

THE ROUTE TO PROFITABLE DECARBONISATION

Insights and practical guidance for the ferry segment

The ferry industry is on the front line of the energy transition and a pioneer of decarbonisation technologies. This white paper takes a deep dive into the challenges facing this hugely diverse industry as it plots a path towards zero-carbon operations. The paper begins with an overview of the current state of play in the industry, a comprehensive review of its geographical nuances and an in-depth look at individual vessel types. We then present the solutions and services that are available today to help operators meet their business and sustainability goals, delivering reliable and cost-effective operation across the vessel lifecycle.

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INTRODUCTION – SETTING A NEW COURSE FOR FERRIES

Driven by unique operating requirements and close scrutiny from the populations they serve, ferries are among the pioneering users of the technologies that will decarbonise shipping.

Few maritime sectors are as diverse or challenging as the ferry market. From small commuter ferries making tens of voyages a day to the biggest RoPax ferries plying the oceans, each segment faces individual challenges based on regulations, business case and operating profile. What unites them is the close link that vessel operators have with the public – no sector except cruise serves end consumers so directly – and their fixed routes, whatever the distance.

The socio-political pressure on companies in all industries to decarbonise is reflected in global maritime through the increasing environmental regulations enacted by the International Maritime Organisation and regional authorities.

The IMO's Energy Efficiency Existing Ships Index (EEXI) will set baseline design efficiency requirements for vessels from 2023, while the Carbon Intensity Indicator (CII) will implement increasingly strict operational emission requirements between 2023 and 2030, by which time IMO aims for a 40% reduction in the carbon intensity of global international shipping (based on 2008 levels). The current ambition – although under review at IMO – is to cut carbon intensity by 70% and halve total emissions from shipping by 2050.

On a regional level, there is the prospect of tighter greenhouse gas emission regulation across Europe, the US and China – and likely other regions – including market-based measures that ultimately aim to accelerate the switch to less carbon-intensive fuels. And on a local level, many ports have already implemented zero-emission zones and require shore power to eliminate engine emissions at berth. More will no doubt follow suit.

Ferries are on the front line of the energy transition and among the first sectors to target zero-carbon operations. Zero-emission ferries already operate and the trend will continue to work its way from the smallest ferries – crossing harbours and fjords – to bigger vessels with longer range.

The relatively small size of many ferries and their fixed, short routes mean that many efficient technologies and power sources are more viable than for bigger vessels with longer voyages and often no fixed itinerary. That difference has traditionally made ferries rapid adopters of new solutions, but innovations must be implemented with caution; many ferry companies operate on slim profit margins and manage demanding schedules. New technologies need to be introduced with minimal service disruption and maximum return on investment.

“Ferries are on the front line of the energy transition and among the first sectors to target zero-carbon operations.”

A PALETTE OF POWER AND EFFICIENCY TECHNOLOGIES

There are more differences than similarities among the global ferry sector. The same solutions that will drive commuter ferries to decarbonisation will not be applicable on larger vessels, while variable fuel availability and cost across the world will guarantee a varied mix of future fuel capabilities are needed across the market. Solutions ranging from electrification to multi-fuelled engines – as well as efficiency upgrades, fuel conversions and effective maintenance across the vessel lifecycle – will all play a role.

Wärtsilä's approach to working with ship owners and operators offers value and confidence as customers consider the way ahead.

“Wärtsilä's technologies, expertise and partnership offer owners a predictable, investable path to decarbonisation, today.”

It all starts with the operator's ambitions, whether to meet or exceed regulatory requirements or to hit specific operating capabilities such as smokeless start or zero-emission port entry. Next comes a detailed exploration of the vessel's operating profile, the owner's business case and market factors (such as projected fuel availability). Several alternative solutions are compared, either by modelling or based on operational data from comparable vessels. Potential CAPEX, OPEX and return on investment are considered, while compliance and efficiency across the lifecycle are also important elements.

The result is a newbuild or retrofit project that ship owners can be confident will meet their business and sustainability goals across the vessel lifecycle, delivering reliable and cost-effective operation.



1. GEOGRAPHICAL VIEW – A GLOBALLY DIVERSE VESSEL SEGMENT

Regional variation in the regulations, market conditions and operating requirements facing ferry operators mean there can be no single solution to decarbonising the sector.

According to a study commissioned by ferry trade association Interferry in 2021, there were around 15,400 ferries in service in 2019 with a combined gross tonnage of more than 31 million tons*. Those vessels carried at least 4.27 billion passengers and 373 million vehicles that year, with the industry estimated to support US\$60 billion in gross domestic product globally and over a million jobs. Given the criteria for inclusion in the study, the true scale of the ferry segment is undoubtedly even bigger.

The study also explored the distribution of the world ferry fleet by region. Between them, Europe and Asia account for 90% of the world distribution with the Americas, Africa and Oceania making up the rest. Asia has 79% of vessels by number while Europe has 11%, but in terms of gross tonnage Europe accounts for 58% and Asia 34%.

The average age of ferries stood at 23 years in 2019. Given the large number of newbuildings that have entered the fleet over the last ten years or so and the large number on order, it is clear that many ferries have lifespans far in excess of the 25 years or so common among other vessel types. The fact that there are many veteran ships in the sector suggests that there is much potential for retrofits and conversions as operators aim for improved efficiency and a decarbonised future.

In this section, we explore the factors shaping the ferry markets across the world.

EUROPE

Without doubt Europe has driven the decarbonisation programme at the IMO and within the EU itself harder and faster than any other region. The EU introduced monitoring of fuel use for vessels above 5,000gt under the Monitoring, Recording and Verification (MRV) regulations in 2017, a year in advance of the IMO's similar Data Collection Service (DCS).

The EU's MRV is intended to preface shipping's inclusion in the Emission Trading System (ETS), while the IMO has not yet formally adopted any market-based measures for decarbonisation. The ETS will begin to affect shipping including the ferry sector in 2023. All intra-EU emissions will be included and half of the emissions if the voyage starts or ends outside of the EU. There is a phase-in period from 2023 to 2026, by which time all of a vessel's emissions will be covered, rather than just 20% in 2023.

In July 2020 the European Commission (EC) launched its 'Fit for 55' proposals, aimed at reducing the EU's total GHG emissions by 55% by 2030 and working to reach full decarbonisation by 2050. The proposals are working their way through the EU's legislative process and the full outcomes will only be known after this stage. Another aspect of the Fit for 55 package is that it will require better provision of LNG bunkering facilities and improved access to shore power.

Related to Fit for 55 is the FuelEU Maritime Regulation. This will impose lifecycle GHG footprint requirements on the energy used by ships when it comes into effect in 2025. It applies to ships covered by the MRV and will cover methane and NOx as well as CO2. The regulation includes increasingly strict requirements for the GHG intensity of fuels used. Passenger vessels staying in port longer than two hours will be required to use shore power.

Finnlines draws on Wärtsilä hybrid capabilities

According to Matteo Sartori, Senior Expert, System Development & Design, Wärtsilä Marine Power, ferry operators are reacting to the European drive to decarbonise in various ways. Hybridisation and the use of batteries are proving a popular path to compliance, particularly for any vessels impacted by the MRV rules, which would include many freight RoRo vessels and most RoPax vessels.

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**Matteo Sartori,
Wärtsilä Marine Power**

Sartori cites Wärtsilä's cooperation with Finnlines for hybrid RoPax and RoRo vessels. Finnlines has undertaken a major fleet renewal programme that will see three hybrid RoRo vessels (Finneco I-III) and two eco-efficient RoPax vessels (Finnsirius and Finncanopus) built in China. The vessels are designed to be partially operated on battery power. The hybrid solution will reduce fuel consumption and allow zero emissions at berth. The noise during the stay in port will also decrease.

Battery banks of 5MWh will allow the use of stored electricity while in port. In addition, the RoRo vessels will have solar panels and RoPax vessels will be fitted with an onshore power connection. The vessels will also be equipped with air lubrication systems, and exhaust gas cleaning equipment to cut emissions further.

Wärtsilä's involvement in the two RoPax includes Wärtsilä 46F main engines, thrusters and a state-of-the-art electric package featuring a hybrid shaft generator system comprising a fully integrated multidrive capable of using shaft generators for power take in and take out. The package also includes the thruster control system and a highly efficient energy management system for performance optimisation. The contract for the freight RoRo vessels is for a similar range of equipment.

Bringing LNG to Brittany Ferries

Wärtsilä has had success in this field. A recent notable example is orders for 46DF dual-fuel main engines and 20DF dual-fuel auxiliary engines for a trio of Stena e-Flexer hybrid RoPax ferries, two of which will be chartered to French operator Brittany ferries and one to Canadian operator Marine Atlantic. The scope of supply for the vessels also extends to gearboxes, controllable pitch propellers, tunnel thrusters and the fuel gas supply system.

In addition to the equipment supply contract, Wärtsilä will provide technical support via a long-term service agreement for one of the vessels, the Salamanca. The extensive scope of the service agreement includes remote operational support and Wärtsilä's unique Expert Insight digital predictive maintenance solution.

“Many countries in the region are engaged in fleet modification programmes, in many cases driven by decarbonisation but also by logistics and economics.”

**Henry Diepeveen,
Wärtsilä Marine Power**

ASIA PACIFIC

Asia has more ferries than any other region around the world and there are signs that in many countries there are government backed initiatives to accelerate development. There is substantial experience to draw on for cutting-edge efficient vessels; shipbuilders in China, South Korea and Japan have been building large RoPax and freight RoRo vessels destined for European operators for many years. And in Australia, Incat and Austal have supplied most of the world's fast multi-hulled, aluminium high-speed ferries, both in passenger only and RoPax configurations. When it comes to vessels for local use, Henry Diepeveen, General Manager Sales – Japan, Wärtsilä Marine Power, says that many countries in the region are engaged in fleet modification programmes. In many cases decarbonisation is the driving factor, but logistics and economics also come into play.

In Japan for example, most imports and exports move through the main ports of Yokohama, Tokyo, Nagoya, Kobe and Osaka. However, the country comprises about 400 inhabited islands and a significant part of all truck journeys is made using ferries.

Most of the larger Japanese ferries are RoPax. Although passenger journey numbers have reduced during the COVID pandemic, freight has increased due to online selling. While COVID has impacted revenues, many operators are still finding funds to invest in fleet renewal programmes.

There are few countrywide initiatives in Japan, although some ship operating companies are exploring potential ideas. Electric ferries and alternatively fuelled vessels are making an appearance, but most are smaller prototypes and the development is in its infancy. Larger vessels mostly run on oil fuels and several newbuildings are equipped with exhaust gas cleaning systems allowing them to run on high sulphur fuels. Although the fuel direction is not set yet in Japan, ammonia seems to be a popular, probably intermediate, alternative.

Optimising fuel efficiency with Hankyu Ferry

One leading operator – **Hankyu Ferry** – took delivery of two 16,292gt RoPax ferries in 2020 that feature Wärtsilä engines and scrubbers. The Wärtsilä 31 engine achieves outstanding fuel efficiency through a combination of innovative technologies, including common rail fuel injection, hydraulic valve control, a 2-stage turbocharger, and the integrated Wärtsilä UNIC engine control system. The resulting high efficiency lowers both fuel costs and emission levels. The ferries are also fitted with Wärtsilä's Hybrid Scrubber system to ensure compliance with the IMO's 2020 sulphur restriction requirements.

