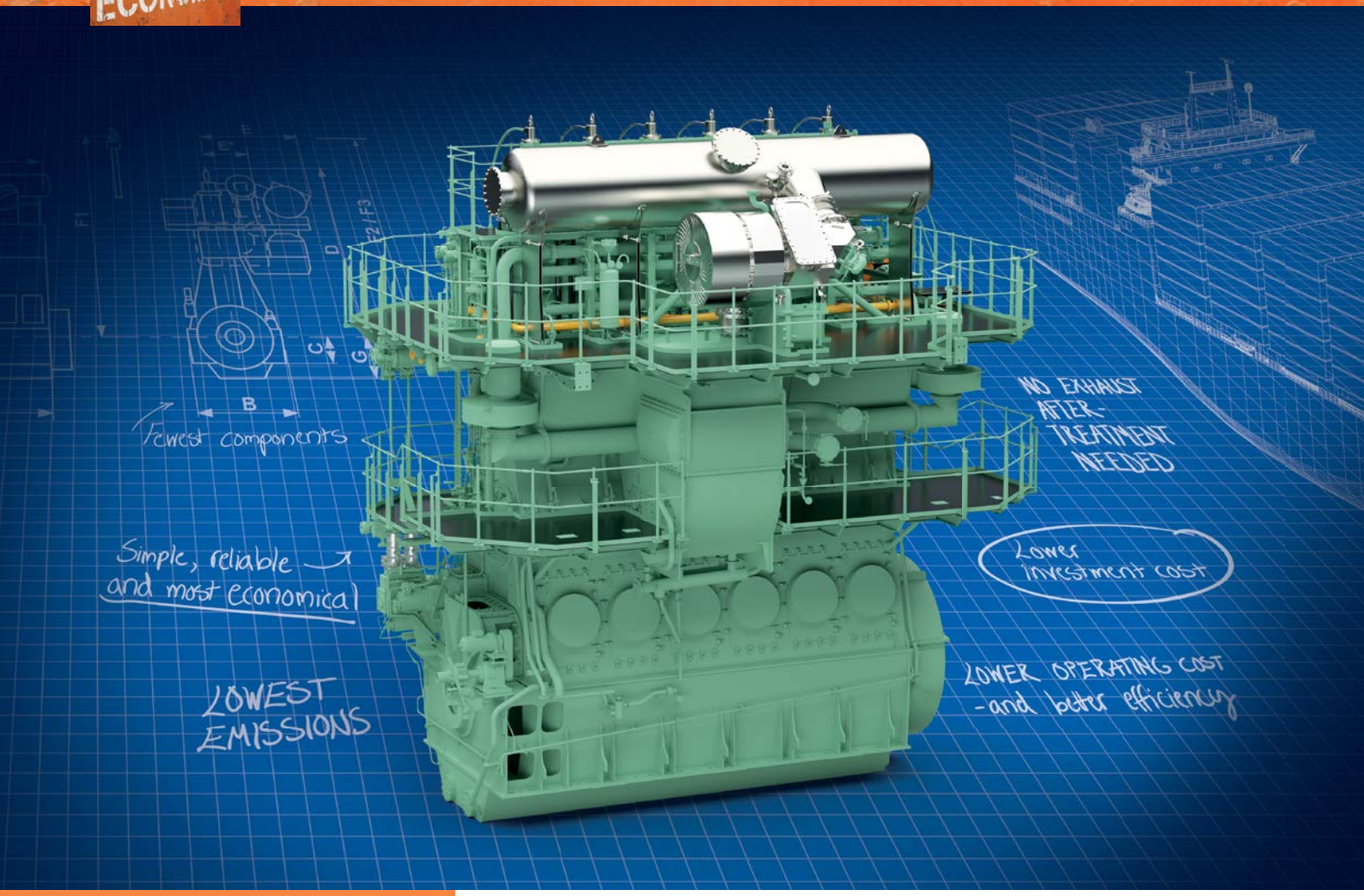
WÄRTSILÄ Engines

ENERGY
ENVIRONMENT
ECONOMY

WÄRTSILÄ LOW-SPEED DUAL-FUEL SOLUTION



The global merchant marine industry is in the midst of a revolutionary transformation, with increasing pressure from new laws, higher environmental requirements and ever-tighter profit margins. As the world's leader in dual-fuel (DF) technology, Wärtsilä now further strengthens its position with the introduction of the new low-pressure 2-stroke dual-fuel engines.

