Demo Case

CNG powered RSD shiphandling tug

This demonstrator case will provide a prototype harbour tug, namely the RSD (Reverse Stern Drive) 2513 CNG, which operates with compressed natural gas (CNG) as a fuel. For the time being there are four tugs operational with liquefied natural gas as a fuel worldwide. These tugs use medium speed engines, which are big, heavy and expensive. The presented demonstrator would use high speed engines, provided by MTU, to directly drive the thrusters. The use of these high speed natural gas engines offers a high power density, matching the compact ship design, combined with cost-efficiency, compared to the medium speed engines, being used in the existing LNG fuelled tugs. It will be the first use of high speed gas engines in a maritime application in this power range.

The tug will also be of an entirely new type with improved hydrodynamic characteristics, which will increase the efficiency by allowing a smaller tug to do the same job in a safe way. To optimise the hydrodynamic behaviour, comprehensive computational fluid dynamics (CFD) calculations and model scale tests will be carried out. In LeanShips work is being carried out to get a functional unit in place in order to compare the effectiveness of different tugs. The new design will also allow the use of a smaller crew (three instead of four to five), which contributes to a decrease in operational costs, and to making natural gas a competitive green alternative to conventional tugs.

Damen Shipyards Gorinchem is responsible for the overall project coordination, including the coordination of the consortium as well as communication with the Project Officer in Brussels. Within LeanShips, Damen, the world leader in the development of workboats, will develop a novel shiphandling tug type. This RSD Tug will be fuelled by natural gas, which is stored on board under compressed form. The advantage of storing the natural gas under compressed form instead of liquefied, as it is the trend in shipbuilding, is that there is no boil-off. This leads to a safer and more environmentally friendly ship.

Pieter Huyskens, Research Manager

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Partner Demo Case

Damen Shipyards Gorinchem, MTU Friedrichshafen GmbH, SVITZER A/S,
Damen Shipyards Galati, MARINE ENGINEERING SRL

Demo Case

The potential of methanol as alternative fuel

A major challenge that is faced by the shipping industry is the reduction of harmful emissions like soot, nitrogen oxides (NOx) and sulphur oxides (SOx). A possible solution is the introduction of methanol in the marine fuel pool. As one of the most widely shipped chemicals in the world, methanol is already present in most terminals. It is also biodegradable and more environmentally friendly than oil-based fuels. Being liquid at atmospheric conditions is a major advantage in handling, distributing and storing methanol. Also, methanol burns cleaner and emits less pollutants than diesel.

The goal of this Demo Case is to convert an existing marine diesel engine to so-called Dual Fuel operation in which the engine runs on both methanol and diesel. In doing so, a substantial part of the original diesel consumption will be replaced with methanol with the corresponding improvement in emissions. To lower the threshold of adopting this technology, the converted engine will maintain 100 % diesel capability.

The engine that will be converted is a Volvo Penta D7C-B TA (265 hp), a high speed diesel engine used for smaller vessels. The data obtained on the engine performance will be used in life cycle emissions and cost calculations for two case study vessels. These case study results will be used to promote market uptake of the high speed methanol/diesel engine.

Ghent University has been working on methanol as an engine fuel since 2009. As of 2015, this has resulted in 2 successfully defended PhDs and 9 master theses, as well as 15 peer-reviewed publications. Ghent University is leading the demo case, converting a high speed marine diesel engine to dual fuel operation on methanol. The engine will be optimised for efficiency and emissions, with measurement results feeding into LCA calculations to show methanol's potential as a fuel for two case study vessels. These will serve to support the market uptake of this promising green fuel.

Prof. Sebastian Verhelst, Associate Professor of Internal Combustion Engines

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Partner Demo Case
Ghent University, Damen Shipyards Gorinchem, Methanex Europe,
ABEKING & RASMUSSEN Schiffs- und Yachtwerft AG,
Kant Marine & Industrie NV, Dredging International NV

Demo Case
SECA Refit Strategy

As per January 1, 2015, sulphur emissions by ships in Sulphur Emission Control Areas (SECA) have been limited substantially, requiring vessels to either switch over to a more expensive low Sulphur fuel or install abatement technologies in order to clean the exhaust gases before they are emitted into the open. Depending on several factors, like overall fuel consumption, investment costs and time spent in these areas, a choice has to be made on the method of compliance to these regulations for each and every individual ship. Technology choices for retrofitting existing ships are further limited by technical and economic factors, since these ships were designed to a different set of constraints. Wagenborg Shipping owns and operates a large fleet of about 185 mostly general cargo vessels which operate partly in these SECA areas. Due to the nature of the trade the operational profile, even of sister vessels, varies enormously and a prediction of any future operational profile for an individual ship is very unreliable. This makes it impossible to warrant any investment in abatement technologies by traditional calculation methods.

