

Engineered to

**X-EL**

by **WinGD**

Shaft Generators  
& Hybrid Solutions

**WINGD**

# Why use the main engine to generate electricity?

WinGD's system integration and advisory services deliver the advantages of electrical power to two-stroke engine powered vessels, helping ship operators **reduce fuel consumption, emissions and operating costs while maximising reliability and operational flexibility.**

Combining WinGD's engine design expertise with cutting-edge capabilities in electrical system design, X-EL Energy Solutions puts the two-stroke engine at the heart of an optimised ship power system.

The only solution that integrates control of the main engine with the vessel-wide energy system.

**Most vessels today do not use the power margin available through their most efficient power generator, the two-stroke engine, to produce electricity.**

## Why?

Historically, many operators have relied on four-stroke diesel engines coupled with generators to provide the electrical output needed for onboard consumers. Today, efficient shaft alternators and frequency converters means that, for many vessels, the main engine can generate electricity at greater efficiency.

Combined with batteries where appropriate, the excess of electricity produced via engines

can be stored for use across the voyage or during manoeuvring.

The two-stroke engine needs far less fuel to produce the required amount of electricity compared with four-stroke driven generating sets. Operating and maintenance costs are also lower, especially on partial loads.

What has been missing are the system integration and optimum energy management strategies to holistically optimise engine use and energy flow across the vessel – delivering electricity exactly when it is needed.

# An electrified future

**As the demand for energy efficient ship operations increases, more vessels are deploying shaft generators, which convert rotational energy from the ships shaftline into electrical energy.**

This can power onboard systems or be stored to supplement engine power later. Among the benefits of this approach are:

**Fuel efficiency:** Shaft generators on main engines reduce use of auxiliary engines for generating electricity, leading to improved fuel efficiency and reduced operational costs.

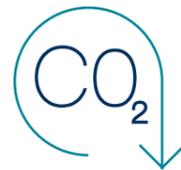
**Emissions reduction:** Reducing fuel consumption translates to lower CO<sub>2</sub> emissions, which is crucial for meeting increasingly stringent environmental regulations.

**Reliability:** Shaft generators are typically more reliable than separate gensets because they have fewer moving parts. This helps ensure consistent power supply and reduces downtime.

**Operational flexibility:** Shaft generators can work with other power sources including auxiliary generators or batteries, offering ships flexible power management and new ways of optimising operations.



**Reduced fuel consumption**



**Reduced greenhouse gas emissions**



**Reduced maintenance costs**

# A step forward

**Decarbonising shipping demands big improvements in both efficiency and emissions to meet regulatory targets.**

Adding shaft generator capability to vessels helps ship owners and operators to improve energy efficiency and reduce fuel consumption supplementing the operation of other energy efficiency enhancing devices, including hull air lubrication, while delivering power efficiently to other CO<sub>2</sub> emission saving technologies including air lubrication, wind-assisted propulsion and waste heat recovery.

Combined with the fuel costs incurred by vessels today, the expense of installing and using these innovative solutions demands a focus on minimising opex.

As the shipping industry transitions towards expensive carbon-neutral fuels, electrifying propulsion systems remain important for optimising efficiency and cost while maintaining the adaptability and reliability of shipboard power systems.

Deploying electrically-supported and hybrid power can also:

- Minimise auxiliary engine maintenance costs
- Reduce installed engine power
- Improve power availability and response to energy demand
- Integrate operators' view of ship power supply and demand
- Optimise energy use based on real-time operations and conditions

Using electrically-supported power systems to minimise spending on fuel makes it easier for ship owners and operators to invest in the solutions they will need to decarbonise.

# Supporting NYK Line's transition to net-zero emissions

Japanese ship operator NYK Line has embarked on a programme of renewal for its fleet of more than 100 car carriers.



**Like many other shipping companies, it has publicly stated a goal of reaching net-zero emissions by 2050 and sees carbon-free and carbon-neutral fuels as the long-term solution.**

To ensure that its recent newbuilds were ready for the transition - and capable of meeting intermediate emission

reduction targets - the company enlisted WinGD to deliver engines and integrated X-EL battery-hybrid systems.

Four vessels feature WinGD's dual-fuel 7X62DF-2.1 two-stroke engines coupled with shaft generators, DC links and battery systems. The overall system energy management was also supplied by WinGD.