The Wärtsilä low-speed dual-fuel engine is designed to lower the pressure – on your investment, on the environment, and on your operating costs. In fact, as the only solution that is specifically made for gas, it is designed to run efficiently – across all loads – from port to port.

GAS AS A MARINE FUEL GAINING SPEED

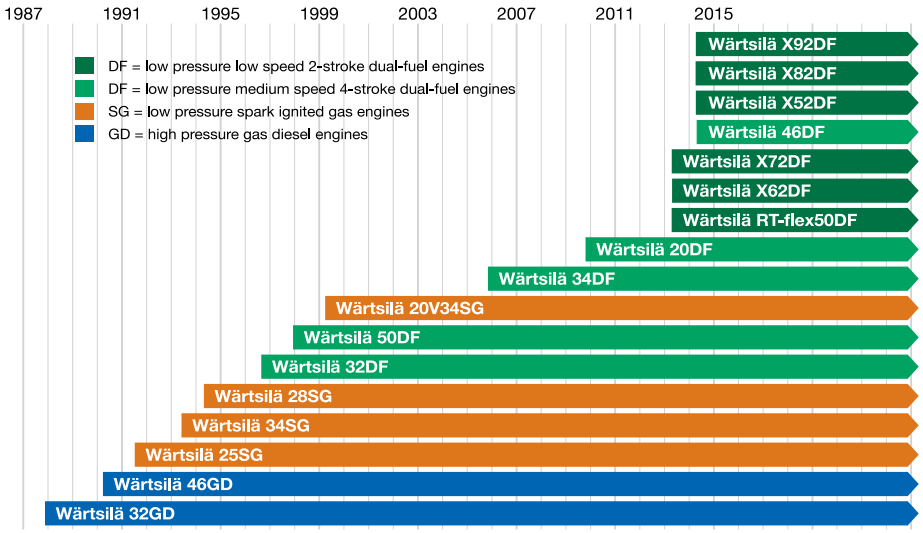
Recent trends in global shipping show gas/LNG becoming more and more attractive as the new fuel of choice. Early adopters in both the ferry and the offshore sectors have shown increasing interest in gas, especially when operating in environmentally sensitive areas and more stringent emission control areas such as the Baltics, Norway and the coastal waters of the North America. Partly due to upcoming legislation for SO_X and NO_X emissions, and also because of its increasing availability at an attractive cost level, this significant shift towards gas/LNG continues to gain speed, including the merchant shipping segment.

THE WÄRTSILÄ 2-STROKE DF ENGINE KEY BENEFITS:

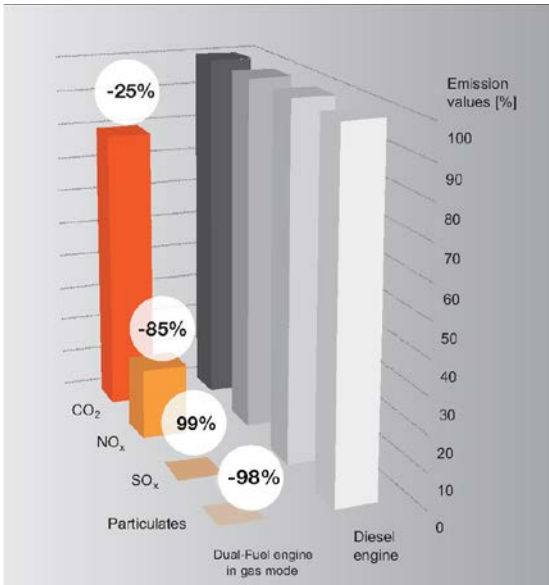
- The lowest emissions that meet Tier III without additional exhaust after-treatment.
- Simple, reliable and most economical low-pressure gas supply system, with the fewest components.
- Stable operation on gas over the entire load for port-to-port operation and manoeuvring.

WÄRTSILÄ

25 YEARS EXPERIENCE WITH DIFFERENT GAS TECHNOLOGIES



Most extensive portfolio of Gas engines featuring main propulsion engines and gensets for marine, Oil & Gas and land-based applications.



Example of emission reduction obtained by switching to gas.

