Short-stroke engines

Compact and efficient medium-bore solutions

WIN GD

State-of-the-art efficiency and lifecycle costs

WinGD short-stroke engines combine state-of-the-art efficiency and lifecycle costs into a compact package, offering significant advantages for newbuilds with low engine room height and dimensions

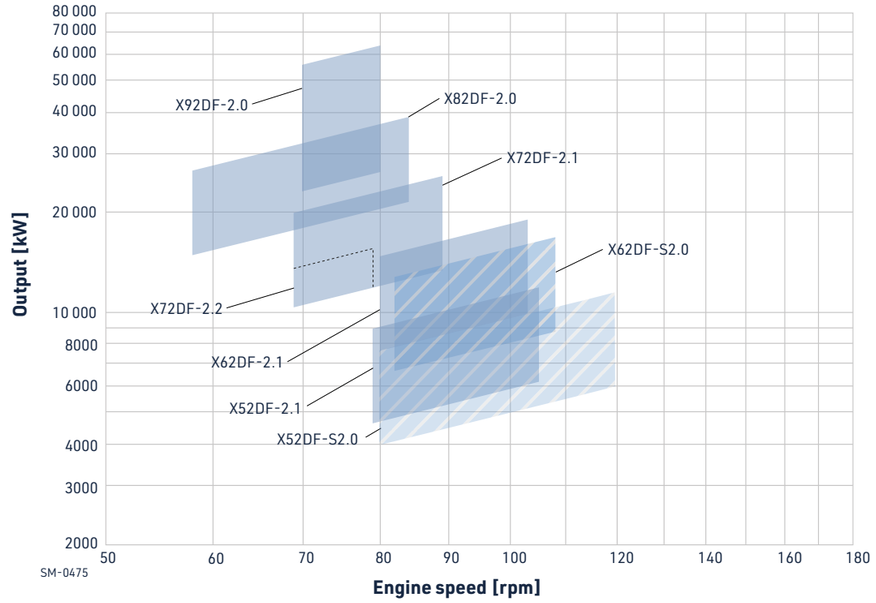
The X-S series comprises two diesel and two dual-fuel engines with a reduced engine height, weight and footprint compared to the standard X52 and X62 platforms.

The short-stroke series replaces the RT-flex50 and RT-flex58, which are well-established workhorses across several vessel sectors including container feeders, car and truck carriers and multipurpose, roro and conro vessels.

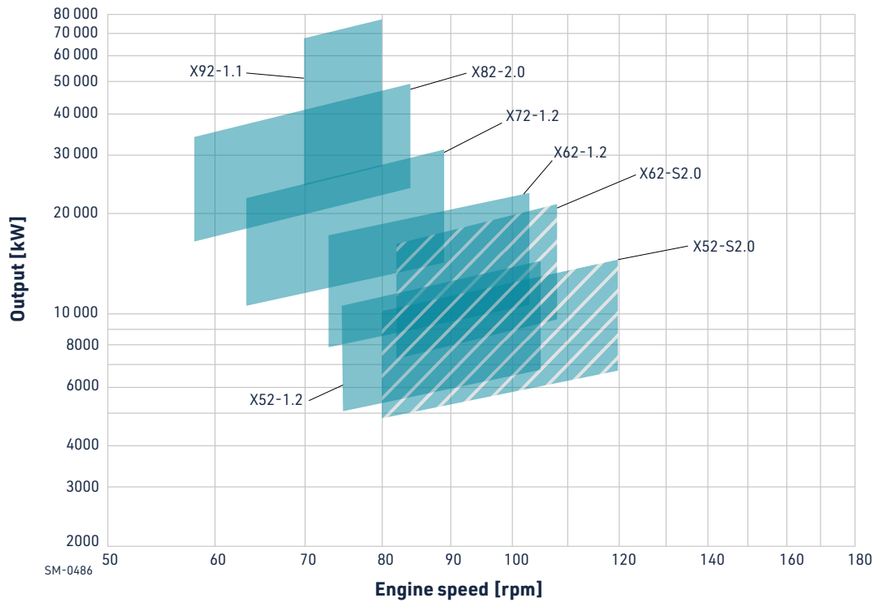
These vessels share design features – lower draft, small propeller diameter and low main deck height – that make compactness a main requirement for engines. Lower engine room height means smaller engines are needed, with shorter strokes and higher speeds, turning smaller propellers.