NYK Line is applying an X-EL battery-hybrid system by WinGD to improve fuel efficiency and emissions. Electrical energy generated through the main engine via a shaft generator is produced on marginal fuel consumption increase, with batteries ensuring no-black-out operation as well as optimal load balancing.

This allows both the main engine and the auxiliary generators to run constantly at their most efficient load points.

The LNG-battery combination allows wide scope for further emissions reductions. Intelligent energy management can identify further optimisation of energy use during the vessels' operation. And fossil LNG can be blended or replaced with carbon-neutral synthetic or bio-methane.

Using WinGD's energy system integration and engine expertise, NYK Line's new car carriers are ready for the transition to net-zero emissions.

# How vessels use battery-hybrid propulsion

Alongside using electricity for auxiliary power or to drive propulsion there are several useful modes of operation that can be filled either more efficiently – or only – by harnessing electricity and energy storage alongside direct engine power.

**Peak shaving:** With engines running at a constant optimal load, excess power is directed to electricity generation and energy storage. When higher power is needed, the demand is fulfilled by energy fed from the batteries charged during low-load operation.

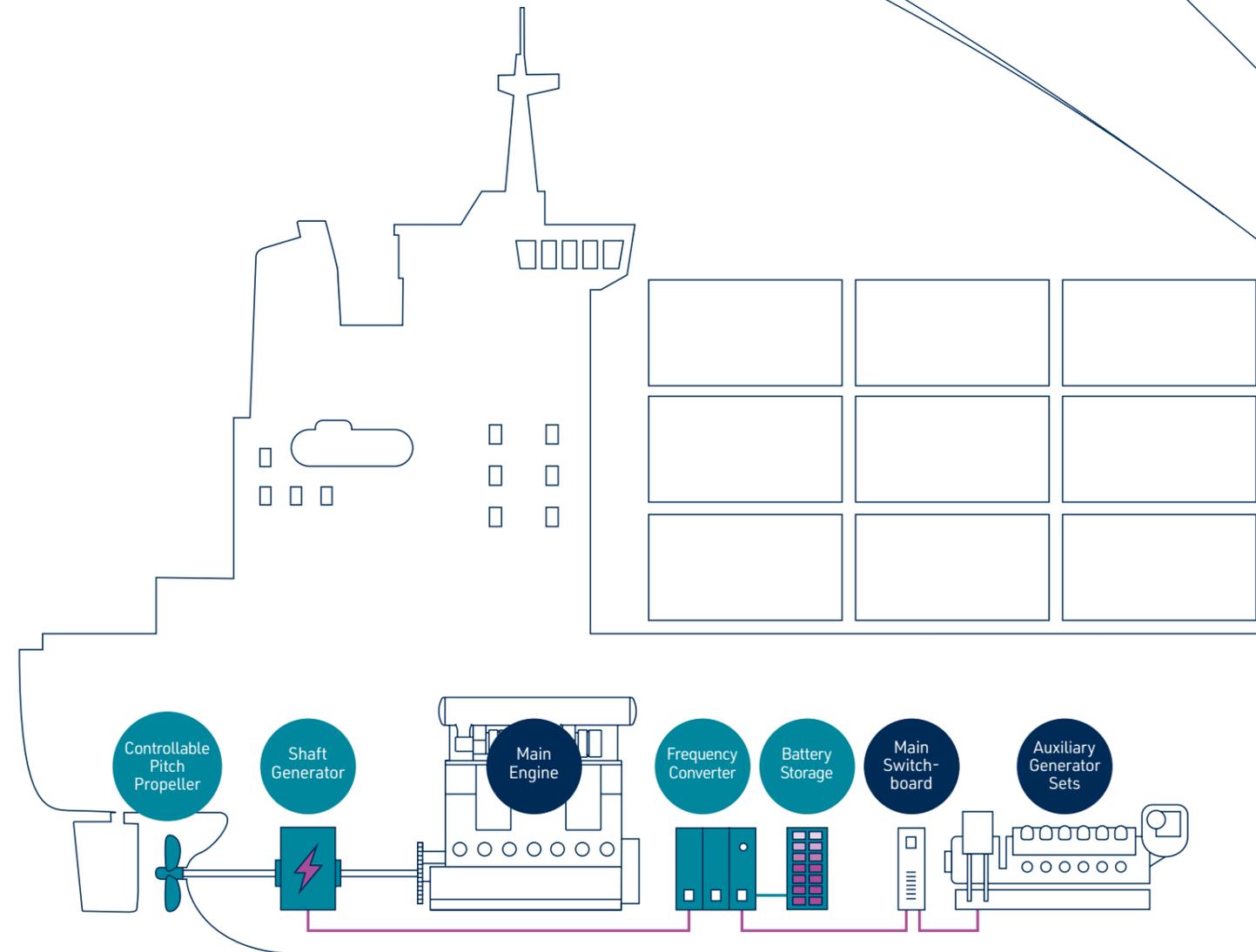
**Spinning reserve:** The fast response time of batteries means that electric power can replace the previous role of auxiliary engines in providing emergency back-up for peak shaving and preventing black out.

