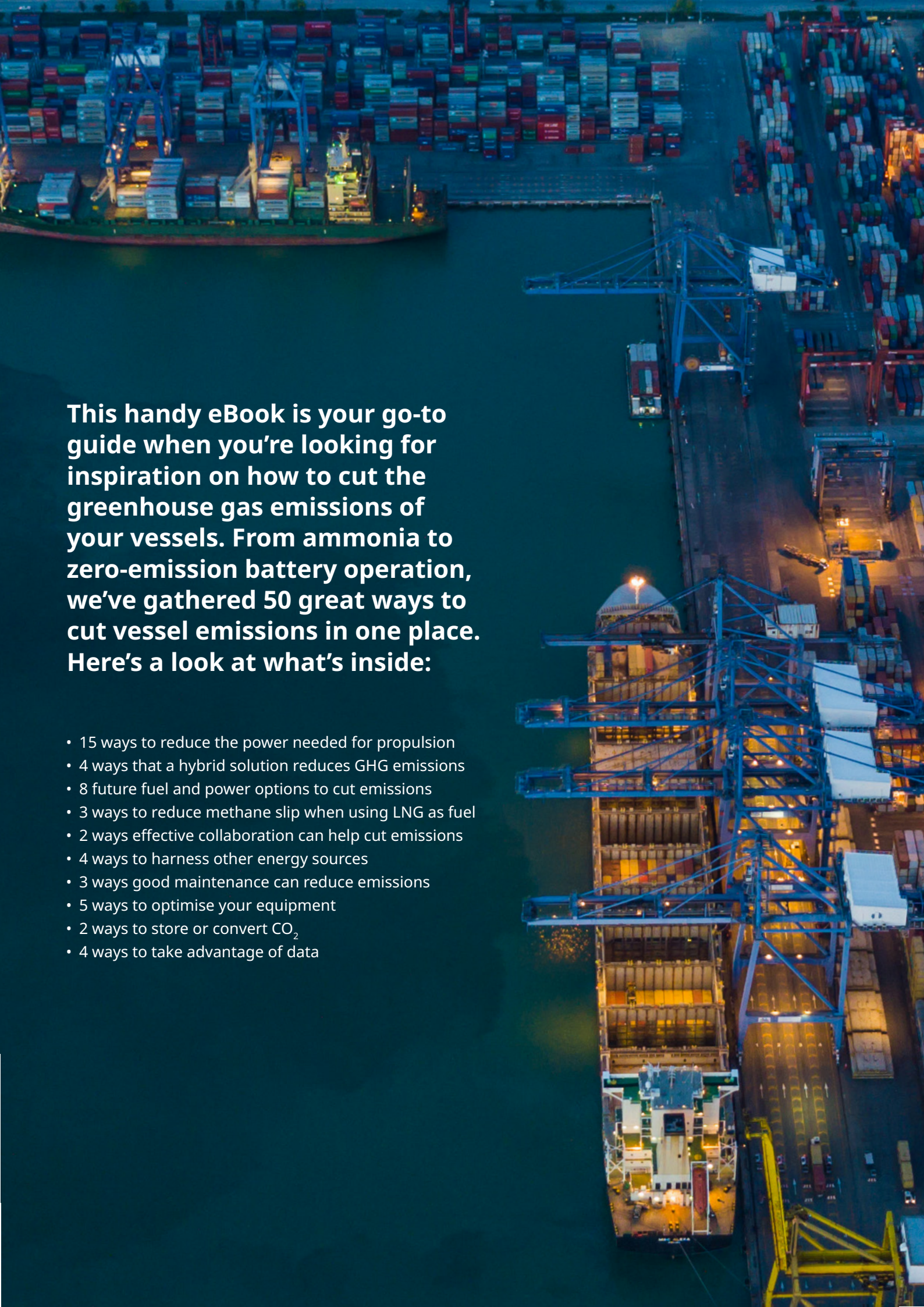


50 great ways the maritime industry could reduce its greenhouse gas emissions



An aerial night photograph of a large container port. Several large container ships are docked at the pier, their decks illuminated with warm yellow lights. Numerous blue and white container cranes are positioned along the quay, some with their booms extended over the ships. The water is dark, reflecting the lights from the port. The sky is a deep blue, and the overall scene is a complex of industrial activity and infrastructure.

This handy eBook is your go-to guide when you're looking for inspiration on how to cut the greenhouse gas emissions of your vessels. From ammonia to zero-emission battery operation, we've gathered 50 great ways to cut vessel emissions in one place. Here's a look at what's inside:

- 15 ways to reduce the power needed for propulsion
- 4 ways that a hybrid solution reduces GHG emissions
- 8 future fuel and power options to cut emissions
- 3 ways to reduce methane slip when using LNG as fuel
- 2 ways effective collaboration can help cut emissions
- 4 ways to harness other energy sources
- 3 ways good maintenance can reduce emissions
- 5 ways to optimise your equipment
- 2 ways to store or convert CO₂
- 4 ways to take advantage of data

15 ways to reduce the power needed for propulsion

Put simply, when you reduce the amount of power needed to push your vessel through the water, you reduce the amount of fuel it needs to consume and therefore the emissions it generates. There are plenty of ways to do this, and many of them can be combined for even greater fuel and emission savings. Here are our 15 top ways to cut the power needed for propulsion.