Other benefits include:

- Best-in-class fuel oil consumption, ideally suited for reduction of EEDI
- Available today as diesel, X-DF LNG and X-DF methanol
- Reduced piston removal height, easing maintenance
- Option of an integrated SCR (iSCR) delivers ultra-compact Tier III NO_X compliance in diesel operation and lowest installation cost for the shipyard
- Low production costs
- Extended time between overhauls and efficient maintenance plans enabled by optional WiDE engine monitoring system (standard for X-DF LNG and X-DF Methanol but optional for diesel)



Engine porfolio rating field: X-Engines



Engine type & Specification	X52-S2.0 X52DF-M-S1.0	X52DF-2.0	X62-S2.0 X62DF-M-S1.0	X62DF-2.0
Bore mm	520	520	620	620
Stroke mm	2,045	2,045	2,245	2,245
Power per cylinder (R1)/kW	1,910	1,500	2,685	2,110
Speed range Rpm	80-120	80-120	82-108	82-108
Cylinder number	5-8	5-8	5-8	5-8
Mean eff. pressure Bar	22	17.3	22	17.3

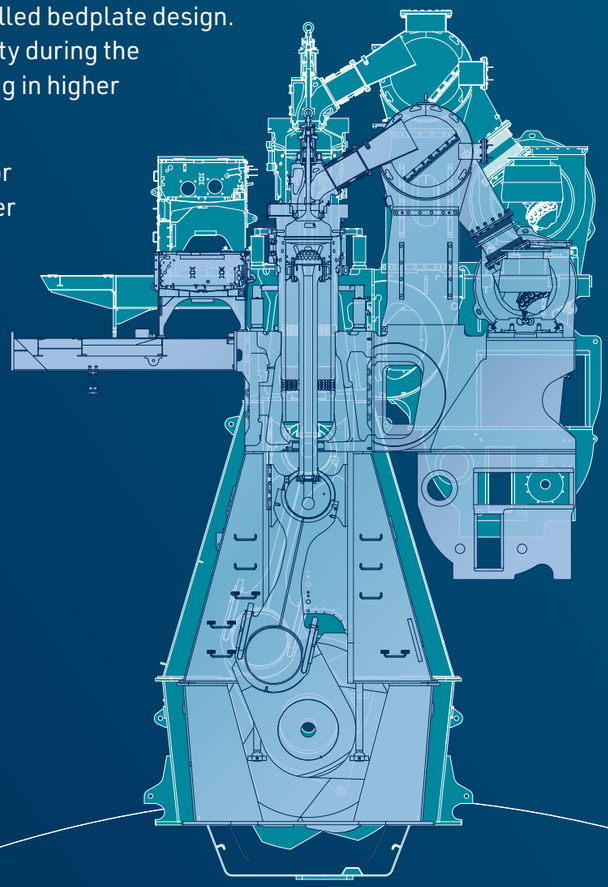
Core benefits and technologies
Compact design

Many vessel types with a lower main deck height also feature a narrow stern, leading to confined engine room spaces.

The shorter stroke of the new engines enables more compact engine dimensions and low piston dismantling height. Design features like a slim middle platform and the option for an integrated SCR deliver a significantly slimmer outline and footprint.