Ferry fleet renewal is also beginning to accelerate in China. While some newbuildings are for domestic service, others are for international operations linking South Korea and China. In this regard, South Korean operators are co-operating with their Chinese counterparts in joint services.

According to Jack Pang, General Manager Sales – China, Wärtsilä Marine Power, China's government is giving encouraging support to operators and setting targets for decarbonisation and technical innovation. Zero-emission vessels are high on the agenda with battery power being seen as the most suitable technology. Fuel cells are also under consideration for the future.

The Chinese government has set 2030 as the date for carbon emissions to peak and thereafter plans to pursue carbon neutrality by 2060. On the way to meeting these targets, methanol is currently seen as the most suitable alternative fuel for large-scale shipping, while for smaller vessels port power systems will be needed for battery recharging.

A similar situation exists in South Korea. In 2021, Busan Port Authority began a decarbonisation project that could see 140 all-electric, battery-powered vessels produced by 2030. The programme fits with the country's plan to achieve net-zero emissions by 2050. Operators Daejeon Construction and Sea World Express Ferry have chosen a different route, ordering almost identical 76m high-speed RoPax ferries from Incat in Tasmania to serve routes to offshore islands.

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Jack Pang,
Wärtsilä Marine Power

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Plans for alternative fuels have not yet gained much traction in South Korea, where LSFO is seen as the fuel of choice with scrubbers not considered an attractive proposition. As with many countries in Asia, the lack of LNG bunkering facilities prevents its use even as a transition fuel. In the short-term, decarbonisation efforts are focused on energy-saving devices, battery systems and shore power.

Singapore is intensifying its decarbonisation efforts in the maritime sector, with the unveiling of a blueprint that sets out strategies and goals to be achieved by 2050 and at least an additional S\$300 million to support these initiatives. The Maritime Singapore Decarbonisation Blueprint 2050 will focus on seven key areas of which one is harbour craft. Numbering 1,600 including ferries and tug boats, these will operate on low-carbon energy solutions by 2030 and full electric propulsion and net-zero fuels by 2050.

Singapore's Maritime and Port Authority is investing significant sums into green initiatives, although most are not aimed at the ferry sector except for COVID-related support. As a major bunkering port, LNG features strongly in decarbonisation policies.

With regards to conventional ferry type operations, owners and operators are looking towards fuel efficiency and total cost of ownership on their current fleets of ferries operating within and out of Singapore waters. The introduction of electric propulsion for newbuild ferries is still at the early stage and so far under development with feasibility studies ongoing by the respective external stakeholders.

Australian operators opt for LNG

In Australia and New Zealand there is a trend towards LNG, with operators such as TT-Line and SeaRoad opting for dual-fuel engines in their newbuilding. Both have opted for systems with Wärtsilä 46DF and 20DF engines along with LNG systems.

SeaRoad's latest newbuild, for example, will be powered by two Wärtsilä 46DF dual-fuel main engines and three Wärtsilä 20DF dual-fuel auxiliary engines. The Fuel Gas Handling System and LNG tanks are designed with the Gas Valve Units (GVUs) integrated into the tank connection space. The new SeaRoad and TT-Line vessels will both feature Wärtsilä PTO/PTI systems to enable electricity generation from the main engine.

Australia has only a small number of players in the larger RoRo and RoPax segments but many more operating smaller vessels. Here there seems to be growing interest in hybrid and fully electric vessels especially for small commuter ferries.

In common with operators around the globe, high fuel prices are driving efficiency improvements and for the smaller vessels where electrification is seen as a desirable route, they could be aided by cruise terminals also looking at providing shore power for visiting cruise ships.

AMERICAS

Along with the EU, the US has been driving the environmental targets emanating from the IMO. In other countries, approaches to decarbonisation vary, partially due to the differing options available.

Canada is a good example. Mark Keneford, Business Development Manager Sales, Wärtsilä Marine Power – whose brief is to cover Canada in the Americas – highlights that on Canada's east coast most of the energy comes from fossil fuels, whereas in Quebec and British Columbia hydro-electricity provides most power, making electric ferries or vessels powered by eFuels a possibility for the future. In Canada's Great Lakes, LNG and dual-fuelled vessels are gaining in popularity.

Gas-fuelled progress for BC Ferries

BC Ferries – the world's third largest ferry operator – has been a major customer of Wärtsilä in recent years. Four 8,728gt Salish class RoPax vessels were contracted with the Polish shipyard Remontowa in 2014 with Wärtsilä 20DF dual-fuel engines, operating on LNG fuel and with Wärtsilä LNGPac fuel storage, supply and control systems. Three of the ships are in service and the fourth will enter service in 2022. All four feature Wärtsilä diesel-electric propulsion systems.

Following that order, the same yard won a contract to convert the RoPax ferries Spirit of British Columbia and Spirit of Vancouver to run on LNG. For this pair Wärtsilä supplied four Wärtsilä 34DF dual-fuel engines with fuel gas systems, LNGPac fuel storage systems, transmission systems and gearboxes, integrated automation systems and power management systems.

In 2021 Wärtsilä won a contract for a small 89m RoPax ferry being built for British Columbia's Ministry of Transportation and Infrastructure. The vessel is being built at the Western Pacific Marine shipyard and will feature two Wärtsilä 20 gensets, the Wärtsilä's Hybrid Solution with a DC electrical system and batteries, the energy management system, and the vessel alarm and monitoring system.

Keneford says Canadian operators are looking to the future with improved efficiency, electrification and alternative fuels all on the agenda. Wärtsilä is working with many of them to explore the possibilities.

Efficiency is always a driver especially with escalating fuel costs and there are social pressures to reduce emissions. Full electrification of short route services will only be possible if the grid in Canada is upgraded, something which the government, utility companies and ferry operators are already in discussion about. Alternative fuels may provide the best answer for some routes especially as the diesel engine dual-fuel variants can be adapted and modified to take advantage of new fuels as they become available.

Although there are many ferries operating in Latin America and the Caribbean, Mario Barbosa, Senior Sales Manager, Wärtsilä Marine Power, describes the sector as being limited in scale and having a conservative attitude to decarbonisation.

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Mark Keneford,
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**Mario Barbosa,
Wärtsilä Marine Power**

In Brazil there are several ferries operating in the State of Bahia carrying mostly tourists but also some vehicles. For the most part, these are small vessels around 600-800gt. Barbosa says these are mostly more than 10 years old and while there are discussions about replacements plans have not yet been confirmed. In the north of Brazil and Amazonia, most vessels are quite elderly.

According to Barbosa, in most of the region, emissions are not as big a public or political issue as they are elsewhere. Decarbonisation is seen as involving high capital expenditure. The obvious route of dual-fuel vessels running on LNG as a transition is complicated by the lack of any bunkering infrastructure. However, ethanol is produced in Brazil in quantities and could potentially be used in engines designed to run on methanol. As a renewable biofuel, it could be a niche solution for the region. Discussions are also taking place about fully electric vessels.

Adding LNG to Argentina's high-speed ferries

At the opposite end of the scale compared to Brazil, Argentinian operator Buquebus frequently adds to its fleet of high-speed ferries. In recent years the company has acquired the fastest ferry in the world, built in Tasmania by Incat with Wärtsilä involvement and running on LNG.

Francisco was delivered in 2013 and, with a recorded speed of more than 58 knots, claims the title of fastest ferry. It has two 22MW GE LM2500 gas turbines driving Wärtsilä LJX 1720 SR waterjets. The new Buquebus ship, Incat hull 096, is predicted to have a maximum speed of over 40 knots.

On the west coast of South America, Chilean operator Navimag took delivery in 2020 of the Esperanza which has become renowned for its unusual bow form. The vessel sails between Puerto Montt and Puerto Natales providing a transportation link with Chile's south, in addition to ferry cruising in the Patagonian fjords. Wärtsilä supplied a pair of Wärtsilä 20 main engines, two controllable pitch propellers and two gearboxes as well as being heavily involved in the design process with Naviform of Canada.



2. SHIP TYPES – ALL SIZES GREAT AND SMALL

The phrase ‘one size fits all’ cannot be said of the ferry segment, where dramatically different ship configurations and profiles require very different approaches to decarbonisation.

The route to decarbonisation differs across the various ship segments within the ferry industry just as it does across regions. Some technologies available for decarbonisation will cross over into different segments but some are more suited to specific ship sizes or operating profiles. Across all sectors shipowners face the dilemma of which way to go.

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“Four-stroke engines provide more scope for energy storage systems on large ferries both RoRo and RoPax as an energy storage system can allow for one engine to be removed.”

RORO FERRIES

There is a fine line to be drawn between short route RoRo liner services and RoRo ferry services. Officially a RoRo vessel is allowed to carry up to 12 drivers as passengers, if designed and intended to carry beyond that number the ship becomes a RoPax and very different safety rules will apply.

In its 2021 study, Interferry identified 15,436 vessels as being active. Around 18% of these were said to be short sea freight RoRo ships, suggesting a global figure of just under 2,800 vessels. Other statistical data in the survey indicates that 46% were based in Europe, 43% in Asia, 8% in the Americas and the balance were operating in Oceania and Africa. In Europe in particular, this segment has been encouraged to expand as it is seen as taking freight off roads and therefore reducing pollution ashore.

From the propulsion perspective there is little difference in the technology employed between RoRo and RoPax, especially at the larger sizes, but for RoPax vessels there is a much higher hotel demand. This difference can manifest itself in many ways and can influence energy and efficiency strategies. It is quite common for large RoRo vessels to be equipped with two-stroke main engines similar to deep sea vessels. However, it increasingly makes sense to opt for four-stroke hybrid machinery for several reasons, not least the extra efficiencies and flexibility such arrangements provide. Most of the vessels that have this propulsion arrangement currently operate on oil fuels only, but dual-fuel engines that run on LNG have made inroads into other ship types and are found on some short-sea RoRo vessels.

Initial thinking was that battery energy storage systems for such ships would provide little advantage but that is being reconsidered today. A two-stroke engine directly linked to the propeller could have a front-end PTO/PTI arrangement that could be used for charging the battery at sea and for manoeuvring or providing power during port stays. Shore power connections are another way that the battery could be recharged, and this also means no engines need be run during port stays.

Four-stroke engines are the most popular choice for freight RoRo and RoPax ferries across all size segments. They can be used for direct propulsion or in diesel-electric configurations or in a mix, usually called hybrid propulsion. A multi-engine set up is usually chosen as this is required by most vessel operating profiles to meet the demands of full speed running, manoeuvring and summer/ winter speeds. Multiple engine installations bring the additional benefit of allowing for engine maintenance without the need for normal service operations to cease.

The smaller size of medium and high-speed engines, especially in height, means that they intrude less into space that can be used for cargo purposes. In a diesel-electric set up they can also be located in areas which would be impossible for a mechanical set up. Four-stroke engines provide more scope for energy storage systems on large RoRo and RoPax ferries as an energy storage system can allow for one engine to be removed. This saves on both CAPEX and OPEX as well as maintenance.