DF TECHNOLOGY – THE TRUE GAS SOLUTION

In the late 1980s Wärtsilä introduced its first dual-fuel engines – deploying gas diesel (GD) high-pressure technology. The concept worked quite well, yet due to such factors as its complex and expensive gas handling system and safety concerns, plus emission levels that were not a marked improvement on conventional diesel engines, the technology was not widely accepted by the market and was only applied in niches.

With the introduction in the late 1990s of low-pressure dual-fuel 4-stroke engines, Wärtsilä became the global DF leader, delivering more than 1,000 DF engines representing more than 9,500,000 operational running hours in both land-based and marine applications. Wärtsilä has now applied this depth of expertise and experience to 2-stroke engines – a move that extends DF benefits across the broader marine industry. A key advantage of this new technology is that it delivers the lowest emissions, which meet Tier III emission mandates without additional exhaust gas after-treatment.

Further, the low-pressure concept offers the possibility to apply the most cost-effective low-pressure gas supply system – one that requires no large compression equipment. This translates into a considerable reduction in investment and operating costs compared to competing GD technology. As significantly, the Wärtsilä 2-stroke dual-fuel engines deliver stable operation on gas over the entire load for port-to-port operation and maneuvering.

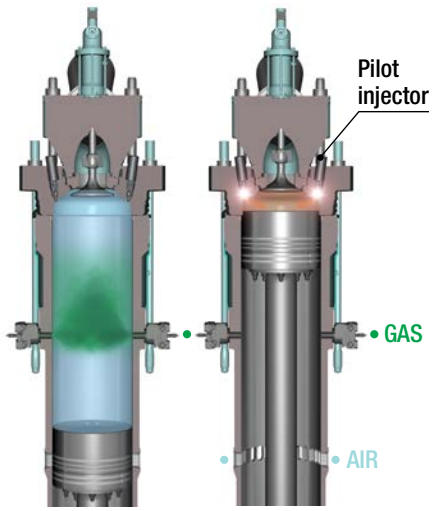
These factors combine to make Wärtsilä low pressure DF technology clearly superior, providing significant customer benefits that are increasingly sought after by the market. What's more, Wärtsilä is currently the only player able to offer complete gas-fuelled solutions.

FULLY COMPLIANT WITH TIER III

Due to its lean-burn combustion, this technology has an inherent potential to reduce the formation of NO_X by up to 90% compared to diffusion combustion of diesel or high-pressure direct-injected gas diesel engines (GD). Thus, with lean-burn Wärtsilä DF engines no additional exhaust gas treatment system is needed to meet the IMO Tier III NO_X requirements.

THE DUAL-FUEL TECHNOLOGY CONCEPT

Wärstilä's DF technology is based on the lean-burn principle, in which fuel and air are premixed and burned at a relatively high air-to-fuel ratio – a concept already used widely in medium-speed engines. With 2-stroke DF, gas is mixed into the scavenge air at the mid-stroke position. At the end of compression, the air/fuel charge is ignited by pilot fuel at a quantity of 1% of the full load fuel consumption. In order to secure stable ignition under all conditions, the pilot fuel is injected into pre-chambers.

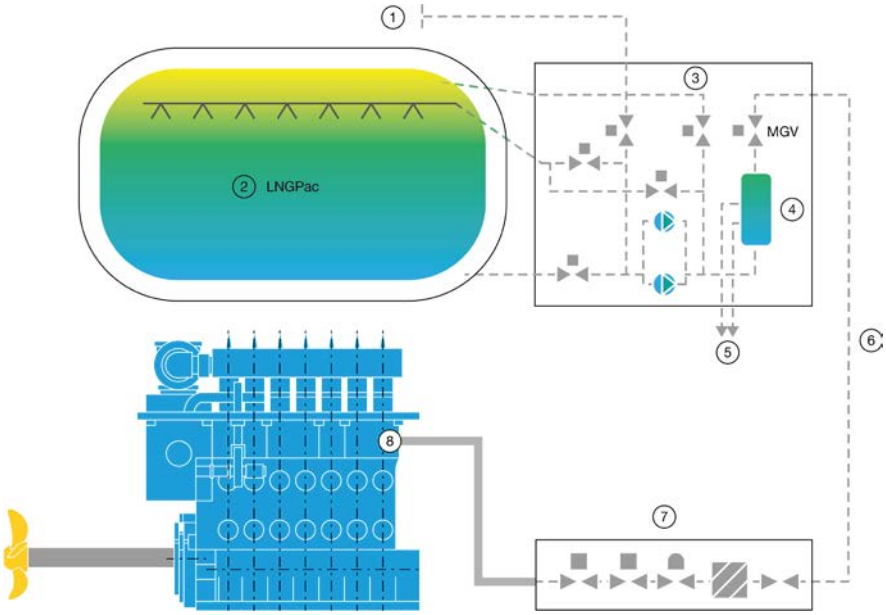


The 2-stroke DF principle with gas admission (left) and ignition (right).