**Zero-emission sailing:** Electricity efficiently generated from power take-out can be stored in batteries and used to propel vessels for a short period without the engine operating.

**Smokeless start:** Charged batteries can take on the propulsion of the vessel from quayside, allowing the engine to be ramped up for full sailing speed, reducing the time the engine spends in any low load range under which visible smoke and vapour would be emitted.

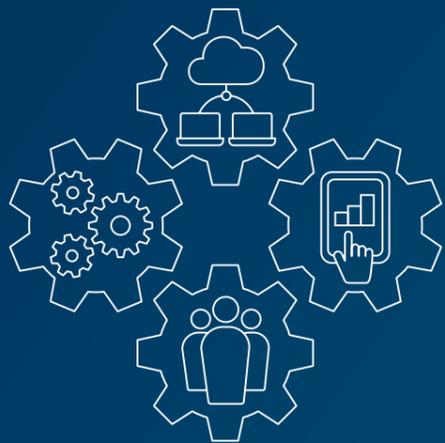
**Low-noise operation:** Using batteries to sail without the engine running also reduces noise and vibration from propulsion, minimising disturbance to marine life. This mode is actively incentivised in some ports surrounded by fragile marine ecosystems.

**Controlled pitch propeller optimisation:** The combination of shaft generator and CPP can be used to optimise energy flow by, for example, changing propeller pitch angle and running the main engine on constant speed, sufficient to ensure optimum shaft generator power output while maintaining the ship's speed set point.



We use the Shaft Generator and other elements to bridge the main engine and electrical energy consumers allowing the main engine to produce electrical power more efficiently and economically.

# Energy efficiency advisory from your engine designer



**The number of possible energy system configurations can be daunting. Using WinGD's long-established expertise and its system integration know-how and digital tools, X-EL Energy Solutions will guide you to the right choices to keep your fleet compliant and commercially attractive.**

WinGD has developed a flexible process for developing sustainable power solutions, using its extensive marine engine experience to optimally integrate the prime mover and electric power sources. This includes selecting appropriate technologies and, crucially, the sizing of all system components. These system integration capabilities ensure that ship operators' chosen solutions – including main engine and electric power sources – are part of an optimised, fit-for-purpose, holistic energy system.

WinGD's engine design expertise gives it unique insight into how engines need to interface with other components of the energy system to maximise energy efficiency. Electrification technologies can include shaft or front-end generators, batteries, power converters and, when required, integration with shore power interfaces, wind supporting systems, solar power generation fuel cells and even onboard carbon capture. WinGD has developed strong relationships with suppliers of key components to enable accurate simulation of complete energy systems.

Combined with WinGD's proprietary digital prototyping tools, this ensures that an optimal system can be planned and all parameters understood in the initial stages of a project, reducing the risk of integration challenges while the vessel is being commissioned and in service.

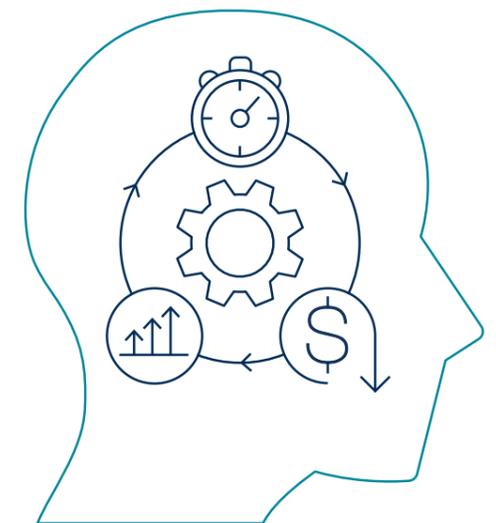
As well as developing energy systems, X-EL Energy Solutions also offers advisory services, using its expertise and digital technologies to simulate optimal configurations and control strategies for ship owners, shipyards, integrators, and naval architects.