Customer references

Wärtsilä is involved in a project for the Australian operator SeaRoad with a freight RoRo vessel being built at FSG in Germany. The 210m vessel will be powered by a pair of Wärtsilä 46DF dual-fuel main engines and also features three Wärtsilä 20DF dual-fuel auxiliary engines. The Fuel Gas Handling System and LNG tanks are designed with the Gas Valve Units (GVUs) integrated into the tank connection space. This solution is unique to Wärtsilä and reduces the amount of piping needed, facilitating easier installation.

Wärtsilä's scope of supply extends to PTI/PTO shaft alternators with multi-drive technology, monitoring and control systems, switchboards, internal communication, and safety systems as well as lighting. The PTI ability of the shaft alternators will allow for later addition of battery storage or other electrical input.

ROPAX FERRIES

This is a sector where the size range is quite extensive ranging from short route vessels with space for a very small number of vehicles through to large cruise ferries with a gross tonnage in excess of 75,000. The propulsion power requirements for large (above 30,000gt) and medium sized (10–30,000gt) RoPax ferries will be similar to that of freight RoRo vessels of comparable size. But there is a considerable increase in the hotel load needed for many hundreds or even thousands of passengers compared to the maximum 12 drivers on freight RoRo vessels.

In this class of vessel, two-stroke engines are a rarity and four-stroke medium speed engines will feature in all but the smallest ships where a high-speed engine may be used. Dual-fuel engines have made considerable inroads into the RoPax ferry segment and can be found in almost every ship size bracket. LNG and dual-fuel four strokes are proven operationally and provide an instant reduction in carbon emissions even if fuel is fossil-based. Bio and synthetic LNG will require no change to equipment and are drop-in fuels that could offer carbon-neutral operation depending on source and manufacturing process.

Initially Norway was a pioneer in LNG-fuelled ferries encouraging its use through subsidies and export credit guarantees. This position has shifted recently in favour of other technologies such as batteries and looking ahead to hydrogen and ammonia. In part this is due to Norway's almost self-sufficiency in hydroelectricity which would facilitate a switch to hybrid and pure electric options for ferries. Norway still recognises LNG as a transition fuel for shipping but no longer supports its wider use in the way that other countries are now embracing it.

Ammonia is under consideration as a future fuel but the question of safety on vessels carrying large numbers of passengers is a factor that needs to be considered. The hazards of dealing with ammonia are unlikely to worry seafarers but there is a perception that the public may balk at its use, at least in the early stages.

Customer references

“LNG and dual-fuel four strokes are proven operationally and provide an instant reduction in carbon emissions even if fuel is fossil-based.”

“Dual-fuel engines are the only effective route to decarbonisation at the present moment.”

Wärtsilä has scored considerable success in the RoPax sector for its dual-fuel engines running on LNG and importantly this is on a global scale and not confined to one area or ship type. Among recent examples are:

- 17,300gt Sunflower Kurenai and Sunflower Murasaki for Japanese operator Ferry Sunflower – Wärtsilä 31DF engines, gearboxes and LNGPac fuel storage. These will be the first LNG-fuelled ferries in Japan.
- Two 48,000gt vessels for Australian operator TT Line – Wärtsilä 46DF and 20DF engines and LNGPac. Future-proofed to operate on other fuels when available.
- Four Stena e-Flexers for Brittany Ferries – two different variations but all using Wärtsilä 46DF and 20DF engines, LNGPac and a PTO/PTI system.
- One Stena e-Flexer for Canadian operator Marine Atlantic – Wärtsilä 46DF and 20DF engines, LNGPac and PTO/PTI hybrid propulsion system.
- Two 68,640gt ‘Superstar’ vessels for Finnlines – Wärtsilä 46F main engines, thrusters, and electric package including a hybrid shaft generator system. These vessels will also feature a Silverstream air lubrication system.
- Three plus one option for 195m RoPax ferries for Poland’s Unity Line – Wärtsilä 31DF engines and hybrid battery system.
- Four 8,728gt Salish class vessels for BC Ferries in Canada – Wärtsilä 20DF dual-fuel engines; LNGPac fuel storage, supply and control system; and diesel-electric propulsion system.

HIGH-SPEED FERRIES

With lengths ranging from 30 to over 120 metres and typical route distances varying from 10 to 100 nautical miles, fast ferries typically transport passengers, cars and trucks directly between two points without multiple port calls along the way. High-speed vessels are a niche segment in the wider ferry sector although they can be found in most parts of the globe. Although almost always lightweight, multi-hulled and constructed from aluminium, they still have a relatively large power requirement to operate at speeds usually around 30 to 35 knots. For large RoPax high-speed ferries this effectively rules out hybrid or pure electric operation, leaving dual-fuel engines as the only currently effective route to decarbonisation, although fuel cells might become possible options for the future.

High-speed ferries tend to use MDO/MGO, but LNG is making inroads. Gas turbine engines have been fitted to a very small number of vessels, but four-stroke medium and high-speed engines are the norm. For these vessels more perhaps than others, lowering speed to meet new efficiency rules is not an option.

Customer references

Spanish operator Balearia’s Eleanor Roosevelt entered service in 2021. It is the world’s first fast ferry to be powered by dual-fuel engines that can run on LNG. The innovative vessel operates on four highly efficient Wärtsilä 31DF dual-fuel engines, four Wärtsilä axial flow LJX1500SRI waterjets, and a Wärtsilä LNGPac fuel gas storage and supply system.

Wärtsilä will provide the propulsion solutions for a new 115m high-speed ferry being built for Molslinjen at Austal's yard in the Philippines. Molslinjen Express 5 will feature four Wärtsilä 31 engines and four high-performance Wärtsilä axial flow WXJ1500SRI waterjets – a unique combination for ferries that delivers exceptional fuel efficiency, reliability, quality and performance.

COMMUTER FERRIES

On a global scale, small passenger-only commuter and tourist ferries outnumber all other ferry types by number. It is not uncommon for these vessels to have the longest service lives of any ferry type with 30, 40 and even 50-year lifespans being notched up. Most are powered by medium-speed or high-speed engines of relatively low power output. Routes tend to be very short although in archipelagos a vessel may operate a service calling at numerous points on a circular route.

Where there is a reliable shore power grid, these vessels are ideal candidates for full electric or hybrid operation. Over the last five years or so, many cities around the globe including New York, Rotterdam, Copenhagen, Wellington and Plymouth to name but a few have inaugurated battery-powered electric commuter ferry services.

In common with every form of electrified transport, the decarbonisation contribution of electric ferries will depend on the grid power sourcing. Even if the power from the grid is not 'green', ferries running on stored power will reduce local emissions and contribute to improvements in air quality and human health.

Another source of power that is just beginning to appear is hydrogen. There are presently two small prototype vessels powered by hydrogen-fuelled internal combustion engines in operation – Hydroville in Belgium and HydroBingo in Japan. In addition, Norwegian operator Norled has recently taken delivery of fuel cells from Ballard Power Systems to allow the 300-passenger RoPax Hydra to run solely on hydrogen.

As with battery storage systems, the decarbonisation potential of hydrogen – whether in an internal combustion engine or in a fuel cell – will depend on how it is produced. The advantage that hydrogen-fuelled vessels may have as regards decarbonisation is that ships capable of carrying liquid hydrogen are already being built, allowing 'green' hydrogen to be transported to areas where electricity is not green.

Since small ferries are often the test bed for new technology in the maritime industry, the concepts will likely be scaled and penetrate other segments of the ferry fleet.

“In common with every form of electrified transport, the decarbonisation contribution of electric ferries will depend on the grid power sourcing.”



3. THE OPERATOR AND TRADE BODY PERSPECTIVE

One of the world's largest RoRo vessel operators and the international ferry trade body share their perspectives on decarbonising the ferry sector while keeping a focus on customer value.

Ferry operators are obliged to comply with regulations emanating from port states, IMO regulations enacted through domestic legislation and unique requirements determined by the flag state. At the same time, operators need to meet the demands of customers – increasingly accommodating both passengers and freight customers keen on reducing their carbon footprint.

“Per Westling, Managing Director of Stena RoRo, and Johan Roos, Director of Regulatory Affairs for Interferry, agree that price will remain the most important factor for freight and passengers alike.”

“Over 15,000 running hours on methanol have been clocked up across the four engines.”

In this environment, any operator that can show its vessels are greener or more efficient than those of its competitors may gain an advantage in two ways. First in attracting business from environmentally conscious passengers and freight owners. Second, by way of efficient technologies and operation, by reducing fuel costs and maintenance bills while keeping to strict schedules.

But while environmental factors will drive the market, both Per Westling, Managing Director of Stena RoRo, and Johan Roos, Director of Regulatory Affairs for ferry operators' trade body Interferry, agree that realistically price will remain the most important factor for freight and passengers alike. Westling sees decarbonisation as a major challenge for the industry and thinks operators will adopt different strategies to meet it, especially in regard to the CII and FuelEU Maritime rules.

STENA BUILDS ON METHANOL MOMENTUM

Stena Germanica – a 51,837gt RoPax – was the first RoPax ever to run on methanol when in 2015 it was converted in a project involving Stena, Wärtsilä, Methanex Corporation, and the Ports of Gothenburg and Kiel. The project was co-financed by the European Union. Under the project, the ship's four Wärtsilä-Sulzer eight-cylinder Z40S medium-speed engines were converted to run on methanol as well as MDO/MGO.

Westling says that over 15,000 running hours on methanol have been clocked up across the four engines and when one cylinder from each engine was dismantled recently, the condition was very good.

Last year Stena took part in a project running Stena Germanica on recycled methanol from residual steel gases. The EU-funded FReSMe project under which the fuelling was performed explores the possibility of converting CO2 to methanol via steel production to power marine transport.

Even before the Stena Germanica project, Stena was experimenting with air lubrication systems. Stena Teknik (the R&D division of the Stena Group) carried out model tests on a system for its AIRMax concept.

Meeting the EEXI and CII challenges will need an improvement in some ferries' performance levels. In 2021 Stena lengthened two ferries and renamed them Stena Baltica and Stena Scandica before introducing them to service in the Baltic Sea. The additional cargo and passenger capacity will translate into better ratings under EEXI and the CII due to the significantly larger gross tonnage as a result of the conversion.

FLEXIBLE ROPAX DESIGN PROVES POPULAR

For Stena, the best demonstration of meeting customer requirements and decarbonisation is the new series of 12 E-Flexer RoPax vessels it has commissioned from a shipyard in China.

Although originating from a standard design, there are nine variants currently in service or under construction. The variations differ in length, number of decks, passenger capacity and choice of engines, fuel and energy storage systems. Five ships have been specified with dual-fuel engines intended to run on LNG and of these three will be hybrids with a battery system installed. All the dual-fuel ships will feature twin Wärtsilä 12V46DF engines.

Interferry's Johan Roos agrees that EEXI and CII present challenges to the ferry industry. To meet the impending rule changes, Roos says that around one quarter of the existing fleet could need replacing, but points out that this does not necessarily imply that older vessels will be heading for scrap.

"There is no strong age correlation with efficiency and in fact some of the older ferries from the 1980s and before were built when speed was not such an important factor. Consequently, they are unlikely to be fast and will more easily meet CII ratings," says Roos.