1 Reduce speed by limiting the engine or shaft power. A relatively quick, easy way to reduce emissions is to limit a vessel's propulsion power, the major factor in the IMO's EEXI calculation. Whether your vessels use 2-stroke or 4-stroke engines, engine power limitation works by using software or a mechanical device to keep the engine power below a set limit. Shaft power limitation works by limiting the shaft pitch and/or rpm via the propulsion control system. In both cases the vessel's sailing speed, and therefore emission level, is reduced, making it a viable option for vessels with high installed power and high design speed to quickly comply with EEXI.

2 Derate your 2-stroke engines. If your vessel has a 2-stroke engine, power derating can save fuel and emissions – extending your ship's CII compliance by years and giving it a new lease of life. Derating can also safeguard your vessel's operating speed if it is affected by EEXI. Wärtsilä's part-load optimisation solution tunes the engine's power to suit current and future operating profiles. It can reduce fuel consumption by more than 5% when combined with turbocharger and propulsion optimisation. For container ships with RT-flex96C-B engines, the Wärtsilä Fit4Power radical derating solution can cut fuel consumption and GHG emissions by up to 15%. In 2022, a pilot installation onboard a container ship with a large bore two-stroke main engine demonstrated that a vessel of this kind could save 2,000 tonnes of fuel and 6,000 tonnes of CO₂ emissions annually with this retrofit.

3 Install a pre-swirl stator on your vessel's propeller. A pre-swirl stator can improve propulsive efficiency by 2–7%, saving fuel and emissions in the process, and can pay itself back in just one to two years. The stator creates an optimal inflow for the propeller by guiding one side of the stern flow in the opposite direction to the propeller rotation, generating pre-swirl. Wärtsilä's EnergoFlow solution consists of multiple curved fins and a ring attached to the hull to prevent power losses from the propeller's slipstream.



4 Add an energy-saving propeller cap. An energy-saving propeller cap can deliver a propulsive energy saving of 2 to 5% by weakening the hub vortex and recovering kinetic energy from the rotating flow aft of the propeller blades. Fins on the cap rotate with the propeller, reducing energy losses and increasing overall propulsive efficiency. Solutions like Wärtsilä's EnergoProFin post-swirl device have the added advantage of reducing propeller-induced noise and vibrations.

5 Install a redesigned propeller. A new propeller that has been designed with the help of computational fluid dynamics (CFD) can lead to significant efficiency gains for vessels that slow steam to save fuel. Fast ferries can also achieve higher speeds and efficiency gains with modifications to controllable pitch propellers. Wärtsilä is a world leader in optimised propeller design, and the Wärtsilä OPTI-Design approach can help you identify how existing propellers can be made more efficient.

6 Integrate your vessel's propeller and rudder design. An integrated propeller and rudder design can reduce propulsive power requirements by 2–9% without compromising manoeuvrability or comfort. Wärtsilä EnergoPac includes propeller installation, a streamlined fairing cap and a rudder system with an efficiency bulb. The rudder system's full spade blade and a flap mechanism provides excellent rudder balance and manoeuvring capabilities.