The main objectives are to identify which methods of compliance are realistic for the fleet of Wagenborg, taking boundary conditions like available space and economic aspects into account. Additionally, a mathematical model will be produced to assess an optimal refit strategy not only for an individual ship, but also for the entire fleet as a group. The economical, ecological, operational and technical effectiveness of each retrofit option will be studied for each of five selected base line vessels.

The Horizon 2020/LeanShips programme gives Wagenborg Shipping the opportunity to develop a strategy for retrofitting our fleet of General Cargo vessels to meet challenging upcoming environmental regulations in our sailing area; reducing the environmental footprint of our vessels while simultaneously improving their commercial capabilities. All companies in our consortium are experts in their respective fields, and together we can take on this ambitious project which hopefully results in one or more real scale 'demo case retrofits' which will be used to validate the developed strategy.

Theo Klimp, Fleet Director

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Partner Demo Case
Wagenborg Shipping, Lloyd's Register EMEA, Conoship International BV, Machinefactory Bolier BV, Cryonorm Systems BV, Niestern Sander Reparatie BV, ENGIE Services Nederland NV, Wärtsilä Finland OY, Wärtsilä Netherlands BV

Demo Case

Expanding the application of ESDs to ships with CPP

In FP7 project GRIP, MARIN and Wärtsilä with partners worked on designing and optimising Energy Saving Devices (ESDs) for ships fitted with a Fixed Pitch Propeller (FPP). This resulted in the full scale demonstration of nearly 7% reduction in required propulsion power on a bulk carrier. To increase the total impact of ESDs on shipping energy consumption in additional markets, the next step is to investigate the energy saving potential of ESDs for ships with a Controllable Pitch Propeller (CPP). Most effective ESDs modify the swirl in the inflow (pre-swirl) or outflow (post-swirl) of the propeller. The amount of swirl strongly depends on the pitch of the propeller. As this is variable in a CPP, an additional optimisation challenge is added for ESDs for CPP.

This is done by designing, simulating and testing an ESD design for a Grimaldi vessel. Wärtsilä and MARIN are responsible for the ESD design and simulations, after model scale testing Wärtsilä will produce the ESD to be installed on the Grimaldi vessel for dedicated demonstration trials. ESDs under consideration are pre-swirl stators, pre-swirl ducts and post swirl propeller hub cap fins.

Ever since the founding of MARIN in 1929, our focus has been on the improvement of ship performance. As independent research institute we support the innovation and developments from the market supporting them with numerical simulations and model testing. In LeanShips MARIN leads this Demo Case in which they collaborate with Wärtsilä and Grimaldi to design an ESD for a ship with CPP. This builds on the experience and results of FP7 project GRIP coordinated by MARIN.

Ir. Maarten Flikkema, Senior Project Manager

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Partner Demo Case
MARIN, Wärtsilä Netherland BV, Grimaldi Group SpA

Demo Case

Large Diameter Propeller for General Cargo Vessel

Improving vessel propulsive efficiency is a fundamental aspect of reducing fuel burn and hence reducing CO_2, and this in turn will result in a corresponding reduction in SOx, NOx and PM. Computational Fluid Dynamics (CFD) assessment and scale model tests carried out in STREAMLINE, an EU Framework 7 project, demonstrated that a large propeller design has the potential to significantly improve the propulsive efficiency of a vessel.

In LeanShips the Large Diameter Propeller Demo Case takes this concept a step further leading to a commercially viable full scale vessel design. This Demo Case assesses the benefits of a new hull design incorporating a Large Diameter Propeller in a traditional position but with much reduced propeller/hull clearance. The main work will consist of developing a Large Diameter Propeller system and integrated aft-ship design for an ice-class general cargo ship, undertaking a CFD performance assessment at full scale simulating a 25,000TDW ice-class demo vessel, and validating this assessment using model testing. The final output of the Demo Case will be a full basic vessel design capable of being further matured into detailed full scale vessel design.