Roos believes that decarbonisation in the ferry sector will best be met by electrification replacing mechanical drive. He argues that it is far easier to feed in new sources of electricity whether from battery systems, fuel cells, engines and technologies yet to be developed than it is to modify engines and fuel systems. Importantly, electrification of the ship also provides opportunities to source 'green' electricity from the shore, through Onshore Power Supply (OPS), to be stored in on-board batteries and used as energy for parts of – or even whole – crossings.

That said, alternative fuels will be needed. But many operators will likely prefer to wait until the technology and availability is more certain. Citing LNG, Roos said the fuel was heavily promoted by policy makers but there is now expressed uncertainty over whether fossil LNG will continue to be seen as a decarbonisation tool in the future. He strongly believes that where operators invest in solutions that are promoted by policy makers, they should not be penalised if mindsets change and should be protected by grandfathering their investment.

On the subject of market-based measures such as the EU's Emission Trading Scheme, Roos sees a silver lining as much of the money raised is earmarked to be reinvested in shipping. Just as the Norwegian NOx fund raised money by charging for NOx emissions and reinvested by financing technologies for ships that reduced NOx emissions, the same could be done for decarbonisation technologies.

"EEXI and CII present challenges to the ferry industry. To meet the impending rule changes, around one quarter of the existing fleet could need replacing."

Johan Roos, Interferry

"Decarbonisation in the ferry sector will best be met by electrification replacing mechanical drive."



4. FUTURE FUELS – STAYING FLEXIBLE TO EMERGING OPTIONS

Flexible fuel supply and engine technology will be key to ensuring a viable energy transition in the ferry sector, even amid uncertainty over the cost and availability of low and zero-carbon fuels.

MARKET LANDSCAPE AND CHALLENGES

If the maritime industry is to achieve the targets set out in the IMO's GHG strategy – namely, a reduction in the carbon intensity of international shipping by at least 40% by 2030 and 50% by 2050 compared to 2008 levels – low and zero-carbon fuels are a must. But for many of these future fuels, the infrastructure and availability still need time to mature.

“Flexible, multi-fuel engine technology eliminates the need for operators to make a long-term commitment to one fuel by allowing the use of multiple fuels.”

“Wärtsilä introduced the first dual-fuel engines to the marine industry in 1995 and has since developed a wide portfolio of LNG-fuelled marine engines.”

Switching to alternative fuels offers immediate benefits in terms of carbon, SO_x and NO_x reductions and compliance with regulations such as EEXI. For ferry owners and operators the key considerations when weighing up what fuel to opt for are fuel availability, operational and financial impacts and technical feasibility. But the choice today can be part of a long-term decarbonisation strategy.

Flexible, multi-fuel engine technology eliminates the need for operators to make a long-term commitment to one fuel by allowing the use of multiple fuels. It provides the flexibility to take the first steps towards decarbonisation with a transition fuel such as LNG then progress through drop-in and fuel-blend strategies towards the renewable zero-carbon fuels of the future.

Converting existing vessels for future fuels can keep operators' current fleets compliant for longer, and offer the biggest immediate emissions saving of any decarbonisation measure. By retrofitting engines and fuel systems capable of using low-carbon fuels, operators can be sure of meeting incoming EEXI and CII regulations.

LNG

LNG has a vital role to play not only in cutting the carbon footprint of vessels but in helping to eliminate other pollutants as well, including SO_x and NO_x emissions – critical for ferries aiming to minimise emissions around the ports they serve.

LNG also provides an established and viable route towards more sustainable operations. Wärtsilä introduced the first dual-fuel engines to the marine industry in 1995 and has since developed a wide portfolio of LNG-fuelled marine engines that have been deployed on a broad range of passenger vessels.

Methanol

Methanol represents one of the best options to meet current and future emissions targets. It is readily available and already widely transported by sea, meaning that storage and handling facilities already exist at most major ports. It is a known quantity in terms of industrial applications and presents a low risk to the environment because it biodegrades rapidly in water. Furthermore, because it is liquid at atmospheric pressure, it can be stored in somewhat similar tanks to traditional diesel onboard a vessel. Wärtsilä's first newbuild methanol-fuelled engine will be in service in early 2023, with further engine platforms to follow towards the end of the year.

Ammonia

Ammonia contains no molecular carbon, and therefore produces no CO₂ emissions when used in engines.

In terms of its viability as a marine fuel, ammonia has excellent potential. On the downside it is a toxic, corrosive chemical with a powerful odour, which adds a new dimension to the handling of leaks as it cannot simply be vented into the surrounding atmosphere. This means it is perhaps not currently the first choice for passenger vessels. Another challenge is ammonia's lower volumetric efficiency and energy density, which means much more storage capacity is required on board.

In early summer 2021, Wärtsilä initiated the world's first full-scale testing of ammonia as a fuel in a marine four-stroke engine. Following these tests and collaborative projects to build experience, Wärtsilä aims to make its first commercial ammonia-fuelled engine in early 2024.

Hydrogen

Today's dual-fuel engine technologies are already capable of using fuel blends comprising LNG and up to 25% hydrogen. However fuel storage and supply remain a challenge due to hydrogen's low volumetric energy density and its explosive and corrosive nature. Furthermore, it will take around a decade until synthetic hydrogen is globally and reliably available. The challenges around hydrogen today mean that it is unlikely to play a major part in shipping's decarbonisation for several years, and its use on long-range vessels seems improbable.

SOLUTIONS

Wärtsilä dual-fuel engines

As uptake of LNG as a marine fuel grows across the maritime market and particularly the ferry segment, operators can choose from a wide portfolio of gas-fuelled engines developed by Wärtsilä. Spanning the small, medium and large-bore four-stroke segments, Wärtsilä has a dual-fuel engine suitable for every size of ferry.

Wärtsilä LNGPac™

Wärtsilä LNGPac™ is a complete Fuel Gas Supply System for LNG-fuelled ships and comprises several modules including, but not limited to, the storage LNG tank, the bunker station, the process equipment and the control and monitoring system.

Wärtsilä W32 Methanol engine

Ferry owners can take advantage of Wärtsilä's long-established methanol expertise with all the state-of-the-art features of one of the company's most widely used engine platforms – offering a viable and proven next step on the path to decarbonisation. The Wärtsilä 32 Methanol engine can run on methanol and/or fuel oils.

Wärtsilä MethanolPac

Alongside the Wärtsilä 32 Methanol engine, the MethanolPac fuel handling system enables Wärtsilä to deliver methanol-capable fuel and power systems across a wide range of vessel segments. MethanolPac includes both the low and high-pressure parts of the fuel supply system as well as the related control and safety functions.

FUEL CONVERSION SOLUTIONS

Converting an existing vessel for alternative fuels brings long-term benefits in terms of carbon, SOx and NOx reductions and compliance with regulations such as EEXI. With one company designing, integrating and supplying the needed systems and components, the result is likely to be a simpler and more effective installation than engaging multiple vendors.

“With one company designing, integrating and supplying the needed systems and components, the result is likely to be a simpler and more effective installation than engaging multiple vendors.”

“For ferry owners and operators the key considerations when weighing up a fuel conversion are fuel availability, operational and financial impacts and technical feasibility.”

LNG conversion

Wärtsilä can manage all aspects of an LNG conversion project from feasibility studies, financing solutions, solution proposals, execution planning and implementation to complete project delivery.

The offering includes conversion packages for specific engine types and Wärtsilä can deliver LNG systems for any marine installation regardless of engine brand or type, either as a standalone gas supply solution or as a complete propulsion system conversion. We also offer LNGPac™, which is a complete fuel gas supply system that includes a bunkering station, tank and related process equipment as well as control and safety systems. Since 1993 we have cut the methane slip from our dual-fuel engines by 85% and have been testing a new combustion concept that will reduce it by a further 50%.

Methanol conversion

Methanol conversion is a viable option for both main, and on larger vessels, auxiliary engines. Wärtsilä converted its first ship engines to run on methanol in 2015 in collaboration with Stena Line. Just like any other fuel conversion project, Wärtsilä can support customers with a holistic approach, beginning with a feasibility study that considers every aspect – the engines, piping, bunkering tanks, pumps, safety systems and so on – to ensure the best possible outcome.

Ammonia conversion

Wärtsilä has proven solutions for handling ammonia based on a stainless steel version of its LNGPac fuel gas systems, and its engine R&D programmes focused on ammonia are already very advanced. Wärtsilä's engine test cell in Vaasa has been approved by the Finnish authorities, and in 2021 the group initiated the world's first long-term, full-scale testing of ammonia as a fuel in a marine four-stroke engine. These testing programmes will provide important insights into the long-term effects of an ammonia-fuelled engine in relation to other vessel systems and components, including the required safety measures.

CUSTOMER REFERENCES

The RoPax ferry [Viking Grace](#) became the world's first LNG-powered passenger vessel in 2013. Onboard are four Wärtsilä 50DF dual-fuel engines, a Wärtsilä LNGPac fuel gas handling system, and Wärtsilä's NACOS Platinum Automation and Navigation system. The Wärtsilä ZA40S four-stroke engine onboard the RoPax ferry [Stena Germanica](#) was converted to a fuel-flexible setup that enables it to run on methanol or traditional marine fuels. The conversion cut the vessel's NOx emissions by 60%, SOx emissions by 99% and particulate emissions by 90%.

Read more about Wärtsilä's future fuel solutions:

- [Dual-fuel engines](#)
- [Wärtsilä LNGPac](#)
- [Marine methanol conversion](#)
- [Wärtsilä 32 Methanol engine](#)



5. ENGINES – POWERING A FLEXIBLE, MULTI-FUELLED FUTURE

The way ferries use their engines – and indeed the engines they choose – is shifting as new fuels, power sources and efficiency measures encourage a more holistic view of vessel emissions.

MARKET LANDSCAPE AND CHALLENGES

Driven by the global demand for maritime decarbonisation and increasingly strict port regulations on air pollution, the use of engines onboard ferries is evolving. What were once the sole power source are increasingly accompanied by electrical sources either onboard or at port, while the introduction of new fuels is offering new opportunities for efficient engine use.

For all but the smallest ferries, engines will remain the prime power converter for the foreseeable future, but operators are increasingly basing their engine selection on a use case that looks towards optimal use of low-carbon fuels and at least part electrification. The increasing deployment of diesel-electric configurations is a case in point.

Most ferries in service still use a traditional diesel-mechanical layout, with engines driving the shaft lines directly. In this respect, newbuild installations have witnessed a growing diffusion of power take-out/take-in utilization to mainly provide supplementary power to mechanical shaft lines. In parallel, electrical generation on board through engine-generators is now being adopted as the new standard electrical propulsion solution.

Diesel electric offers several advantages over diesel-mechanical drives. Chiefly, the use of electric propulsion can increase efficiency for some vessels – reducing fuel consumption and emissions – and therefore reduce the vessel's installed power requirement. Use of electric propulsion also eliminates the constraint of shaft lines, giving operators the ability to make smaller engine rooms and maximise their payload, and therefore their earning opportunity. Finally, the crucial element of passenger comfort is also improved by reducing the number of mechanical components in the drivetrain.

Diesel-electric arrangements also pave the way for greater integration of electrification, and further efficiency, by enabling the deployment of solutions such as batteries, shore connection and hybrid power sources including fuel cells, solar and wind. Excess energy generated when power demand is low can be stored in batteries for use when power demand is high, or when zero-emission operation is required – in and around ports and while at berth if no shore power is available.