SIMPLE GAS SUPPLY SYSTEM

Wärtsilä DF technology requires only a low gas pressure supply system. Since the fuel gas is mixed with the intake air before compression starts, the required pressure is below 16 bar. As a result, the fuel supply system is relatively simple, reliable and proven – as extensively demonstrated on Wärtsilä 4-stroke DF installations over many years.

THE MAIN ELEMENTS OF THE LOW PRESSURE GAS SUPPLY SYSTEM: 1. Bunker line 2. Gas tank 3. Pressure build up unit 4. Evaporator 5. Heating (water+glycol) 6. Double walled pipe 7. Gas valve unit 8. Supply piping on the engine



BETTER NET EFFICIENCY IN ALL LOAD LEVELS ON GAS

When all engine ancillary systems parasitic loads – such as gas handling/supply and exhaust gas cleaning – are taken into consideration, the net efficiency of the low pressure DF engine is the same or better than for any equivalent gas engine. What's more, the amount of pilot fuel required, especially under partial and low load operation, is significant less – only about one percent of the total energy at full load – and remains constant over the whole operation range.

While idling or manoeuvring, or during extreme slow steaming close to shore, in ports or in channels, the Wärtsilä low pressure DF engines are able to operate efficiently and stably on gas – thus meeting Tier III emission levels.

RETROFIT SOLUTION WILL BE AVAILABLE

In the marine business, the low-pressure 2-stroke DF solution is an increasingly attractive alternative for companies looking for environmental propulsion solutions. As the life span of a vessel is usually measured in decades, retrofitting of its engine to DF is often highly cost-effective, as it "future proofs" your investment.

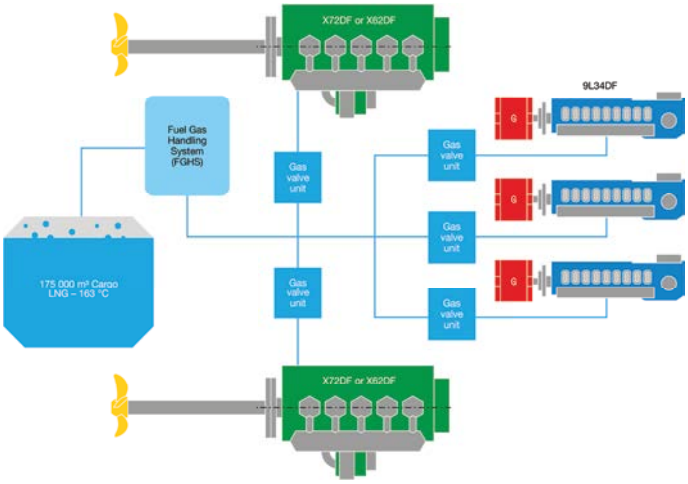
Retrofitting with a Wärtsilä low-speed DF engine is possible, and retrofit work can be done during a standard docking period.

Retrofit packages will become available in response to specfic market requirements. Wärtsilä is able to offer turnkey retrofit packages including engine retrofit, LNG tank systems and gas handling systems on board based on the well-proven standardised LNGpac products.