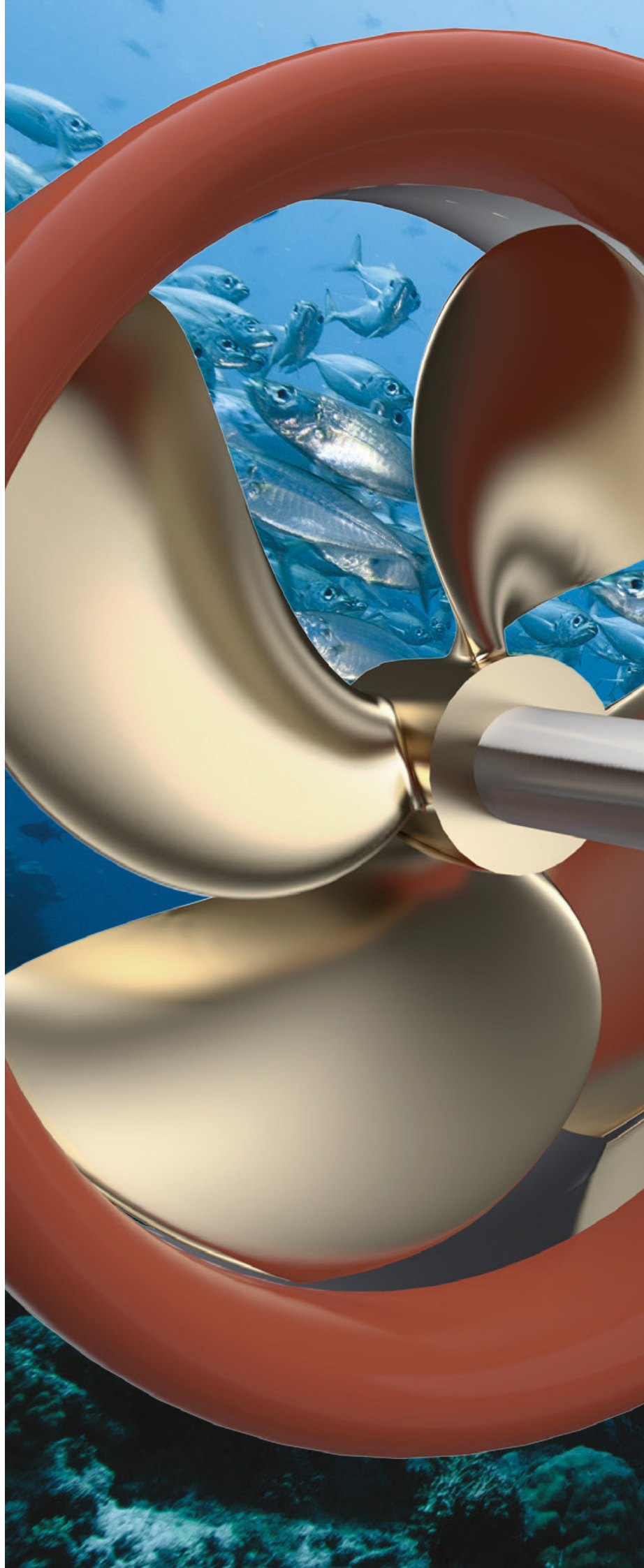
7 Fit your vessel with a gate rudder. Upgrading your ship's steering system with a special device comprising foils on either side of the propeller offers several different advantages. This type of device can greatly enhance fuel efficiency and maneuverability as well as improve the vessel's noise and vibration signature. GATE RUDDER™ by Wärtsilä changes the hydrodynamic load on both the propeller and the foils – which can rotate their angular position – to improve performance during transit. The solution can change from a thrust-generating to a thrust-directing device that improves vessel maneuverability, enabling faster turns in port, for example. Vessels with a GATE RUDDER have reported fuel savings as high as 20%.



8 **Install a high-performance nozzle.** A Wärtsilä high-performance nozzle can increase your vessel's bollard pull performance by up to 5% for the same power compared to industry-standard nozzle types. The nozzle is a circular ring-type casing that surrounds the propeller and has a hydrofoil-shaped cross-section. In particular, heavy-duty vessels that operate with heavily loaded propellers, such as tugs and anchor handling vessels, can benefit from the thrust-generating properties of this type of solution.

9 **Add an air lubrication system to your ship's hull.** Air lubrication is a proven technology that can cut fuel consumption and emissions up to 10%. The technology reduces the frictional resistance of a ship's hull by creating a carpet of microbubbles on the flat bottom of a vessel's hull. The microbubbles are generated by air release units installed in the hull bottom. The system design and installation can be simplified by making use of an existing air source onboard the ship. Air lubrication works in all sea and weather conditions and does not restrict or negatively impact the vessel's normal operational profile.

10 **Map out currents in advance.** With a modern route-planning system you can use global weather forecasts to build an optimal route for your vessel that allows it to arrive safely and in time while avoiding changing speed too much because of varying ocean currents. This means your ship can maintain constant power for as long as possible, reducing fuel consumption and, of course, emissions.



11

Use CFD to design an efficient ship hull. Hull design is the biggest factor in determining your

ship's fuel efficiency, so getting it right first time will pay off in the form of a more efficient ship that burns less fuel and produces less emissions. Engaging an expert partner early in the design phase is a must, preferably one with knowledge of using computational fluid dynamics to model how your hull will perform in real sea conditions. Once your hull design is available, Wärtsilä's OPTI-Design methodology will help achieve a perfect match between the propeller, propulsion motor and hull for optimal efficiency.