To date, the diesel-electric efficiency gain has been noticed particularly by operators using LNG as fuel. Engines can be run steadily at the most optimal, steady engine load, which is particularly important for LNG-fuelled engines due to the combustion parameters needed for the fuel. This factor will also be crucial to the business case as ferry operators look to low-carbon and zero-carbon fuels. These fuels are predicted to be more expensive than conventional fuels, and minimising consumption will help to make their use as marine fuels viable.

While engine demands are changing, the traditional values that owners look for in engines will remain crucial: efficiency, power density and ease of maintenance. Combined with these long-standing needs, the marine engines of the future – already evidenced in recent installations – will need to be capable of using multiple fuels, and their use in hybrid power configurations will place further demands on engine integration.

SOLUTIONS

Wärtsilä's range of marine engines fits well across all ferry types and features many of the market's most efficient engines with low lifecycle cost, simple maintenance, hybrid readiness and easy upgradability for new fuels. This applies across a well-established diesel and dual-fuel portfolio and for multi-fuel engines recently launched and under development.

“While engine demands are changing, the traditional values that owners look for in engines will remain crucial: efficiency, power density and ease of maintenance.”

Wärtsilä 31DF

The Wärtsilä 31 engine has set new efficiency records in the marine four-stroke market, and is available in diesel and dual-fuel models. With a power output ranging from 4.6 to 9.6 MW, it is suited to medium-sized RoRo and RoPax vessels and has been applied widely in the ferry sector, in both diesel-mechanical and diesel-electric configurations.

Wärtsilä 46TS-DF

The Wärtsilä 46TS-DF offers class-leading efficiency for vessels including the largest RoPax ferries. It allows vessel owners and operators to act now to reduce fuel consumption and emissions in the knowledge that modularity enables potential upgrades in the future as well as the ability to run on alternative fuels.

Wärtsilä 14

The Wärtsilä 14 is the most compact engine in its power range in the marine market, serving both propulsion and auxiliary genset applications. It provides a powerful core that offers operators the chance to further reduce their engine installed power while retaining the performance they need.

CUSTOMER REFERENCES

Three new LNG-fuelled RoPax vessels being built for Swedish ferry operator **Stena RoRo** will feature dual-fuel Wärtsilä solutions when delivered in 2024 and 2025. Wärtsilä will supply Wärtsilä 46DF dual-fuel main engines, Wärtsilä 20DF dual-fuel auxiliary engines, two gearboxes, two controllable pitch propellers (CPP), tunnel thrusters, the fuel gas supply system and integrated systems.

Read more about Wärtsilä's engine portfolio:

- [Diesel engines](#)
- [Dual-fuel engines](#)
- [Future fuel engines](#)



6. ELECTRIFICATION – THE POWER TO CHANGE

Environmental expectations from authorities and passengers mean that ferries will likely be some of the first vessels to achieve low or zero-emission operations, either through hybrid or fully electric solutions.

MARKET LANDSCAPE AND CHALLENGES

At the larger end of the vessel scale, hybridisation is making significant inroads among RoPax vessels, while at the smaller end fully electric vessels are already commonplace in countries such as Norway. Both onboard and onshore solutions have a role to play, while smart power management and integration will be essential if operators are to take full advantage of electrification.

Leading the way towards zero-emission vessel operations

Public tenders for ferry routes are placing increasing weight on emission levels and many ferry operators are publicly owned, meaning there is extra pressure to decarbonise. Fortunately, ferries are also uniquely positioned as prime candidates for hybridisation and electrification because they typically ply fixed routes, meaning that the necessary infrastructure, including shore power connection, can be put in place to support it.

Naturally, vessel type and operational profile will determine the appropriate electrification solution. The fastest growing segment in terms of hybridisation today is RoPax ferries, where almost all newbuilds are being built with hybrid propulsion and where installations are including battery power capacities as large as 5–10 MWh. But designing a hybrid ferry – whether a power take-out/take-in solution for a constant-speed long-range ferry or a diesel-electric solution for a ferry with more variable speeds – is not simply a case of creating your design and then adding a battery into the mix; it requires a complete rethink of the propulsion train setup and an understanding of how to manage the complex interactions between the various current and future power producers and consumers.

The smaller commuter ferry segment, where routes are typically shorter, is already well on its way to going all-electric in some countries. In Norway, for example, it is already common for short routes to islands and in sensitive coastal areas like fjords to be operated by fully electric vessels.

The demand for shore power solutions is increasing in line with the demand for hybrid and fully electric vessels. The ability to utilise onshore electricity is a requirement in many ports today and is quickly becoming standard in new-build vessels. When in port a large RoPax ferry consumes a significant amount of electricity, and connecting to shore power eliminates the need to use auxiliary engines to generate this electricity, reducing both emissions and fuel costs.

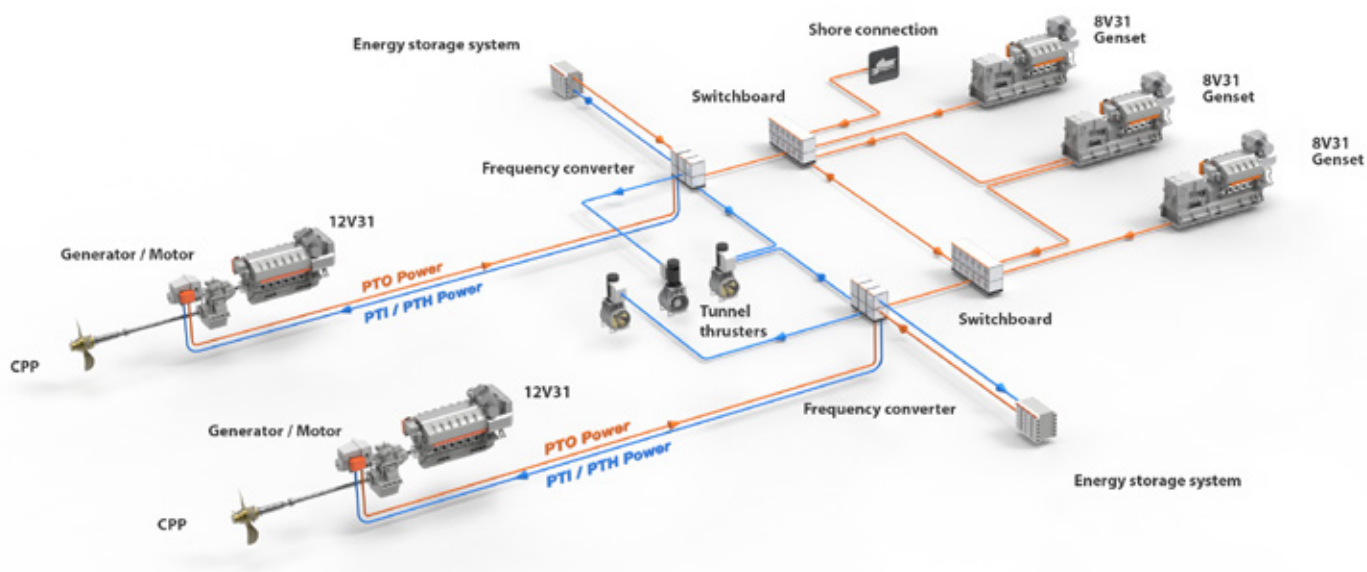
SOLUTIONS

Flexible, fuel-saving hybrid solutions

A hybrid solution enables fuel savings by optimising propulsion efficiency. This will become even more relevant in the future as more expensive low and zero-carbon fuels come into play and means you can reduce the installed power, which goes some way to offsetting the cost of the battery. 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 ramp-up, further increasing manoeuvrability and safety. The battery also provides instant reserve power in case of emergency, with no need to wait for a second engine to ramp up.

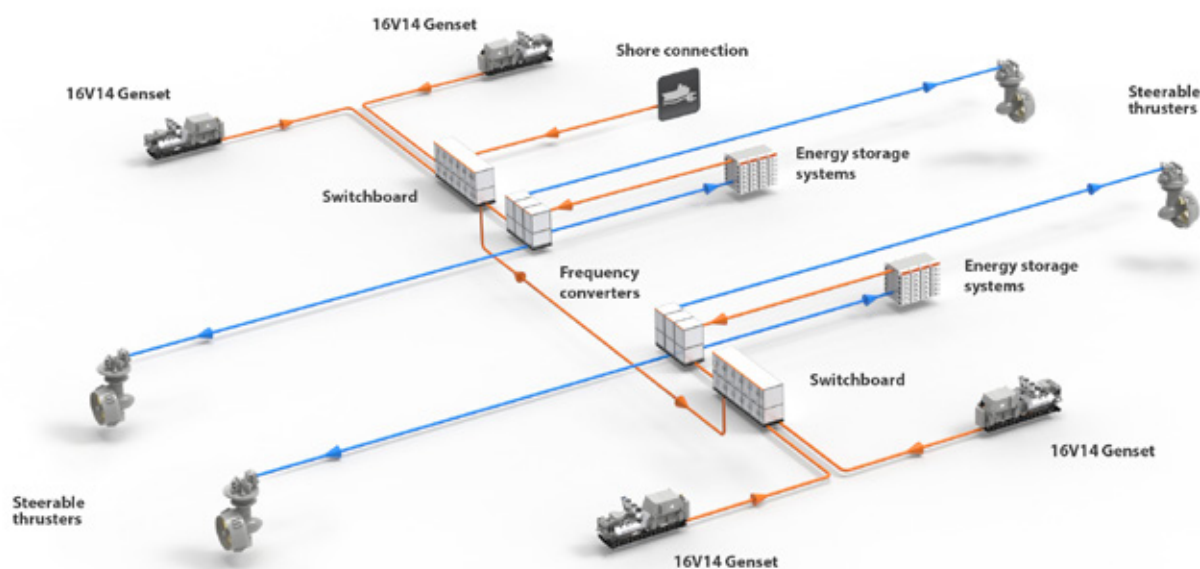
RoPax ferries operating on longer-range routes and at constant speeds will typically employ a power take-off/power take-in solution with a shaft generator between the propeller and main engine. This provides electrical power for onboard systems, reducing the need to burn extra fuel to power these systems via separate diesel gensets and helping the engines to run close to their optimal design point.

The drawing below shows a hybrid solution comprising shaft generators, converters and transformers. The solution includes a 5000 kWh energy storage system (ESS) that enables zero-emission operations while in port.



Ferries with varying speed profiles typically opt for diesel-electric propulsion, where the diesel engines are used as the prime mover to supply power to generators. This setup provides a great deal of flexibility and allows the vessel to sail at maximum efficiency across the full speed range.

The drawing below shows a flexible hybrid solution that allows the vessel to operate the engines at their optimal load by providing peak shaving, which removes variable loads and acts as spinning reserve. This reduces fuel consumption and associated emissions, increases engine maintenance intervals and reduces noise levels when needed.



Intelligent energy management – the brains behind the brawn

Whereas a traditional propulsion control system is engine centric, hybrid systems have multiple power sources – not just batteries but potentially solar panels, wind rotors and mixed fuels. This means the core of the system is no longer the engine, but the energy management system (EMS) that controls the entire system.