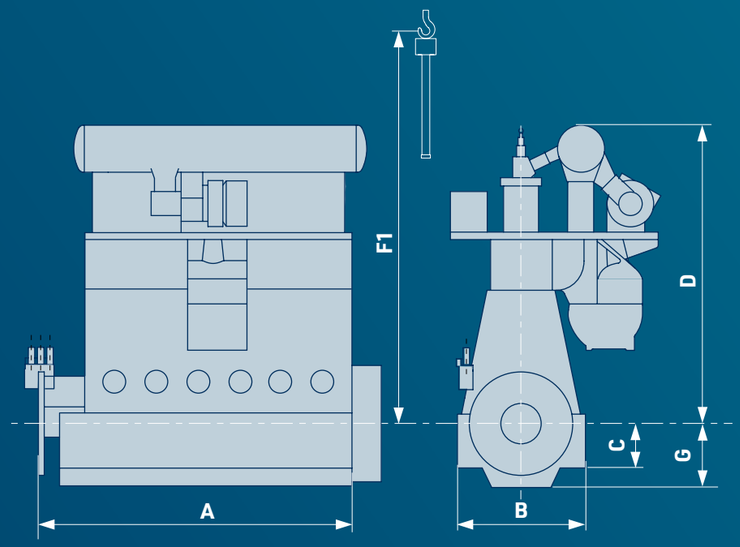
A noteworthy contribution is the introduction of the slimmer single-walled bedplate design. This improves accessibility during the welding process, resulting in higher quality welds.

The design also allows for a new and improved girder design, reducing the load on the bearings, which in turn allows for more compact reliable main bearing design.



Comparison: 6X62-1.2 vs 6X62-S2.0 footprint

Main dimensions mm	**6X52-S2.0 6X52DF-2.0 X52DF-M-S1.0**	**6X52-1.2 6X52DF**	**6X62-S2.0 6X62DF-2.0 X62DF-M-S1.0**	**X62-1.2 6X62DF**
A	6,345	6,925	7,260	7,910 8,110
B	3,100	3,514	3,440	4,200
C	1,185	1,205	1,295	1,360
D	7,775	8,562	8,575	9,580
F1	9,340	10,350	10,230 10,300	11,830 11,775
G	1,675	1,910	1,835	2,110
Engine dry mass tonnes	215	251	325	377



Low operational cost

The X52-S and X62-S diesel engines offer the most competitive fuel consumption in their class for both variable speed and constant speed operation.

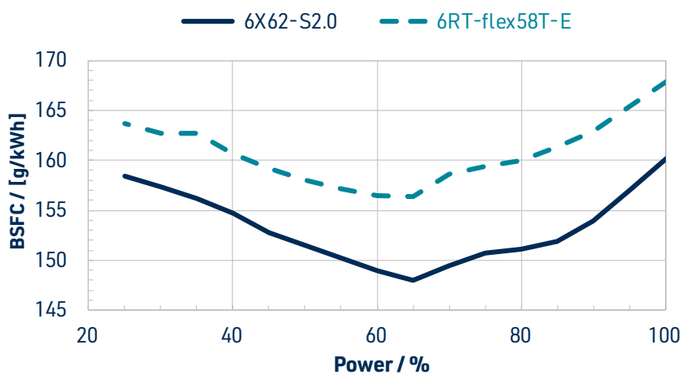
In comparison to the RT-flex50 and RT-flex58, specific fuel oil consumption is reduced by up to 10 g/kWh. For a typical ship operating profile with frequent part-load operation, this can amount to savings of more than 200 tons of fuel oil per year.

Example: Fuel consumption savings for a 1,900 TEU container feeder

Rating		Operation profile	
CMCR	12 900 kW @ 105 rpm	18.3 kn	**10%**
CSR	10 965 kW @ 99.5 rpm	15 kn	**40%**
CSR speed	18.3 kn	13 kn	**50%**
		Total:	**6,000 hours (Tier II)**

Main engine		Fuel	
Previous	6RT-flex58T-E	VLSFO (0.5% S)	**600 $/ton**
New	6X62-S2.0		

Comparison: Specific fuel consumption between 6RT-flex58T-E and 6X62-S2.0 rated at 12 900 kW / 105 rpm



Comparison: Annual fuel consumption and cost

Engine	Consumption Tons	Cost $
6RT-flex58T-E	6,222	3,733,200
6X62-S2.0	6,014	3,608,400
Savings	**208**	**124,800**

Combined with optimised overhaul intervals, the increased lifetime of components in the new engines will reduce planned downtime. Together with a maintenance-friendly design, this results in a further reduction in maintenance cost.