12

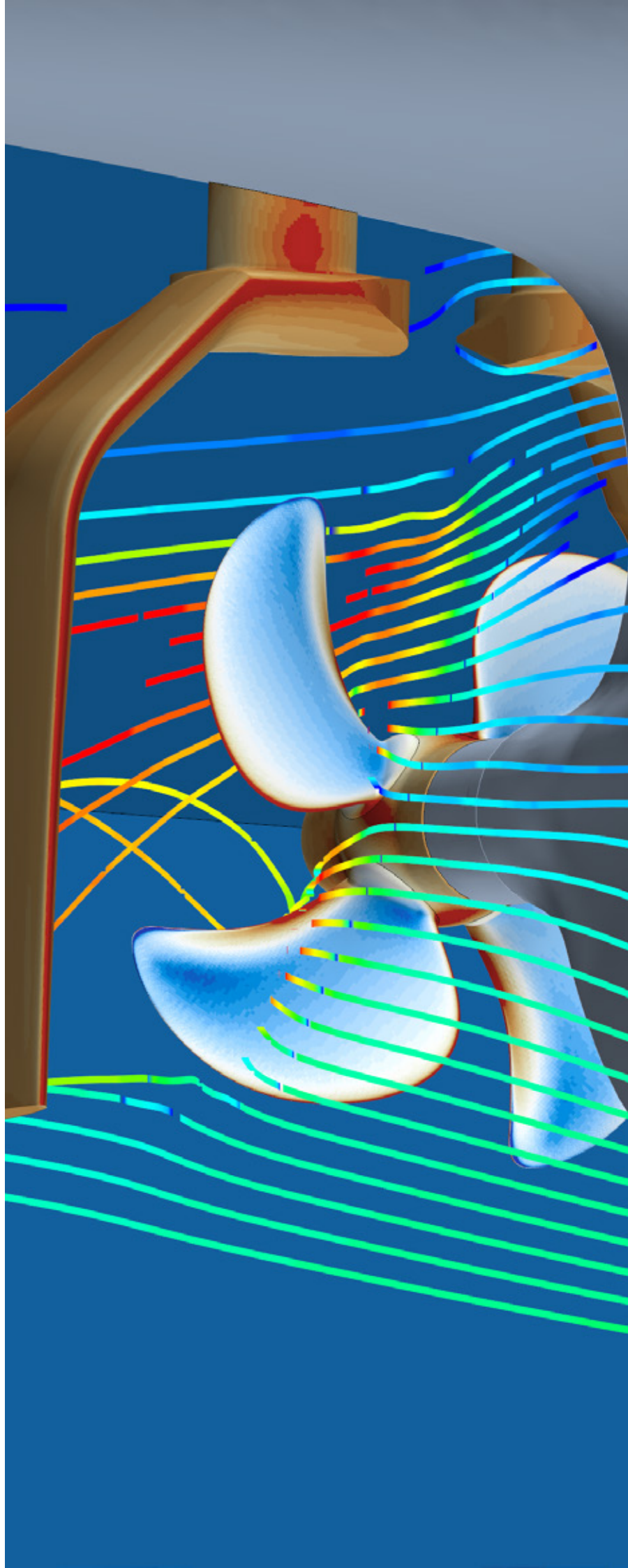
Add a special drag-reducing coating to your ship's hull.

It's estimated that as much as 90% of the energy expended by a ship is accounted for by propulsion, so anything you can do to reduce the friction of the hull will save fuel and emissions. Cutting-edge hull coatings made from graphene and even coatings that mimic the skin of hyper-efficient swimmers like sharks and penguins have already been developed and tested.

13

Optimise your thrusters. Optimising your vessel's thrusters instead of just buying the cheapest off-the-

shelf option can deliver big fuel savings. If your ship's thrusters are going to be used at part or low loads, a fixed pitch propeller (FPP) thruster can save as much as 10–20% in fuel during manoeuvring and cut CO₂ emissions by 15%. A thruster with an optimised opening also offers big savings by reducing parasitic drag. A study by Wärtsilä estimates that for a 2,500–20,000 TEU container ship, reducing the drag from tunnel openings by 5% (a 0.05% improvement in vessel resistance) will save €10,000–22,000 in annual fuel costs, which equals emission savings too.



14 Install efficient, lightweight waterjets. Waterjets are a popular choice for medium and high-speed applications, vessels with a draft restriction or vessels where excellent maneuverability and/or low vibration and noise are important requirements. They work by feeding water from an inlet duct under the vessel to an inboard pump, which pumps the water at high speed through an outlet nozzle, propelling the vessel forwards. Wärtsilä's modular WXJ waterjets are designed to be as efficient and lightweight as possible, with high propulsion efficiency and an improved axial pump design that improves vessel fuel economy and reduces GHG emissions.

15 Adopt a smart propulsion control system. Adding a smart control system that combines the optimal propeller pitch with the optimal engine loading can vastly improve the fuel efficiency of your ship during transit sailing. Wärtsilä EcoControl fine-tunes the propeller pitch to optimise efficiency and can easily adapt to changing load demands and weather conditions to maintain maximum fuel efficiency at all times.



4 ways that a hybrid solution reduces GHG emissions

Hybrid ships offer plenty of different ways to reduce greenhouse gas emissions. A hybrid ship can use 15–25% less fuel (and therefore generate 15–25% less emissions) compared to an equivalent diesel-powered vessel. Gensets also suffer less wear and tear because they can be powered down when the battery takes over, meaning maintenance costs are lower too. Let's discover 4 ways that a hybrid system can help you save on fuel and emissions.



16

Avoid operating engines at low load.