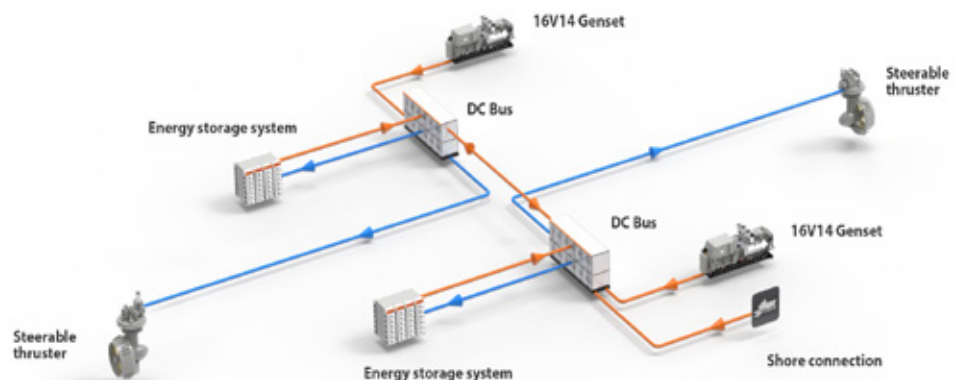
A power management system (PMS) to turn power sources off and on as required is not enough; an intelligent EMS is needed to optimise the energy flows under different operational modes between the different power producers, ESS and power consumers onboard to maximise efficiency. This digitalisation of the propulsion train means that the software rather than the mechanical components becomes the differentiating factor.

Some vessels are designed with only a PMS, but by omitting the EMS, the vessel misses out on optimisation – getting the right amount of power from the right source at the right time. In a well-designed hybrid system the engines should run at a stable, optimal load and waves and other external forces should not create peaks. With an EMS the engine can run at the same load and get instant extra power from the battery when needed.

The Wärtsilä EMS, which is included as part of Wärtsilä HY hybrid solutions, has been developed based on Wärtsilä's years of experience of designing and delivering hybrid systems. Wärtsilä completed its first hybridisation projects in 2012, working with offshore supply vessels, and now has more than twice the number of references (over 70) than any other provider.

Zero-emission electric solutions

With no need to switch between power sources, fully electric ferries have less complex systems than their hybrid counterparts. The drawing below shows a battery solution that enables ferry operations using fully electric propulsion with shore charging at destination. This offers zero-emissions transportation and faster thruster response time, which allows for better manoeuvrability and efficiency.



Plug and play with shore power

Wärtsilä is one of only a handful of providers in the world with real experience of designing and delivering shore power installations, particularly the medium voltage solutions required by commercial vessels like ferries. There are around 130 vessels sailing with one of our shore power solutions, most of which use our containerised retrofit solution, the Wärtsilä Shore Power Container (SPC) system.

CUSTOMER REFERENCES

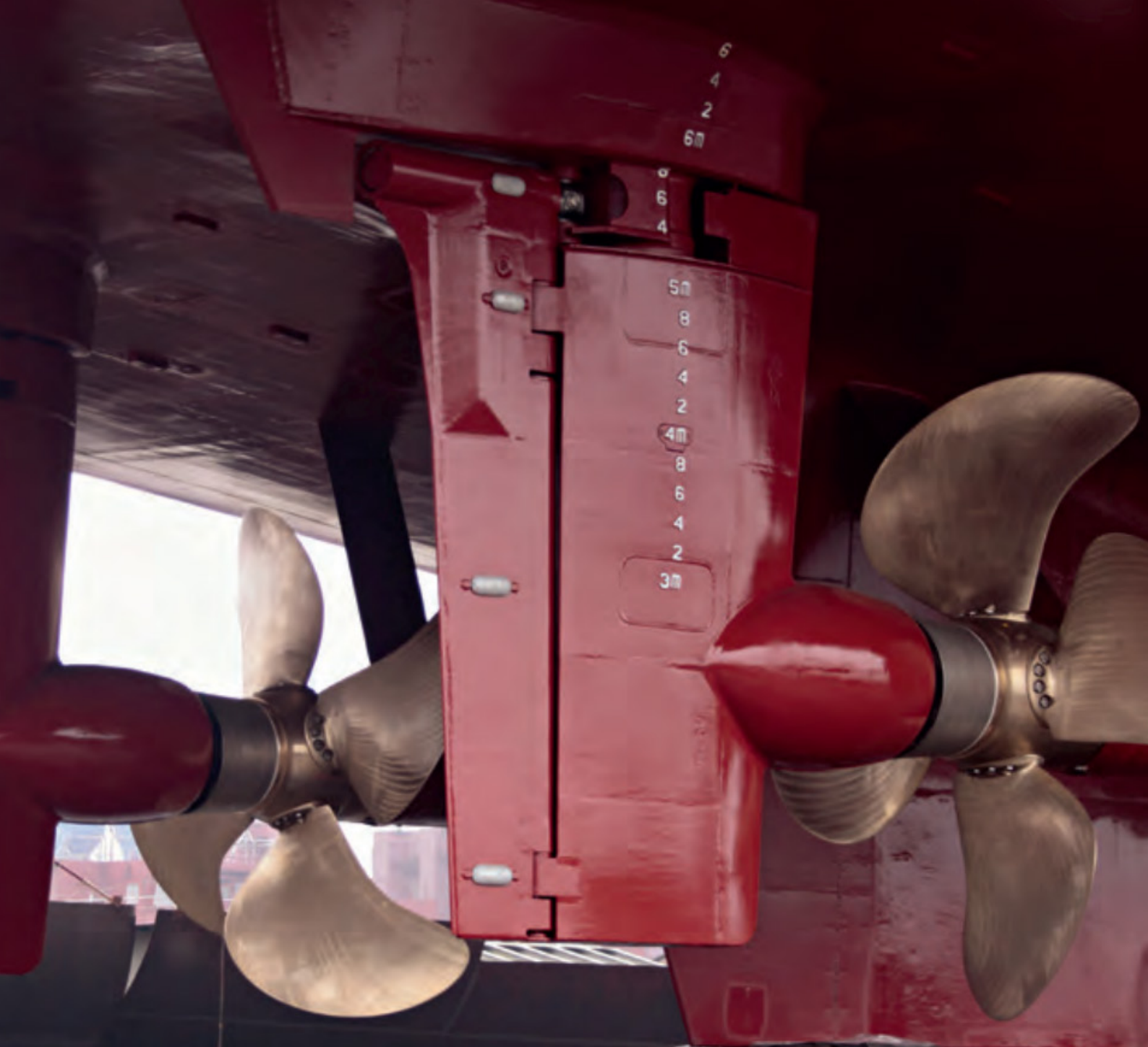
Delivered in 2018, Wightlink's [Victoria of Wight](#) hybrid RoPax ferry plies the route between Portsmouth on the UK mainland and Fishbourne on the nearby Isle of Wight. Onboard is the Wärtsilä hybrid management system, which enables significant energy-efficiency gains by allowing the engines to run at optimal load and load fluctuations to be absorbed using the onboard batteries. The vessel is driven by four Wärtsilä 20 four-stroke diesel engines. Electrical and automation systems include an integrated automation system (IAS), a power and energy management system and a 690 volt main switchboard.

Wärtsilä's state-of-the-art electrical solutions feature onboard two new ferries being built for [Finlines](#), part of the Grimaldi Group, at the China Merchants Jinling Shipyard (Weihai) in China. The Wärtsilä solutions include a hybrid shaft generator system and a highly efficient energy management system for performance optimisation which will enable zero-emission operation on either batteries or shore power while in port.

Wärtsilä's customised integrated solution for a new 132-metre RoPax ferry for the [Isle of Man Steam Packet Co](#) (IOMSPC) includes Wärtsilä 31 engines, electrical and automation solutions including the [Wärtsilä Low Loss Concept \(LLC\)](#) power distribution system, and an energy storage system.

Read more about Wärtsilä electrification solutions for ferries

- [Wärtsilä Smart Electrification Solutions](#)
- [Wärtsilä HY hybrid solution](#)
- [Wärtsilä shore power solutions](#)



7. EFFICIENCY MEASURES – STACKING THE GAINS

The cumulation of efficiency across optimised propulsion, energy saving technologies and power limitation can add up to big emissions savings in a sector where meeting strict schedules and high standards of comfort are crucial.

MARKET LANDSCAPE AND CHALLENGES

The incremental gains from multiple efficiency technologies can go a long way to reaching the emission targets set by regulators and operators themselves. Energy saving technologies (EST), engine power limitation (EPL) and efficient propulsion solutions are cost-effective, often easily implemented solutions that can add up to big improvements in energy efficiency and fuel savings.

“Choosing the right combination of solutions is critical. For example, while power limitation offers EEXI compliance, in the later stages of CII operators may need to add other measures.”

In the short term, as proven solutions that are already available today, ESTs and efficient propulsion can help operators meet EEXI requirements by reducing the amount of power needed to propel a vessel. EPL, which effectively reduces the maximum power a vessel can use, offers another route to compliance. Over the longer term, these solutions can help maintain CII compliance and increase operational efficiency by reducing fuel consumption. As the industry transitions towards more expensive future fuels, the savings from improved efficiency will have a critical role in making these fuels viable options.

Choosing the right combination of solutions is critical. For example, while power limitation offers EEXI compliance, in the later stages of CII operators may need to add other measures. As profitability for ferries relies on the ability to adhere to strict schedules, reducing sailing speeds may not always be practical and further investments could be required. Power limitation may also not be an option where vessels require significant power redundancy to ensure safe maneuvering in difficult conditions.

SOLUTIONS

A complete shaft-line package from one partner

Efficient, compliant vessels require a suite of energy-efficient solutions carefully optimised to work together: from the rudder, propeller, shaft, seals, gearbox, engines and auxiliary systems to ESTs. Identifying and integrating the right solutions takes a great deal of expertise. It is this combination of broad solution offering, ability to integrate solutions to maximise performance and its global coverage service capabilities that set Wärtsilä apart.

Efficient propulsion and energy saving technologies

Wärtsilä's cutting-edge OPTI Design methodology and software enables Wärtsilä's experienced design engineers to improve efficiency beyond the savings achievable through conventional design methods. The focus is on the vessel's total propulsive efficiency, which in the end determines its fuel consumption. This propulsive efficiency depends in turn on the efficiency of the propeller and the interaction between the propeller and the vessel.

Propeller design

Wärtsilä's team of industry-leading hydrodynamic experts design both fixed pitch propellers and controllable pitch propellers. The Wärtsilä OPTI Design methodology takes into consideration the full-scale interaction between the propeller and hull to ensure optimal performance and efficiency, while minimising noise and vibration levels.

Wärtsilä EnergoPac

An integrated design approach offers huge advantages in terms of optimising vessel performance and efficiency, and this includes the interaction between the vessel's propeller and rudder. Wärtsilä EnergoPac is an optimised propulsion and manoeuvring solution that is designed to reduce fuel consumption and emissions without compromising manoeuvrability or comfort through an integrated propeller and rudder design.

GATE RUDDER™

GATE RUDDER by Wärtsilä reduces a vessel's fuel consumption by replacing the drag of a traditional rudder system with a thrust-generating arrangement that also improves manoeuvring capabilities and reduces a vessel's noise and vibration signature. Installing a GATE RUDDER can substantially reduce a vessel's fuel consumption.