On the fuel injection side, the third generation Injection Control Unit (ICU) is applied offering significantly improved ease of service. The design allows on-board maintenance; all service-related jobs can be performed by the ship's crew. The spare parts have been drastically reduced in weight and dimension, thus improving ease of handling while contributing to a reduction in downtime and maintenance cost.

Optimum Operation

The new short-stroke engines feature enhancements which substantially ease the strain on operators.

Revised load limits allow operators to meet future requirements for minimum propulsive power in adverse weather conditions.

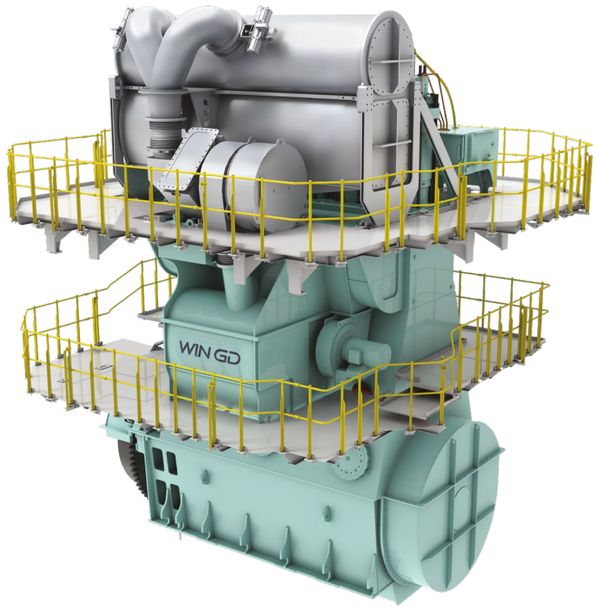
An optimised piston running concept with lubrication oil feed rate adaptation based on monitored operating conditions, **provides the highest reliability** at the lowest lube oil consumption.

Conversely, for some applications, energy efficiency considerations require a PTO layout within the available propulsion power. These applications are likely to raise engine operations to near the continuous power limit.

Component design in the X-S engines accounts for the impact of special operation regimes to ensure they do not affect engine durability.

iSCR
(Integrated SCR)

The integrated SCR is WinGD's on-engine selective catalytic reduction solution, ensuring the diesel engine's compliance with the Tier III level of IMO's NOX emission regulation. Integrating this essential component into the engine exhaust manifold design reduces overall space requirements and interface complexity.



Shipyards will benefit from reduced installation work and less testing effort since the SCR can be tested together with the engine. Owners and operators will enjoy more engine room space, easier access for maintenance work and the simplicity that accompanies greater integration of control systems, with control of the SCR being taken into the engine control system.

Besides the iSCR, traditional arrangements of low and high pressure SCR systems are also available.

WiDE
(WinGD integrated Digital Expert)

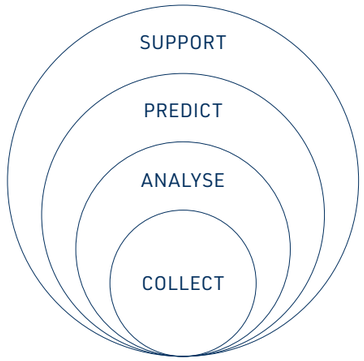
WiDE (WinGD integrated Digital Expert) is a digital solution providing ship owners and operators full awareness of the operating condition of their vessels.