Rolls-Royce has world leading capability in propeller design and is leading the Large Diameter Propeller Demo Case in LeanShips. The successful outcome of this work will be achieved by harnessing the considerable and varied capabilities of the Demo Case partners: Wagenborg and Conoship providing ship design, Rolls-Royce delivering the propeller design, MARIN affording design, modelling and testing capability, Chalmers providing modelling design capability and Lloyd's Register supplying the Classification Society input.

David Bone, Marine R&T Programme Manager

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Partner Demo Case
Rolls-Royce Power Engineering plc, Rolls-Royce Marine AS, Rolls-Royce AB, MARIN, Lloyd's Register EMEA, Wagenborg Shipping, Conoship International BV, Chalmers University of Technology

Demo Case

Decision Support System for ship energy efficiency

The Demo Case activities will focus on an holistic approach to energy efficiency and emission reduction on board passenger ships of different sizes. The entire ship energy balance, the ship lay-out, the integration of innovative technologies into various configurations and the improvement of hull appendices and propeller hydrodynamic characteristics will be studied for new buildings and retrofit ships. A dedicated Decision Support System for Energy Management will be developed to further optimise the ship in operation, a fully operational demonstrator will be installed and tested on board Tallink Victoria I ferry.

All the activities will be targeted to the improvement of overall energy efficiency of passenger ships, with a consequent reduction of emissions into the atmosphere in terms of emission/payload (number of passengers)/mile ratio.

Cost effectiveness of the solutions, compliance with the applicable regulatory framework, as well as market opportunities will be the main drivers in the development.

The objective of AS Tallink Grupp by participating in and investing into LeanShips is to search for additional possibilities for further decreasing the negative environmental impact from its fleet's operations. The company looks into various innovative solutions, including software based ones like this, to cut the overall fuel consumption through smart sailing methods and by doing so also cut the emissions from the operations. The new alternatives in cooperation with the current ones should deliver noticeable results in diminishing the company's ecological footprint. Tallink is especially interested in green and smart solutions, which are applicable for both existing fleet and new buildings.

Aaro Arnus, Technical Superintendent

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Partner Demo Case
Fincantieri S.p.A., AS Tallink Grupp, STX France SA, Sirehna, CETENA S.p.A., RINA SERVICES S.p.A., MEC Insenerilahendused OÜ, Revnetek Systems

Demo Case

Energy efficient systems for leisure/passenger ship

The activities will contribute to enhance the energy efficiency of leisure/passenger ships with a consequent reduction of emissions into the atmosphere, addressing different ship functions. The objective of the **Waste Treatment System** is to explore two solutions based on hydrothermal oxidation and conditioning of waste. The first process uses a hydrothermal oxidation reaction for liquid organic waste treatment on board ship leading to no harmful polluting air-emissions. The second process conditions the shipboard generated waste making their handling easier, more energy efficient and environmentally friendly. The **Heat based Energy Production System** aims to develop a solution adapted to marine constraints integrating the Organic Ranking Cycle technology enabling to recover waste heat aboard passenger ships, convert it into electricity and decrease the ship fuel consumption. The **Energy Storage System** will provide a large scale and none stationary thermal energy storage system based on high temperatures phase change material encapsulated within paraffin. The expected outcome is to recover and store waste thermal energy from the engine exhaust pipes of passenger ships while cruising and restitute it while anchoring at port. The **Solutions for Emission Reduction** will reduce harmful emissions of soot, particles generated by heavy fuel oil engines on board ships, developing filters capable of filtering and chemically breaking down the pollutants while resisting to large amounts of solid residues, metals and ash from the combustion of heavy fuel oil and lubricated oil burned by the engine.

Heir to a long tradition of innovation, European shipbuilding industry settled programmes for Research & Development and participates to national and European co-funded R&D projects for decades. These R&D programmes aim at strengthening European shipbuilding's leadership for designing and building more environmental friendly ships, with a particular focus on energy, air emission and waste management. Therefore every partner of the demo case is fully prepared to contribute to improve the energy efficiency of leisure/passenger ships.

Pierre Berseneff, Research & Development Senior Project Manager

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Partner Demo Case
STX France SA, Fincantieri S.p.A., CETENA S.p.A., RINA SERVICES S.p.A., Enertime, Leroux & Lotz Technologies, Hug Engineering Italia s.r.l., Hochschule Emden-Leer, Hutchinson Paulstra, Lloyd's Register EMEA, MEYER WERFT GmbH & Co. KG, HUG AG

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Contact: Pieter Huyskens
LeanShips Project Manager
E-mail: pieter.huyskens@damen.com
Project website: www.leanships-project.eu