Air lubrication

Wärtsilä is an authorised seller and servicing partner of the Silverstream® System – a proven air lubrication system (ALS) that reduces hull resistance by creating a carpet of microbubbles on the full flat bottom of a ferry's hull using compressors connected to air release units on the hull bottom. The reduced resistance helps to cut fuel consumption and associated GHG emissions.

Rotor sail technology

Rotor sails provide the opportunity to harness the wind to provide auxiliary propulsive power, enabling a significant reduction in fuel consumption and associated GHG emissions. Wärtsilä is an authorised seller and servicing partner of the proven Anemoi Rotor Sail System.

POWER LIMITATION SOLUTIONS

Depending on the solution applied, power limitation effectively limits the engine or shaft power during normal vessel operation, regardless of the power train combination and control system arrangements.

All Wärtsilä Shaft Power Limitation (ShaPoLi) and Engine Power Limitation (EPL) solutions are designed to be quick and easy to install, and the scope of supply includes hardware, software, installation and commissioning. The choice between ShaPoLi and EPL depends purely on the propulsion system. EPL is applicable for ships with a single, direct-driven main engine and propeller, while ShaPoLi is designed for those with a twin-in-single-out propulsion train.

Wärtsilä Shaft Power Limitation

Wärtsilä Shaft Power Limitation is an upgrade package for vessels with Wärtsilä controllable pitch propellers. It is a fully integrated solution that can be installed as an add-on to Wärtsilä systems.

Wärtsilä 2-Stroke Engine Power Limitation

Wärtsilä 2-Stroke Engine Power Limitation is an upgrade package for vessels with Wärtsilä, WinGD and Sulzer branded two-stroke low-speed engines that enables safe compliance with new EEXI requirements.

Wärtsilä 4-Stroke Engine Power Limitation

Wärtsilä 4-Stroke Engine Power Limitation is an upgrade package for vessels with a single main engine per shaft-line with a fixed pitch propeller (FFP) but without PTO/PTI. The solution can be installed as an add-on to Wärtsilä four-stroke engines.

Read more about Wärtsilä ESTs and propulsion solutions for ferries

- [Wärtsilä energy saving technology](#)
- [Wärtsilä propulsion solutions](#)
- [Wärtsilä propulsion services](#)

“The combination of a broad solution offering, ability to integrate solutions to maximise performance and global service capabilities is what sets Wärtsilä apart.”



8. LIFECYCLE SERVICES – KEEPING VESSELS EFFICIENT AND RELIABLE

Service agreements are crucial to ferry operators' efforts to ensure their vessels remain on schedule and environmentally compliant across their lifecycle, as well as reducing maintenance costs.

MARKET LANDSCAPE AND CHALLENGES

Major concerns for operators of all ferry types include ensuring reliable and uninterrupted operation, keeping operational costs predictable and controlled, and meeting legislative requirements and customer expectations around decarbonisation.

“Well-maintained engines run more optimally and are more efficient, thereby helping reduce fuel costs. But proper maintenance can cut costs in less obvious ways too.”

Well-maintained engines run more optimally and are more efficient, thereby helping reduce fuel costs. But proper maintenance can cut costs in less obvious ways too. Dynamic maintenance planning – based on data from engine sensors – enables greater flexibility when it comes to the time and place for maintenance and major overhauls.

A dynamic approach to maintenance

Rather than basing maintenance solely on the amount of time that has elapsed since the previous maintenance, equipment monitoring means that work can be scheduled based on the actual condition of the engine and main components. This can lead to longer time between overhauls, increasing uptime and reducing maintenance costs while giving operators the flexibility to perform major maintenance with minimum disturbance to operations.

As an integral part of local transport networks, ferries need maximum reliability and uptime, and as passenger vessels they are subject to strict safety requirements. For example, ferries must have a minimum of two shafts in operational condition to ensure they are able to return to port safely in the event of an emergency. This demand for reliability means that equipment should be maintained according to a carefully planned programme, leading to greater uptime and uninterrupted operations.

SOLUTIONS

The key to increased reliability, efficiency and profitability is a lifecycle service-agreement approach driven by asset data gathering and analysis. Combining human expertise and technological excellence delivers maximum impact through innovative service agreement models that neatly dovetail with operators' needs to minimise maintenance cost while increasing flexibility.

When it comes to maximising lifecycle performance, no single service, software or skill is enough. Service is not just maintenance; the key is to continuously optimise the technology mix and proactively identifying efficiency-enhancing upgrades throughout the vessel's working life.

Lifecycle Service Agreements

Wärtsilä Lifecycle Service Agreements are available at varying levels depending on the customer's needs. The agreement scope can be tailored to cover everything from engines and the power train to fuel supply systems and emissions abatement technologies. For customers in the ferry segment, the following solutions are most applicable:

Wärtsilä Technical Management Agreements provide asset maintenance support that reduces the risk of unexpected downtime by helping customers to optimise maintenance intervals based on their actual needs and the condition of their assets, as opposed to a simple time-based approach. Wärtsilä Expertise Centres provide proactive support whenever and wherever needed to help customers operate and maintain assets in a smarter way.

Wärtsilä Optimised Maintenance Agreements add continuous proactive support and recommendations from experts in Wärtsilä Expertise Centres. This improves long-term cost predictability and asset availability by planning and scheduling

maintenance procedures according to the customer's business operations. An Optimised Maintenance agreement typically includes Wärtsilä's Expert Insight service, which uses artificial intelligence and advanced diagnostics to flag and follow up anomalies. Experts can then provide actionable advice and recommendations to address them.

Through the Operational Support service customers also have round-the-clock access to expert support, and a possibility for real-time, bi-directional connection and collaboration for support and troubleshooting of issues on assets in operation.

Wärtsilä Guaranteed Asset Performance Agreements contain all the elements of Optimised Maintenance, adding mutually agreed, quantifiable performance targets based on the customer's business needs. The measurable indicators can include availability, emissions and fuel consumption. Wärtsilä will guarantee that these targets are reached and maintained.

Transitioning from a transactional to an agreement-based approach

For ferry operators, agreements offer several advantages compared to a transactional approach to maintenance, where spare parts and field services are simply purchased as and when needed. With transactional arrangements, operators ask questions when problems arise, but with agreements, Wärtsilä helps prevent problems arising in the first place.

CUSTOMER REFERENCES

In late 2021 Wärtsilä signed a 10-year service agreement for its broad scope of solutions installed on [Brittany Ferries'](#) latest RoPax vessel, the Salamanca, the first LNG-fuelled passenger ferry to operate from the UK. The agreement includes remote operational support and Wärtsilä's unique Expert Insight digital predictive maintenance solution.

Canadian ferry operator [Société des Traversiers du Québec](#) (STQ) opted for a Wärtsilä Optimised Maintenance Agreement to enhance reliability, optimise maintenance and ensure efficient performance for three of its vessels. The agreement delivers equipment data insights, real-time operational support and data-driven dynamic maintenance planning to provide STQ with the operational certainty they need.

Read more about Wärtsilä lifecycle services for ferries

- [Wärtsilä Lifecycle Agreements](#)
- [Wärtsilä Services](#)
- [Wärtsilä Digital Services](#)
- [Wärtsilä Online](#)

“For ferry operators, agreements offer several advantages compared to a transactional approach to maintenance.”



9. PROPULSION – COMPLIANCE, COST CONTROL AND PERFORMANCE

Waterjets and thrusters can help high-speed ferry operators meet demanding environmental regulations while controlling lifecycle costs, offering them substantial room to manoeuvre on their route to decarbonisation.

WATERJETS – COMPLIANCE AND COST CONTROL AT SPEED

Unbeaten efficiency above 25-30 knots compared to other propulsion methods means waterjets are a must for high-speed operators. When you are propelling thousands of tons of vessel through the water at high speeds for thousands of hours a year, reliability and efficiency are crucial.

“When you are propelling thousands of tons of vessel through the water at high speeds for thousands of hours a year, reliability and efficiency are crucial.”

“For the long term, large high-speed RoPax ferry operators will need to transfer to renewable energies with the aim of achieving zero-emission shipping by 2050.”

High-speed ferries often operate in emission control areas, so the need for good environmental performance is a given. Add to that the increasing pressure from regulators and passengers to decarbonise operations and it's easy to see why operators are starting to seek out greener propulsion solutions.

The CII challenge

The IMO's Carbon Intensity Indicator (CII), which comes into force at the start of 2023, considers the ferry industry as homogenous. High-speed ferries are bundled together with conventional RoPax vessels in the CII dataset despite being a fundamentally different type of vessel, whose energy efficiency cannot be measured in the same way.

If high-speed ferries are forced to reduce speed to comply with the CII requirements their business case will be eroded dramatically. This means efficient and fuel flexible propulsion is even more critical in the high-speed ferry sector. One result of this is the uptake of future fuels on large waterjet-equipped high-speed RoPax ferries.

LNG is seen by many ferry operators as a transition fuel and will remain part of the fuel mix in the medium term. For the long term, large high-speed RoPax ferry operators will need to transfer to renewable energies with the aim of achieving zero-emission shipping by 2050. Potentially this could be achieved by using green hydrogen, biomethane, methanol, ethanol or renewable LNG. Dual-fuel engines will be able to inject all these fuels and are currently being investigated.

Only high-speed ferries up to 60 meters are likely to go fully electric, likely stopping there due to the weight and cost of the batteries. A leading light in this regard is Norway, where all coastal vessels must be fully electric by 2030. Fortunately, subsidies and grants from public bodies are often available for investments in the required improvements and to help keep key routes operational.

Modern waterjets must be capable of operating with alternative power requirements, but that is not the only challenge. Lifecycle cost is another key consideration in this competitive sector.

SOLUTIONS

The widest portfolio available

Wärtsilä has been in the waterjet market for nearly 50 years and provides both mid-size skid build and modular waterjets for a variety of vessels including high-speed ferries. Wärtsilä's modular waterjet portfolio covers units from 500 kW at the low end of the scale up to units with around 10 MW for large RoPax high-speed ferries.

To complement its mid-size waterjet offering, Wärtsilä developed its first high-speed engine, the Wärtsilä 14, which is the most compact engine in its power range in the marine market.

Wärtsilä's modular waterjets represent the state-of-the-art in this field, delivering outstanding benefits and offering a high level of customisation with a wide variety of options available depending on the needs of the operator. Wärtsilä is the leading manufacturer of waterjets over 4 MW. The Wärtsilä 31 dual-fuel medium-speed engine is an ideal match for large modular waterjets and is both more efficient and cheaper to maintain than the high-speed engines that are typically paired with waterjets.

Light, efficient and easy to maintain

The key for a good propulsor is of course to generate as much thrust as possible from the input power. Equally important is the mechanical integrity of the product.

The hydrodynamic performance and technology of Wärtsilä waterjets has proven itself for many world-class high-speed ferry operators. Wärtsilä axial waterjets are a line of single-stage, compact, high-performance waterjets combining mixed flow properties with an axial build. The result is a much-reduced vessel transom occupation with greatly increased waterjet cavitation margins for optimum vessel operating flexibility, improving manoeuvring and giving faster response on acceleration. The reduced transom occupation is achieved without reduction of the inlet duct diameter and waterjet pump size in order to maintain maximum efficiency for lowest fuel consumption.