A hybrid system saves fuel by optimising power-system efficiency, meaning you can reduce the installed power of your engines. A hybrid solution also allows zero-emission operations for short periods, for example when manoeuvring in port, with the added advantage of instant full power from the battery with no need to wait for auxiliary gensets to kick in, further increasing manoeuvrability and safety. With a hybrid system, your vessel's engines can operate at optimal load, which significantly improves efficiency. The batteries are used to absorb load fluctuations and provide power redundancy. Hybrid operation is becoming especially popular in the ferry industry.

17

Charge your hybrid vessel's batteries with green energy.

With a shore power connection system and access to fully renewable energy produced by wind, solar or hydro, you can operate your hybrid vessel on truly zero-carbon battery power



18

Adopt fuel cells as an additional power source.

With a flexible, smart hybrid system you have the option to incorporate fuel cells to provide power for auxiliary or propulsion systems without generating additional GHG emissions. Fuel cells convert the chemical energy of fuels, for example hydrogen, into electrical and thermal energy.



19

Use swappable batteries to enable zero-emission operation.

If you're operate vessels on shorter, inland routes a swappable battery solution will allow you to eliminate GHG emissions altogether. The concept comprises a mobile battery container solution that can be swapped out at charging stations along the route. Such a system is already in use in the Netherlands, where a 104 TEU inland waterway container vessel has been modified to allow two swappable battery units to be mounted onboard.

A woman with short grey hair and black-rimmed glasses is looking upwards with a focused expression. She is wearing a grey Wartsila work jacket with orange accents and blue nitrile gloves. In her right hand, she holds a glass test tube, and her left index finger is pointing towards the tip of the tube. The background is a bright, out-of-focus industrial or laboratory setting.

8 alternative fuel and power options to cut emissions

New sustainable fuels in shipping are being developed all the time, and many of them are or can be carbon neutral or zero-carbon, depending on how they are manufactured. They include bio and synthetic methane as well as ammonia, methanol, hydrogen and biofuels. Let's look at the eight top options to cut emissions.

20

Convert your vessel's engines for alternative fuels.

Converting engines to provide greater fuel flexibility allows you to

make use of sustainable fuels that generate lower carbon, SO_x and NO_x emissions. With the IMO's CII regulations now in force, dual-fuel or future fuel conversion is one way to avoid stranded assets and gain the flexibility to adopt future fuels quickly and easily. Wärtsilä offers fuel conversion solutions for 2-stroke and 4-stroke engines.



21

Use ammonia as fuel.

Ammonia doesn't contain any molecular carbon, so when it's combusted in an engine it produces no tank-to-wake CO₂ emissions. Ammonia made from renewable sources using renewable energy is known as green ammonia, which is carbon free from a well-to-wake perspective. Even though precautions must be taken when storing and handling ammonia onboard ships, engines that use ammonia as fuel are at a very advanced stage of development.

22

Use LNG as fuel.

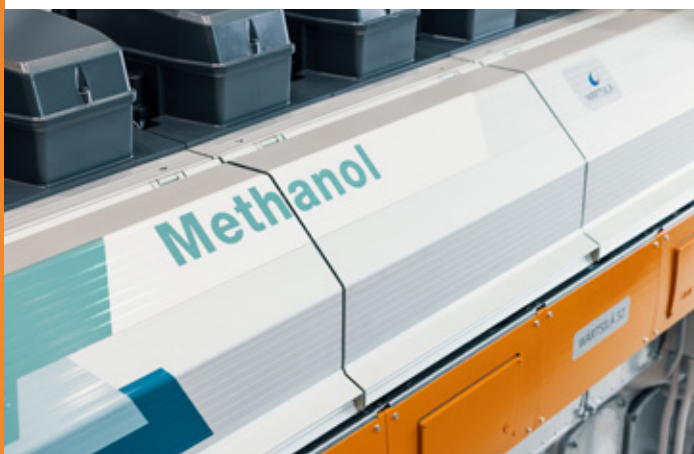
Liquefied natural gas (LNG) is a well-established maritime fuel that has been adopted across a variety of vessel

segments. No surprise given that it can help reduce greenhouse gas emissions significantly and provides an excellent platform for other future fuel options too. Adopting LNG is a concrete step towards decarbonisation and it opens up the possibility to use biomethane and, eventually, synthetic methane.

23

Use methanol as fuel.

If you're currently using diesel, switching to methanol will reduce CO₂ (tank-to-wake) emissions by up to 7%, SO_x emissions by up to 99% and NO_x emissions by up to 60% compared to HFO operation. Methanol made from renewable sources using renewable energy is known as green methanol. Wärtsilä offers a methanol conversion for marine vessels, and the Wärtsilä 32 methanol engine has been built from the ground up to run on methanol.



24 Use biofuels. As a rule of thumb, biofuels can reduce overall carbon emissions by 40–80% from a well-to-wake perspective compared to fossil fuels like diesel. Sustainable biofuels are produced mainly from waste biomass such as animal waste, sewage from wastewater treatment and food waste from industry and households. The three biofuels considered most relevant for shipping are hydrotreated vegetable oil (HVO), also known as renewable diesel; fatty acid methyl ester (FAME), also known as biodiesel; and bioLNG, which is liquefied biomethane produced from biomass.