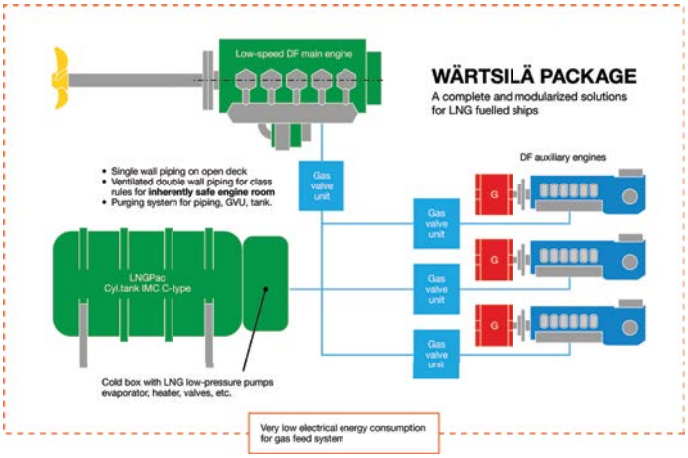
EASY SERVICE

The Wärtsilä DF technology for 2-stroke engines is based on the same principle – and uses similar engine components – as the well-proven Wärtsilä 4-stroke DF engines. Likewise, for automation and the engine control system the same hardware and similar software structure is used, and the pilot fuel common-rail system is as developed as for 4-stroke engines. What's more, the gas handling and supply system is also identical to Wärtsilä's 4-stroke engines. The benefit of these similarities is that only well-proven components are employed, ensuring a long engine life and long intervals between overhauls. Wärtsilä Services is able to offer custom-made service packages from spare parts supply to maintenance contracts depending on the level of your needs.

175,000 m³ LNG carrier with twin-shaft machinery



Dual-fuel engine machinery for merchant vessels



Wärtsilä RT-flex50DF	IMO Tier III in gas mode
Cylinder bore	500mm
Piston stroke	2050mm
Speed	99–124rpm
Mean effective pressure at R1	17.3 bar
Stroke/bore	4.10

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A (mm)	Length A* (mm)	Weight tonnes
	124 rpm	124 rpm	99 rpm	99 rpm			
	R1	R2	R3	R4			
5	7 200	6 000	5 750	4 775	5 576	6 793	200
6	8 640	7 200	6 900	5 730	6 456	7 670	225
7	10 080	8 400	8 050	6 685	7 336		255
8	11 520	9 600	9 200	7 640	8 216		280

Wärtsilä X52DF	IMO Tier III in gas mode
Cylinder bore	520 mm
Piston stroke	2315 mm
Speed	82–105 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	4.45

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Lenght A mm	Weight tonnes
	105 rpm		82 rpm			
	R1	R2	R3	R4		
5	7 450	6 200	5 825	4 850	5 950	217
6	8 940	7 440	6 990	5 820	6 900	251
7	10 430	8 680	8 155	6 790	7 850	288
8	11 920	9 920	9 320	7 760	8 800	323

Wärtsilä X62DF	IMO Tier III in gas mode
Cylinder bore	620 mm
Piston stroke	2658 mm
Speed	80–103 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	4.29

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Lenght A mm	Weight tonnes
	103 rpm		80 rpm			
	R1	R2	R3	R4		
5	11 925	9 925	9 250	7 700	7 000	325
6	14 310	11 910	11 100	9 240	8 110	377
7	16 695	13 895	12 950	10 780	9 215	435
8	19 080	15 880	14 800	12 320	10 320	482

Wärtsilä X72DF	IMO Tier III in gas mode
Cylinder bore	720 mm
Piston stroke	3086 mm
Speed	69-89 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	4.29

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Lenght A mm	Weight tonnes
	89 rpm		69 rpm			
	R1	R2	R3	R4		
5	16 125	13 425	12 500	10 400	8 085	481
6	19 350	16 110	15 000	12 480	9 375	561
7	22 575	18 795	17 500	14 560	10 665	642
8	25 800	21 480	20 000	16 640	11 960	716

Wärtsilä X82DF	IMO Tier III in gas mode
Cylinder bore	820 mm
Piston stroke	3375 mm
Speed	65–84 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	4.12

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	84 rpm		65 rpm			
	R1	R2	R3	R4		
6	25 920	21 600	20 070	16 710	11 045	805
7	30 240	25 200	23 415	19 495	12 550	910
8	34 560	28 800	26 760	22 280	14 055	1 020
9	38 880	32 400	30 105	25 065	16 500	1 160

Wärtsilä X92DF	IMO Tier III in gas mode
Cylinder bore	920 mm
Piston stroke	3468 mm
Speed	70–80 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	3.77

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	80 rpm		70 rpm			
	R1	R2	R3	R4		
6	31 920	26 580	27 930	23 250	11 630	1 120
7	37 240	31 010	32 585	27 125	13 210	1 260
8	42 560	35 440	37 240	31 000	16 350	1 460
9	47 880	39 870	41 895	34 875	17 850	1 630
10	53 200	44 300	46 500	38 750	19 520	1 790
11	58 520	48 730	51 205	42 625	21 280	1 960
12	63 840	53 160	55 860	46 500	22 870	2 140

WÄRTSILÄ