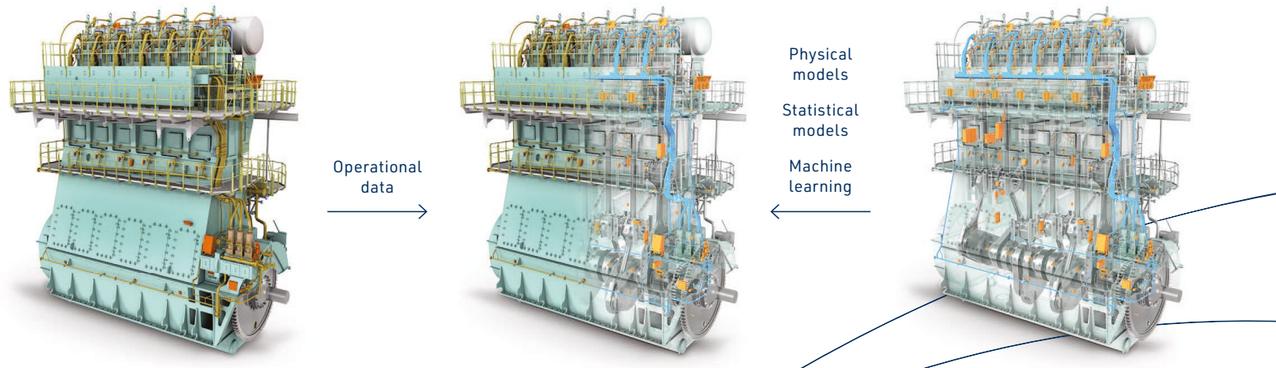
WiDE constantly collects both engine and ship data that are analysed in real time by advanced analytics and machine learning algorithms.

Combined with WinGD's vast operational knowledge, this provides valuable insights at a component level to keep the engine operating at its optimum and anticipate potential alarms that could limit its operational efficiency.

WiDE supports the decision-making of onboard crew through live troubleshooting and diagnostic advice to enhance operational efficiency.

It allows for visualisation of the data, both locally on board the ship and remotely at the shipping company's office, enhancing visibility and communication between the crew and fleet managers.





X-DF

The proven platform for fuel-flexibility

The X52DF-2.0 and the X62DF-2.0 build on the technology of the current X-DF engine series, incorporating all the innovations which make X-DF engines the cutting edge in dual-fuel marine propulsion.

Low-pressure X-DF technology is based on the lean-burn principle (Otto cycle), in which fuel and air are premixed and burned at a relatively high air-to-fuel ratio.

The benefits this concept provides are:

X52DF-S2.0 and X62DF-S2.0 engines deploy iCER technology – intelligent control by exhaust recycling – which both reduces methane slip in gas mode and increases fuel efficiency in both gas and diesel modes.

Methane slip is reduced by up to 50% and there is a significant reduction of energy consumption in both gas and diesel mode.

X-DF2.0 engines also meet Tier III NOx emission limits in both gas and diesel modes.

Both the X52DF-S2.0 and the X62DF-S2.0 are available with VCR as option.

