Numerous regulations, both global and local, aimed at controlling emitted levels of NOₓ, SOₓ smoke, particulates and other pollutants are already in effect.

Among these are the International Maritime Organization stipulations for significantly reducing sulphur oxide (SOₓ) emissions. Carbon dioxide (CO₂) emissions are also being discussed within the IMO, as are proposals for defining energy efficiency design and operational indexes for ships. Furthermore, the operators of ships able to achieve lower nitrogen oxide (NOₓ) emissions when sailing in Norwegian waters will be rewarded through reduced NOₓ fees.

Legislation is expected to become increasingly stricter in the future. Wärtsilä is continuously developing new technologies to meet these requirements. The company is committed to facilitating environmentally sound operation in terms of low emissions, low environmental impact and sustainability.

These new technologies will be available as standard on new installations, and are also suitable for retrofitting on existing installations. In this way all equipment, old or new, benefits from the latest technological improvements, even if these were not available at the time of original installation.
ENVIRONMENTAL SERVICES

Our broad portfolio of environmental products and services is geared towards solving different environmental problems. Particular emphasis lies on optimizing lifecycle efficiency, minimizing environmental impact by reducing air and water emissions, and minimizing waste volumes from both land-based power plants and ship installations.

We offer turnkey solutions for reducing the environmental footprint of our customers. These include the reduction of various airborne emissions of NOₓ, SOₓ, CO, and VOC, the ability to adapt to alternative fuels, the treatment of oily waste water, and other water-related solutions.

AIR EMISSION SOLUTIONS

Air emission solutions are, by definition, designed in order to minimize emissions in the exhaust gas, and can be divided into primary and secondary method solutions.

NOₓ ABATEMENT SOLUTIONS

Primary methods for lowering NOₓ levels involve conversions made directly to the diesel engine. Our NOₓ conversion options include a range of packages, from engine modifications, up to and including a saturation system for combustion air.

Wärtsilä’s Low NOₓ solutions combine various engine modifications designed to find the ideal combination of compression ratio, injection timing and injection rate. The Wärtsilä concept has been developed to achieve the best possible trade-off between NOₓ reduction and fuel consumption. In most Wärtsilä engine types, the Low NOₓ upgrade not only generates decreased NOₓ emissions, but does this without any negative impact on fuel consumption. On the contrary, fuel consumption is often improved.

Selective Catalytic Reduction (SCR) is one of the secondary methods for reducing NOₓ emissions. The combined silencer and SCR unit developed by Wärtsilä is an ideal package for retrofitting, thereby enabling existing installations to comply with the IMO requirements.

(*) EGCS = Exhaust Gas Cleaning System
A typical SCR installation consists of a reactor, containing several catalyst layers, a dosing and storage system for the reagent, and a control system.

The parameter for controlling the amount of urea injected is the engine load. To achieve more accurate control, the injection can be linked to a feedback NOX analyzer after the catalyst. The rate of NOX reduction depends on the amount of urea injected which can be expressed as the ratio of NH3 to NOX. The reduction rate can also be increased by increasing the catalyst volume.

IMO Tier I Upgrade Solutions
The solutions focus on NOX emissions reduction below the IMO Tier I NOX limits for a certain category of engines built between 1.1.1990 and 31.12.1999. Depending on engine type and rating, the solution will consist of injection timing related modifications or a combination of injection timing and compression ratio related modifications. The solutions will be commercially available for most 2-stroke engine types, when they are registered with IMO as certified Approved Methods. The regulation for engines built 1990–1999 will be in force as of 01.07.2010.
SO\textsubscript{X} ABATEMENT SOLUTIONS

The reduction of SO\textsubscript{X} emissions cannot be achieved using primary engine conversion methods. One option is to burn fuel with low sulphur content. Wärtsilä engines are already designed to run on fuels with any sulphur content. We offer engine checks and modifications, as well as tank and system modifications, on ships expected to operate inside and outside sulphur emissions controlled areas.

The alternative is to install a secondary method for reducing SO\textsubscript{X} emissions. This involves installing an exhaust gas cleaning system, commonly known as a scrubber. Scrubbers may use seawater or different chemicals, such as limestone (CaCO\textsubscript{3}), sodium hydroxide (NaOH) and ammonia (NH\textsubscript{4}OH), depending on the particular case. Land-based applications usually clean exhaust gases using a limestone or sodium hydroxide scrubber.