25 Use eFuels. eFuels – synthetic fuels made using renewable electricity – are yet another way to cut vessel emissions by switching away from fossil-based alternatives. Hydrogen extracted from water using electrolysis is combined with CO₂ extracted from the air and converted into eFuel. eFuels can be blended with conventional fuels in any ratio and can use existing logistics, distribution and refuelling infrastructures.

26 Use renewable power via a shore connection. A shore power connection eliminates the need to use auxiliary engines to generate electricity when in port, reducing emissions and fuel costs as well as lowering OPEX. In many European countries today up to 50% of the electricity is generated from renewable sources like wind, hydro or solar power, making shore power a far greener option. Consistent use of shore power can reduce fuel consumption and emissions by as much as 10% depending on the vessel type and trade.

27 Go fully electric. Not possible for most vessels yet, but in some segments it is already a reality. Vessels such as ferries and tugs that operate short routes, close to shore and land-based electrical infrastructure can benefit from zero-emission, full-electric solutions. In addition to the environmental benefits, the vessel's thrusters will have a faster response, which means that it is easier to manoeuvre and operates more efficiently.



3 ways to reduce methane slip when using LNG as fuel

The popularity of liquid natural gas (LNG) as a transition fuel is growing in virtually every vessel segment. It can help you reduce greenhouse gas emissions significantly and provides an excellent platform for other future fuel options too. To maximise the benefits of LNG as a ship fuel, the key is to reduce methane slip – the unburned methane that escapes into the atmosphere when LNG is burned as fuel. Here are three ways this critical challenge can be tackled.



28 **Upgrade your engines.** If your vessel has a Wärtsilä dual-fuel engine there are tailored upgrade packages available to optimise engine operation and reduce methane slip significantly when operating in gas mode with LNG. For the Wärtsilä 34DF engine for example, a simple software upgrade is all it takes to reduce methane slip by as much as 60% and total GHG emissions by 20%.

29 **Use engines with combustion chambers designed to minimise methane slip.** Engine combustion chambers can contain tiny crevices that can trap unburned methane. Using engines where the combustion chambers have been designed to minimise the number of crevices will reduce methane slip and total GHG emissions.

30 **Use engines with optimised combustion controls.** Upgrading your vessel with more modern and efficient engines will help you reduce methane slip significantly. Engine manufacturers have been working hard to reduce methane slip in a number of ways. These include optimised gas admission timing, which maximises the efficiency of scavenging and reduces the amount of gas that escapes during the process, and reduced overlap time, which means reducing both the compression work and the combustion temperature to lower emissions. Active closed-loop cycle-to-cycle controls improve the combustion stability that plays an important role in minimising emissions.



2 ways effective collaboration can help cut emissions

When you're targeting GHG reductions, having the right partner at your side can help you focus your efforts on the right investments and maximise your savings. Let's look at just two ways that collaborating with an expert partner can boost your emission reductions.

31

Use decarbonisation services.

You know you need to decarbonise your operations, but how can you choose the right solution or combination of

solutions for your operational profile and business case? Wärtsilä Decarbonisation Services takes the guesswork and uncertainty out of choosing the right solutions by providing you with a clear plan of action based on solid data rather than static assumptions.

32

Take advantage of an outcome-based business partnership.

An outcome-based business partnership follows a holistic rather than a transactional

approach, helping you to gain maximum value from your decarbonisation-related investments. In these types of service agreements, your supplier guarantees that a certain quantifiable outcome will be achieved – for example, fuel savings or emission reduction. If the agreed outcome is realised, you share the rewards. Wärtsilä's approach is based on specific solutions belonging to the Wärtsilä Lifecycle Agreement portfolio. These solutions start from the equipment and vessel power train level and go all the way up to the overall vessel and fleet level.



4 ways to harness other energy sources

The cleanest fuel is the fuel you don't use at all. There are lots of alternative energy sources out there that you can harness onboard to provide propulsive power and electricity for power consumers. Even the heat from engines can be reused for a variety of purposes. Read on for four ways to reduce greenhouse gas emissions by generating energy while your ship is sailing.

33 Harness wind power with rotor sails. Installing rotor sails can cut your vessel's fuel consumption and emissions by up to 30% by providing auxiliary propulsive power. These tall, cylindrical columns are installed on the deck. When rotating, they generate thrust as the result of the difference in air pressure on the aft and forward sides of the rotor. The total thrust depends on wind angle and wind speed. Wärtsilä is an authorised seller and servicing partner of the Anemoi Rotor Sail System.

34 Use solar power. Adding solar panels to your vessel provides a clean, green source of energy. Onboard hybrid vessels solar can be one of the power sources managed by a smart energy management system like Wärtsilä's Energy Management System (EMS) to deliver auxiliary power. And if your vessel has a shore connection and the local grid supplies solar-generated energy, then you can take advantage of free zero-carbon power.