Weight is another extremely important factor for efficiency. Since waterjet weight at the very end of the vessel is usually difficult to compensate elsewhere in the ship, jet weight savings can result in improved trim and weight savings will deliver an increase in payload within the same vessel design.

All Wärtsilä waterjets have an inboard mounted thrust bearing, which means that the bearing is not within the water flow of the jet. This eliminates the risk of oil leaking into the water. Locating the bearing mounting inside the ship enables good maintainability and allows the use of larger bearings with increased operating lifetime. Both mid-size and modular waterjets for large RoPax high-speed ferries feature inboard hydraulics options, which are designed to be easily maintainable and replaceable, meaning scheduled maintenance can be arranged around normal ship docking intervals.

An integrated package from one supplier

Wärtsilä is in the unique position to be able to supply the whole power train, from dual-fuel engine through gearbox, shaft line, electrical motors and fuel systems to the waterjets themselves. High-speed ferry owners and operators are benefitting from the competence of engine and waterjet design engineers working closely together to provide the most optimised drivetrain in terms of performance, fuel consumption and OPEX.

Last but not least, we take the full risk as many interface problems are avoided, it will reduce the number of vendors for yards and for operators it will contribute to the serviceability of the entire drivetrain when the vessel is in operation.

Wärtsilä's waterjet offering also includes the Wärtsilä Data Collection Unit, which collects data from all onboard equipment, allowing owners to see how their equipment is performing and improve vessel uptime with proactive maintenance.

“Wärtsilä's modular waterjets represent the state-of-the-art in this field, delivering outstanding benefits and offering a high level of customisation.”

Advanced assistance systems for vessel movements

The integration and digitalisation of technologies is an important pillar of the Wärtsilä offering. To work in tandem with its waterjets offering, Wärtsilä offers the SmartMove suite, which brings together various tools for automated capabilities to assist ferry crews with challenging manoeuvres such as docking and undocking, harbour entry and even quay-to-quay transit.

CUSTOMER REFERENCES

The 125m **Eleanor Roosevelt**, owned by Spanish ferry company Baleària, is the world's first high-speed ferry to be powered by dual-fuel engines that can run on LNG. The Wärtsilä integrated solution included four highly efficient medium-speed Wärtsilä 31DF dual-fuel engines and Wärtsilä LJX1500SRI axial-flow waterjets, which are lighter and more compact than non-axial designs and reduce noise and vibrations by more than 50% at speeds over 20 knots.

Funded by the European Union's Horizon 2020 Research and Innovation programme, the aim of the **TrAM project** is to develop a zero-emission high-speed passenger vessel through advanced modular production. Wärtsilä is a key partner in the project and is responsible for the system and detail design of the electrical energy system on-board and on-shore including the pilot hardware and software.

Read more about Wärtsilä waterjet solutions and services for ferries

- [Wärtsilä mid-size and modular waterjet solutions](#)
- [Wärtsilä waterjets services](#)
- [Wärtsilä SmartMove](#)



"Each year the Eleanor Roosevelt will reduce CO2 emissions by approximately the same amount as eliminating more than 8,900 conventional passenger cars or planting almost 27,000 trees. We are very happy – together with Wärtsilä we have achieved a world first."

Adolfo Utor, President of Baleària

THRUSTERS – PERFORMANCE NOT POWER

Ferries of all types and sizes spend significant time manoeuvring around busy ports, making thrusters – both tunnel (or transverse) and steerable azimuth types – a critical piece of equipment for this segment. Thrusters need to be powerful enough to provide safe and accurate manoeuvring. But focusing only on power can lead to inefficient thruster selection and hinder efforts to improve energy efficiency.

Specifying thrusters simply in terms of power overlooks a whole host of other factors, including thruster design, hull design and operational profile. This leads to yards installing thrusters that meet the required power at the lowest cost. While this might minimise CAPEX in the short term, it can increase OPEX over the vessel's lifetime.

By taking a more holistic view, vessel designers can achieve more thrust with less power. Aside from the obvious fuel and cost savings, this will reduce emissions over the vessel's lifetime.

Pressure to reduce emissions from all sides

As well as global and regional environmental legislation, regulatory pressures come from port authorities and the (often public) bodies that put out tenders for route operators. Ferry operators face additional pressure from their passengers and the local populations of the ports they serve, which are often located in or close to densely populated areas. As tunnel thrusters are significant contributors of total propulsion power used at quayside, these pressures naturally have an impact on specification.

The choice of thruster also has a considerable impact on passenger comfort, with onboard noise and vibration being greatly affected by the selection. A ferry that can provide the most comfortable passenger experience will fare better and retain customers over the long term.

Expert consultation for an optimal outcome

To achieve the optimal thruster selection, it is critical that thruster packages are properly integrated with the propulsion and engine control systems. Early consideration should be given to this integration. Wärtsilä's breadth of knowledge enables it to consult closely with ferry owners on integration and design.

Integrating thruster controls with other control systems to provide an intuitive, uniform user interface is becoming more critical as ferry operations become more complex.

The goal of a consultative approach is to identify the optimal number of thrusters and the correct thrust and power output for the application in question. Computational fluid dynamics expertise and advanced simulation tools are used to optimise the whole vessel, helping to provide the lowest possible CAPEX and highest operational efficiency for each individual application.

“Focusing only on power can lead to inefficient thruster selection and hinder efforts to improve energy efficiency.”

“To achieve the optimal thruster selection, it is critical that thruster packages are properly integrated with the propulsion and engine control systems.”

“Industry-leading hydrodynamics expertise enables operators to optimise thruster entrances to minimise resistance, noise and vibration and maximise performance.”

Industry-leading hydrodynamic expertise is a huge benefit, enabling operators to optimise entrances on tunnel thrusters to minimise resistance during ferry transit, maximise thruster performance and ensure noise and vibration are kept to a minimum. By controlling the way water enters and exits the tunnel, an optimised tunnel entrance minimises resistance and cavitation. This factor alone can reduce vibration by up to 50% and boost thruster performance by as much as 20%.

Whether the tunnel thrusters are equipped with controllable or fixed pitch propellers, optimising tunnel entrances is always beneficial. While tunnel thrusters with fixed pitch propellers, together with needed frequency converters, require a higher initial CAPEX, their increased efficiency – providing up to 10% more thrust at the same power level – leads to lifetime OPEX savings by reducing the installed power requirement and cutting resistance in free sailing with smaller propeller diameters. They also cut energy consumption by more than 20% when running at idle, i.e. with zero thrust.

Controllable pitch propellers are still the most common choice for tunnel thrusters in the ferry segment and they represent a good choice for vessels with limited space or if thruster use is limited.

Advanced assistance for vessel movements

Working in tandem with its thruster offering, Wärtsilä offers the SmartMove suite, which brings together various tools for automated capabilities to assist ferry crews with challenging manoeuvres such as docking and undocking, harbour entry and even quay-to-quay transit. The operational profile of many ferries, calling at the same ports and same berths at the same times each day, make them perfect for this kind of solution. The quicker the port call can be made, the more time is available for open sailing, offering operators greater flexibility over speed and, consequently, helping to save fuel.

Wide thruster portfolio

Wärtsilä has over 50 years' experience in designing, manufacturing and optimising thrusters, with one of the widest portfolios in the industry covering every ferry subsegment from the largest RoPax vessels down to the smallest end-to-end ferries.

Wärtsilä's transverse thruster portfolio comprises 13 thruster sizes with a power range from 500 up to 5500 kW. Its transverse thrusters use either controllable pitch (CPP) or fixed pitch (FPP) propellers. Integrated hydraulics contribute to a compact design with a small footprint, making them easy to integrate, install and maintain. The typical thruster size and power range seen in most ferry applications are well within the capabilities of Wärtsilä's proven and reliable technology.

Passenger comfort is a key concern across all sub-segments of the ferry market. For this reason, the design of Wärtsilä's transverse thrusters has been developed to minimise the disturbance of water flow, delivering a smoother sailing experience for passengers.

The Wärtsilä Steerable Thruster, suitable for short-distance commuter ferries, has been developed to meet today's operating demands – ensuring optimal efficiency, high hydrodynamic performance, high reliability and improved serviceability. Wärtsilä's offering includes 11 thruster sizes ranging from 700 to 6500 kW, with those in the 700 to 1600 kW range being applicable to short-distance coastal ferries, which typically have a thruster installed on each end of the vessel.

These thrusters can be powered either by a traditional diesel engine or, more commonly for newbuilds, fully electric systems using motors and batteries. If limited battery capacity necessitates sailing at slightly slower speeds, ducted propeller thrusters usually represent the best choice as they provide better thrust and manoeuvrability as well as faster acceleration and deceleration.

Above around 14 or 15 knots, open propellers become more favourable, providing more efficient transit operations. Whatever speed a ferry sails at, reaching cruising speed quickly and achieving good manoeuvrability are important to reduce the time spent in port and enable slower speeds at open sailing.

CUSTOMER REFERENCES

Wärtsilä supplied transverse thrusters and a thruster control system for two new 'Superstar' class ferries being built for [Finnlines](#), a part of the Grimaldi Group.

Wärtsilä tunnel thrusters were selected by Wasaline for its state-of-the-art [Aurora Botnia](#), a 150m RoPax vessel with a hybrid propulsion solution capable of operating on liquefied natural gas (LNG) and/or biogas.

Two sister ferries being built for [Rederi AB Gotland](#) in Sweden will also include Wärtsilä tunnel thrusters. When launched the vessels will be the world's fastest LNG-powered RoPax ferries.

Three new LNG-fuelled RoPax vessels being built for Swedish ferry operator Stena RoRo will feature Wärtsilä tunnel thrusters alongside a broad scope of other Wärtsilä solutions.

Read more about Wärtsilä thruster solutions for ferries

- [Wärtsilä transverse thrusters](#)
- [Wärtsilä steerable thrusters](#)
- [Wärtsilä thruster solutions](#)
- [Wärtsilä SmartMove](#)

A note on integration

Smart integration will be the key to success on the journey to decarbonise ferries regardless of type or operational profile. In order to gain the maximum combined benefit from the various technologies discussed in this paper, a holistic approach is needed.

It is for this reason that Wärtsilä's Integrated Systems & Solutions (IS&S) unit was established. IS&S brings together Wärtsilä's vast expertise in ship design, powertrain systems, electrification and energy-saving solutions with the goal of developing an integrated solution that delivers significantly higher value than the sum of its individual parts.

Working with IS&S, shipyards and vessel owners benefit from having the equipment, interfaces, software and project management handled by one expert supplier, bringing peace of mind in the form of a single efficient, streamlined and sustainable whole that is easy to manage, maintain and enhance.

WÄRTSILÄ MARINE POWER LEADS THE INDUSTRY IN ITS JOURNEY TOWARDS A DECARBONISED AND SUSTAINABLE FUTURE.

Our broad portfolio of engines, propulsion systems, hybrid technology and integrated powertrain systems delivers the efficiency, reliability, safety and environmental performance needed to support our customers to be successful.

Our offering includes performance-based agreements, lifecycle solutions and an unrivalled global network of maritime expertise.

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