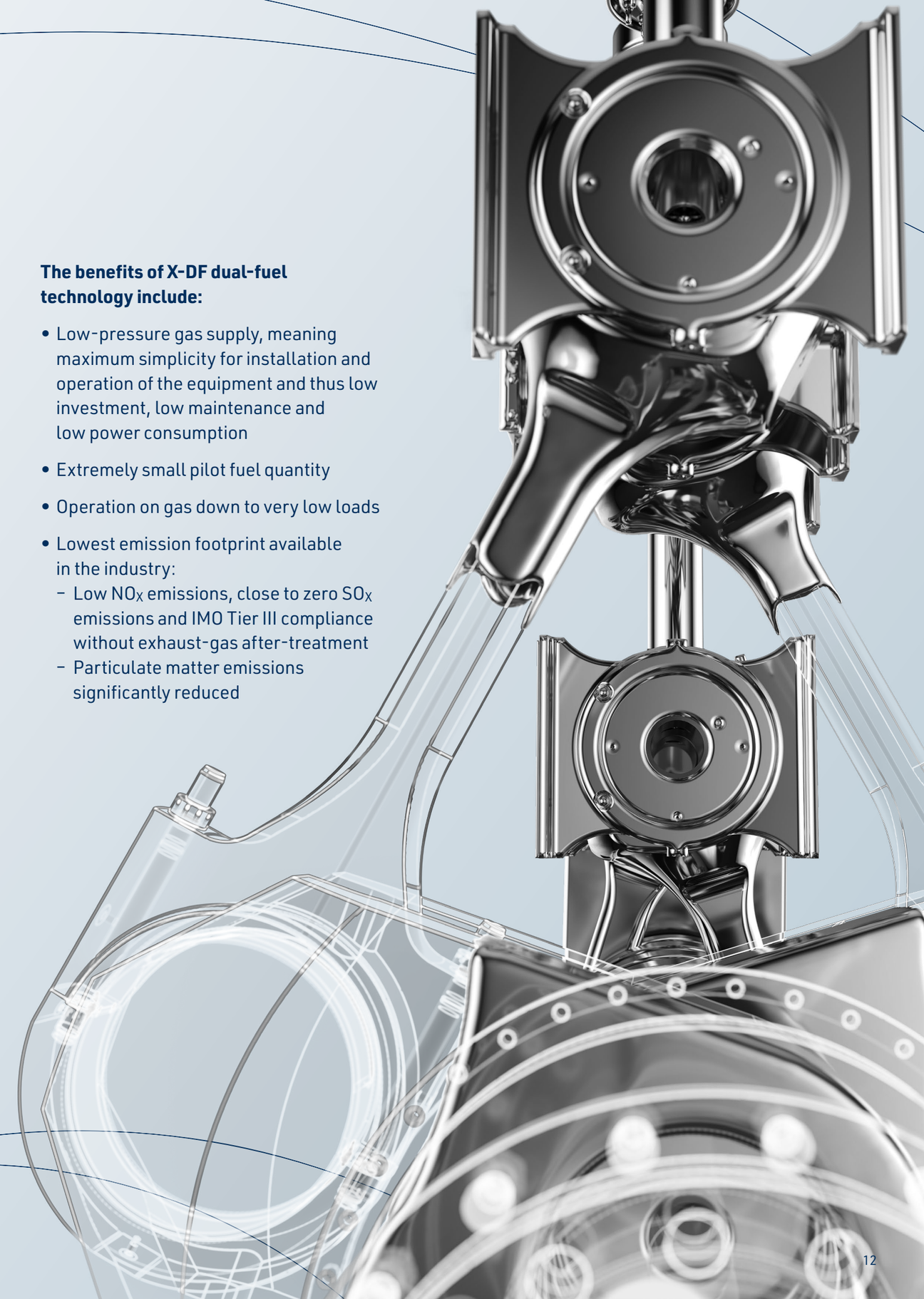
Lower fuel consumption

Reduced Methane slip and CO_2 emissions

Proven design for reliability and safety

The benefits of X-DF dual-fuel technology include:

- Low-pressure gas supply, meaning maximum simplicity for installation and operation of the equipment and thus low investment, low maintenance and low power consumption
- Extremely small pilot fuel quantity
- Operation on gas down to very low loads
- Lowest emission footprint available in the industry:
  - Low NO_X emissions, close to zero SO_X emissions and IMO Tier III compliance without exhaust-gas after-treatment
  - Particulate matter emissions significantly reduced



Fuel flexibility

As shipping faces greater environmental and climate regulation, a wider range of fuels will be needed to help deliver the greenhouse gas emission reductions demanded by regulators and by society.

All WinGD engines have fuel flexibility built into their base design, making them ready for future conversion to LNG, methanol, ammonia and other emerging zero - or near zero - emission (ZNZ) fuels without needing to replace major elements of the engine structure or powertrain.

Methanol engines are currently available whilst an ammonia fuel option will be ready by 2026. Engines currently in service and on order will be able to be retrofitted to use methanol and ammonia (available after newbuild designs have been introduced).

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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