35 Capture wave energy. The power of the waves your vessel sails on can be harvested in a variety of different ways to reduce fuel consumption and generate usable power. There are solutions being developed that convert wave energy into stored energy using devices on the hull, and proposals for hull devices that turn the motion of the ocean into useable energy via a flywheel system. In 2020 Wärtsilä launched the SeaTech project, which has conceptualised a bio-mimetic dynamic wing mounted at the bow of the vessel. The wing captures wave energy to generate extra thrust.

36 Recover waste heat from your ship's engine. Using heat generated by your vessel's engine can help you improve the total fuel energy utilisation rate by as much as 10%, reducing energy consumption and emissions in the process. Heat energy recovered from your engine can be used to generate hot water, produce potable water, provide heat for the air conditioning system and even preheat standby engines to ensure maximum efficiency on start-up. Wärtsilä has developed a Smart Heat Recovery system for its Wärtsilä 31 marine engine that not only recovers heat from the cooling water circuit but also heat from the engine lube oil circuit.



3 ways good maintenance can reduce emissions

If your vessel is well maintained and has a clean hull, you're going to save on fuel and generate less emissions. While this might sound like basic common sense, lots of ship owners and operators are not aware of the impact that some simple good practices can have on vessel efficiency. Here are just two examples.

37 Follow good maintenance practices.

Well-planned and executed maintenance can offer some big savings in fuel and therefore

emissions. For example, taking good care of the charge air system, cylinder unit and fuel injection system of your vessel's engines can cut fuel use by small percentages that add up to big savings when you're burning thousands of tons of fuel a year. Every drop of fuel saved can also help improve your vessel's CII rating.

38 Keep your ship's hull clean.

Some basic house-keeping on your hull can have a huge impact on your ship's efficiency and therefore the level of greenhouse gas emissions it emits. Regular hull cleaning to remove biofouling – the build-up of microorganisms, plants, algae or small animals – reduces the frictional resistance of the hull. A report by GloFouling Partnerships estimates that a layer of slime as thin as 0.5 mm covering up to 50% of a hull surface could increase GHG emissions by as much as 25–30%, depending on your ship's characteristics, speed and other prevailing conditions.

39 Adopt a predictive maintenance approach.

Artificial intelligence-enabled predictive maintenance services can be used to predict maintenance needs and identify potential failures before they happen, maximising the availability of your maritime assets. Predictive maintenance can bring you fuel savings of as much as 5% and provides a clearer picture of when upgrades should be carried out based on your vessel's operational profile.



5 ways to optimise your equipment

Optimisation is all about taking what you have and squeezing every last drop of efficiency from it. Your ship's engine, auxiliary gensets and hull are just a few examples of elements that can be optimised to reduce emissions. Read on to find out more.

40 **Add a shaft generator system.**

Shaft generator systems can improve a vessel's energy

efficiency by 3–5% by using the main engine instead of auxiliary engines to generate electricity for use onboard. Driven by the main engine, these systems use the main engine and propeller shaft's rotational motion to generate electricity. A frequency converter supplies three-phase current at a constant voltage to engines and thrusters and to cover the hotel load, even if the vessel speed changes or the propeller speed varies due to changing sea conditions. Shaft generators can be installed on newbuilds and retrofitted to existing vessels.



41

Take advantage of computational fluid dynamics (CFD). CFD is a fantastic tool when you want to design the most energy-

efficient hull possible or fine-tune components – for example, propellers, thrusters or waterjets – on an existing ship to make it more efficient. CFD predicts flow phenomena to analyse how individual components work together, allowing greater optimisation than would be possible individually. Wärtsilä uses CFD as part of its OPTI-Design methodology.

42

Avoid just-in-case sizing.

You can go a long way to cutting propulsion and auxiliary emissions by doing some smart planning when designing your ship. Instead of specifying engines and auxiliary gensets based on how much power you think you might need, you should consider your actual needs. With some expert advice you can put together a system that provides the optimal amount of power. In other words, not too much, not too little. That way, your ship isn't consuming unnecessary fuel and therefore generating excess emissions.

43

Take advantage of onboard monitoring and automation.

Data and digitally connected operations are key to optimising vessel efficiency.

Wärtsilä's Fleet Optimisation Solution (FOS) can include the Hull and Machinery web module, which keeps you fully informed about the condition and performance of your assets. For example, it can monitor hull, propeller and engine condition as well as vessel fuel and lubricant consumption and notify crews of any deviations.

44

Treat your engine to a performance upgrade.

If your vessel is powered by a Wärtsilä 4-stroke diesel engine, you can take advantage of a tailored performance upgrade package that optimises the combustion process and tunes your engine to the most frequently used operating range. Modern, high-efficiency turbochargers are combined with engine tuning to reduce fuel consumption and emissions.