The Wärtsilä Scrubber system for marine application is IMO certified. It uses fresh water and sodium hydroxide additives, a configuration that offers the best control of efficiency since it is not dependent on the alkalinity of the seawater. It also allows effluent to be kept onboard in port and estuaries, and because the water flow is clearly smaller than in seawater scrubbers, it consumes the least energy. We can help you to select the system best suited for your installation and budget, and then design and install it accordingly.

SMOKE REDUCTION

During recent years, there has been an increasing demand that ships operate with non-visible smoke.

Local regulations and restrictions on smoke emissions have been imposed in more and more geographical areas. Most notably, Alaska has imposed duties and fees for vessels sailing in

SCHEMATIC VIEW OF THE SO\textsubscript{X} SCRUBBER

Exhaust gases are scrubbed with fresh water to which NaOH is added for the neutralization of SO\textsubscript{X}. Seawater is used for cooling. The closed-loop system features cleaning of the small bleed-off extracted from the loop, and thereby fulfills all quality and monitoring requirements stipulated by the IMO. Clean effluents can safely be discharged overboard with no harm to the environment. If operation in zero discharge mode is requested, the effluent can be led to a holding tank for later discharge.
the region during the summer season, and more such measures can be expected in the not-too-distant future.

Part-load performance can be improved via the use of various types of equipment, depending on engine type. These include waste gate arrangement and variable valve timing devices.

**DIESEL TO GAS CONVERSIONS**

Emissions from a gas engine have an 85% lower content of NOX, and about a 20% lower content of CO2 than one running on HFO. The conversion of an HFO (Heavy Fuel Oil) or MDO (Marine Diesel Oil) installation to operate on natural gas offers many benefits, and is becoming increasingly attractive throughout the industry.

Engine conversions are carried out, essentially by installing a gas fuel system on the engine. Plant conversions require modifications to the gas handling systems, as well as to the control system.

The end result of such conversions is that engines operating on HFO or MDO can now be run on gas-diesel. Since gas-diesel is based on the diesel cycle, the engine modification is limited to the injection equipment and control systems.
EMISSIONS MEASUREMENT
Targeting lower emission levels inevitably means that the methods for measuring and controlling them need to become more accurate and reliable.

Wärtsilä offers systems and services for emissions measurements which meet local and international regulations, such as the IMO Annex VI of Marpol 73/78 regulations for the prevention of air pollution from ships.

Our emissions measurement laboratory has internationally approved accreditation by FINAS (Finnish Accreditation Service) for measuring exhaust gas emissions according to the IMO NOX Code and ISO 8217 measurement standards.

The accredited compounds are NOX, CO, CO2, O2 and THC, while the accredited measurement ranges cover all typical levels for both diesel and gas operated engines.

Other gaseous components that can be measured are, for example, SO2, CH4, FSN (Filter Smoke Number), NH3, HCl, formaldehyde, benzene, and others.

Our laboratory also has the equipment and experience to measure natural gas composition.

Other types of exhaust emission parameters and properties can also be analysed at site conditions on request. Gravimetric particulate measurements would be one such example.

Our broad portfolio includes continuous emissions monitoring systems, which provide on-line data on an installation’s environmental performance.
WATER TREATMENT SOLUTIONS

Water treatment concentrates on minimizing the harmful substances present in different kinds of water streams. Wärtsilä’s water solutions portfolio provides the means to efficiently treat and monitor oily water from land-based industrial installations as well as bilge, sludge and ballast water from marine vessels.

OILY WATER TREATMENT

The oily water treatment units of Wärtsilä’s M- and P-series are among the most evolved and cost-effective units on the market, available both for land-based and marine use. Depending on configuration, the M- and P-series guarantee a maximum oil content in the effluent of 5, 10 or 15 ppm, with actual levels during continuous running normally being less than 1 ppm. All units in the M-series are fully certified according to IMO MPEC 107(49) and US Coast Guard US 46 CFR §162.050.

BILGE DISCHARGE MONITORING SYSTEM

The Wärtsilä BilgeGuard™ is a fully automated bilge discharge monitoring system installed between the bilge system and the overboard discharge pipe. The BilgeGuard™ constantly monitors the oil content in the water being discharged, instantly stopping the flow should the oil content rise above the set limit. The system is installed in a tamper-proof cabinet and logs all discharge quantities complete with oil content as well as the time and the location of the vessel. All data is stored in memory for later retrieval.