# Financial foresight

**More efficient vessels are incentivised in multiple ways in the modern market, from access to green capital to lower port dues for vessels that reduce or eliminate emissions at berth or while manoeuvring.**

WinGD's energy system virtualisation and simulation means that vessel efficiency, emissions reductions and the availability of operating modes (such as zero-emissions manoeuvring) can be validated during the early design stage. This gives owners the evidence they need to tap opportunities in green finance and subsidies before the vessel is built.

Our experts can tailor both the system configuration and documentation to illustrate vessel efficiency in line with your requirements, as well as making further recommendations on available finance options.

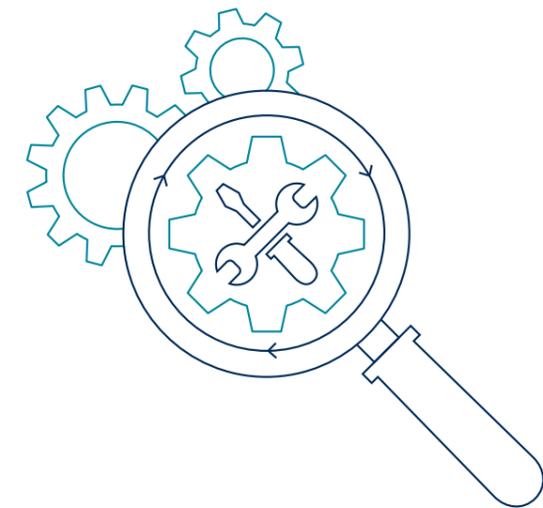


# Real-time optimisation to real-life conditions

**To truly maximise the efficiency potential of hybrid power arrangements, operators need a management system that can respond to in-service conditions to direct energy flow from various energy resource energy resource in real time.**

WinGD's X-EL Energy Manager is designed to deliver maximum ship efficiency at any given moment without jeopardising the reliability of the system's operation.. A well-managed energy system delivers intelligently optimised energy production at any moment, weighing a range of factors including cargo load, ship speed, environmental conditions and route.

The development tools used by WinGD form the basis for a digital twin that enables benchmarking of system behaviour in service, leading to further efficiency improvements by optimising control strategies depending on real operating conditions. The digital twin also informs the integrated advisory system designed to assist ship operators with optimising power system operation, diagnostics and maintenance.



Validation and tuning of controls can take place at an early stage in development thanks to WinGD's simulation and development capabilities. These enable customers to assess the build and operation of the power arrangement in digital form – ensuring that it meets requirements before installation as well as simplifying the ultimate integration, commissioning and testing of the systems.

The lifecycle benefits of an optimally integrated holistic energy system go deeper than intelligent control and advisory. Integration leads to efficient utilisation across all energy resources, including maximising use of the main engine, increasing propeller efficiency through power take-out and minimising (or even eliminating) the use of less efficient auxiliary engines at lower loads.

Transient behaviour of machinery is also improved as the system can respond quicker to load changes than a single power source prime mover.



## Why WinGD for energy system integration?

WinGD takes a holistic approach to designing power and control arrangements **that go far beyond the main engine.**

Its flexible process for deploying hybrid power solutions draws on extensive engine experience to optimally integrate the prime mover and electric power sources. This includes selecting appropriate technologies and, crucially, the sizing of all system components.

The WinGD X-EL team combines simulation expertise, electrical system and testing excellence capable of integrating any system into marine applications.



Collaborating with leading academic institutions and market-leading suppliers of components and hybrid technologies, WinGD can incorporate and configure appropriate technologies to suit your vessel characteristics and operating profile.

Combined with WinGD's proprietary energy management system to keep you operating at optimal efficiency, **X-EL ensures that vessels built or retrofitted today are prepared to face operational and regulatory challenges across their lifetime.**

## **Committed to the decarbonisation of marine transportation through sustainable energy systems**

WinGD designs marine power ecosystems utilising the most advanced technology in emissions reduction, fuel efficiency, digitalisation, service and support.

With their two-stroke low-speed engines at the heart of the power equation, WinGD sets the industry standard for reliability, safety, efficiency and environmental design. Headquartered in Winterthur, Switzerland, since its inception as the Sulzer Diesel Engine business in 1893, it is powering the transformation to a sustainable future. WinGD is a CSSC Group company.

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