2 ways to store or convert CO₂

Just because your vessels create CO₂ doesn't mean that it has to be released into the atmosphere as a pollutant. Technologies are emerging that will allow you to store the gas for onshore disposal or even convert it into a low carbon fuel.

45 **Capture CO₂ with exhaust-treatment technology.** Capture carbon directly at the source with an onboard carbon capture and storage (CCS) system. When combined with a CCS-ready scrubber (already available) the vessel will tackle SO_x, particulate matter (PM) and CO₂ emissions. With add-on devices it could also tackle NO_x and microplastics. The captured CO₂ will be stored onboard in liquid form. Once offloaded in port it can then be sequestered or used in other applications. Wärtsilä has developed and piloted onboard CCS systems that reduce CO₂ emissions from any fuel by up to 70%.

46 **Convert CO₂ to something else – such as ethanol, which can be used as fuel.** When you capture carbon dioxide and mix it with hydrogen, an environmentally friendly gas, and add a catalyst you can make ethanol. Ethanol (C₂H₅OH) is being studied as a potential future maritime fuel as it is easy and safe to handle. What could be better than turning a greenhouse gas into a low-carbon source of power?



4 ways to take advantage of data

As ships and shipping become more digitalised and connected, data is becoming increasingly valuable as a way to optimise equipment, routing and vessel operations. Here are four ways you can leverage data to help reduce greenhouse gas emissions.

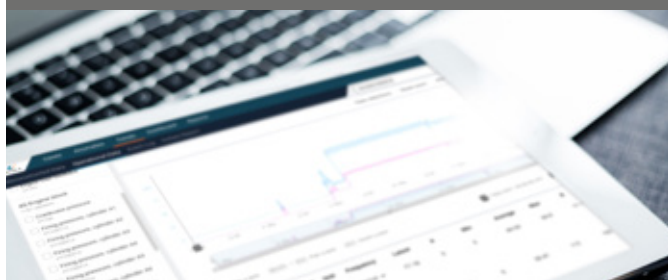
47 Optimise port operations. When vessels can move into, within and out of ports as efficiently as possible, there's less vessel idling and less fuel burnt unnecessarily. Shifting to digital port management information systems is a fantastic way to optimise port operations, saving time, fuel and emissions. A single, digital system for planning, managing, monitoring and reporting all operations and related business processes is the best way to achieve this. Wärtsilä offers end-to-end digital solutions for ports of all sizes.

49 Optimise your engines. With the right data, you can identify how to make your ship's engines operate as efficiently as possible. Lots of small improvements can add up to substantial fuel savings – and therefore a significant reduction in emissions. The trick is to start simple by making sure your ship's powertrain is optimised to match its operating profile, with the flexibility to cover your full range of sailing speeds. A trusted partner and a solid lifecycle service agreement can help you find these marginal gains.

48 Optimise vessel route planning. Choosing the optimal route and speed for your vessel according to the weather, wind, waves and currents en route can help you save big on fuel and therefore emissions too. With modern cloud-based, AI-enhanced planning software that gathers data from weather forecasts, vessel models and historical traffic information, cutting your fuel bill can be as simple as entering your port of origin and destination to get the most fuel-economic route. The Wärtsilä Fleet Optimisation Solution is already helping to decarbonise over 2,000 cloud-connected vessels in this way.



50 Monitor every component you can. The more data you collect, the more you can do to reduce your vessel's overall carbon emissions by keeping components operating optimally. Every single component has a part to play. For example, exchanging a filter or cleaning an air cooler at the right time can cut fuel consumption by around 2% – and data can tell us when that time is.



Conclusion

So there you have it. An inspiring list of 50 ways you can cut the greenhouse gas emissions of your vessels all in one place. It's helpful to know about these ways and the potential impact of different technologies and combinations of technologies on your greenhouse gas emissions. But what should you do with this knowledge? If you're not sure how to apply it you could end up investing in solutions that don't deliver the results that make the most sense for your business.

To see clearly which investments make most sense for your ships, you need actionable advice from a reputable partner with the right tools and expertise at their disposal.

Wärtsilä is just such a partner. Let's discuss some of the solutions described in this eBook and together plan the best way to reduce your greenhouse gas emissions.

[Contact us today!](#)



Wärtsilä Marine Power leads the industry in its journey towards a decarbonised and sustainable future.

Build your success with Wärtsilä's broad portfolio of marine technology. Engines, propulsion systems, hybrid solutions, data and digital tools, liquid and gas handling on vessels, and integrated powertrain systems. These building blocks offer you efficiency, reliability, safety, and world-class environmental performance.

The offering includes performance-based agreements and lifecycle solutions as well as spare parts services and an unrivalled global network of maritime expertise. With us, you can navigate decarbonisation with confidence.



www.wartsila.com/marine

Wärtsilä is a global leader in innovative technologies and lifecycle solutions for the marine and energy markets. We emphasise innovation in sustainable technology and services to help our customers continuously improve their environmental and economic performance.

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