BALLAST WATER TREATMENT

Untreated ballast water has been an issue of serious public concern during recent years. Wärtsilä is currently developing the next generation of ballast water treatment systems, aimed for release in the third quarter of 2010. The new system is designed to conform to the IMO Global Ballast Water Convention, which mandates ballast water treatment for both existing and new vessels and is expected to come into full force in 2011.
GO GREEN

In developing its portfolio, Wärtsilä Environmental Services not only follows existing or future legislation, it also strives constantly to lessen the environmental impact of its customers’ installations. Examples include:

OIL MIST SEPARATOR
The oil mist separator module removes oil particles from the engine crankcase ventilation gas, and is suitable for both diesel and gas engines.

INTEGRATED OXIDATION CATALYST FOR CO REDUCTION
This is a retrofit solution for moderate CO and formaldehyde abatement on gas engines. The Integrated Oxidation Catalyst (IOXI) consists of a metallic catalyst element and a flange, and fits into the existing exhaust gas system. Moreover, it does not require any electricity or consumables.

ENVIROSEALS
Any leakage of oil from a ship’s stern shaft sealing system is unacceptable. Enviroseals offer pollution-free sealing systems with a proven track record, and are suitable for all types of vessels.

INSTALLATION GLOBAL PERFORMANCE IMPROVEMENT
We can keep your installation up-to-date with our latest advances in technologies and developments for improving fuel consumption, global efficiency, and lube-oil consumption.

These include:

PROPELLER IMPROVEMENT
Simple blade polishing and edge damage repairs can shave up to 5% off the total fuel consumption.

Our engineers have also designed propeller modifications that can actually improve a ship’s energy fuel efficiency by up to 15%, while at the same time reducing the vessel’s carbon footprint.

SLOW STEAMING
For ships with Wärtsilä RTA and RT-flex low-speed engines, Wärtsilä has introduced its Upgrade Slow Steaming Kit to enable ship owners and operators to make major savings in fuel consumption through slow steaming their ships.

The kit both extends the load range of the engine for continuous operation, and results in a major reduction in BSFC in the low-load range.

ENGINE OPTIMIZATION
Using low sulphur distillate fuels in Wärtsilä engines can have a negative effect on engine performance. To improve performance when using low sulphur diesel fuel, and to facilitate the switch to HFO, adaptation kits are available.

BOILER OPTIMIZATION
Most ships have boilers and burners fully capable of running on marine diesel oil and marine gas oil. Apart from using scrubbers, the use of such fuels may be the only means for complying with legislation concerning the use of low sulphur fuel. However, one must be aware that most systems are designed to operate on low grade heavy fuel oil and existing systems in operation should, therefore, be carefully examined to verify whether or not modifications are necessary for safe and extended boiler operation.
FROM SERVICE TO SERVICES

A number of our customers have recognized us as their preferred service supplier to ensure the availability and cost-efficient operation of their installations. They find they get leverage from a variety of benefits by having their entire power system fully serviced by one global supplier.

Wärtsilä Services provides holistic, integrated service for our marine and power plant customers. To serve you better, we are continually broadening our range of solutions by adding products and services that further enhance the value of our one-stop-shop service and expanding our global network. We support your business, in-situ or from our numerous service centers around the globe, regardless of your equipment make.

We provide tailored efficiency solutions throughout the marine propulsion and power plant product lifecycle in the following services product lines:
- Engine Services
- Propulsion Services
- Boiler Services
- Electrical & Automation Services
- Operations & Management Services
- Training Services
- Environmental Services

We can tackle everything from basic support with parts, manpower and technical support to full service agreements. The work can encompass installation and commissioning, performance optimization, upgrades, conversions, and environmental solutions. Service contracts can extend from parts and manpower all the way to long-term, comprehensive contracts including performance and asset management agreements.

Wherever your installation is located, you will find a Wärtsilä Services center nearby. More than 11,000 dedicated professionals, operating in over 70 countries in 160 locations, are waiting for your call. We are never too far away to help.

This not just service, it is peace of mind — the security of knowing that your installation is covered by the world’s most experienced marine and power plant services company: Wärtsilä.

VISIT US AT WWW.WARTSILA.COM/ENVIRONMENTALSERVICES
Wärtsilä is a global leader in complete lifecycle power solutions for the marine and energy markets. By emphasising technological innovation and total efficiency, Wärtsilä maximises the environmental and economic performance of the vessels and power plants of its customers. In 2009, Wärtsilä’s net sales totalled EUR 5.3 billion with more than 18,000 employees. The company has operations in 160 locations in 70 countries around the world. Wärtsilä is listed on the NASDAQ OMX Helsinki, Finland.