WÄRTSILÄ

ANNUAL REPORT '05

Sustainability Report

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The consolidated financial statements presented in this annual report have been prepared in accordance with International Financial Reporting Standards (IFRS). Wärtsilä's date of transition was 1 January 2005. Prior to IFRS, Wärtsilä's financial reporting was based on Finnish accounting standards (FAS). In the graphs and tables, the data for 2004 and 2005 are presented according to IFRS and for prior years according to FAS.

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GRI content	Status/Report/Page			Remarks
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EN2 Percentage of waste materials used from external sources				Information is not available at the corporate level. Recycled materials are used in engine and propeller manufacturing.
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● Covered ● Partly covered ● Not covered

2005 was Wärtsilä's best operating year in the company's history. Our perseverance in working to achieve our goals has produced results that we can be proud of. We have made sustained efforts to promote responsible operation by the company. The objectives of sustainable development and our Code of Conduct steer development of the company's operations in line with Wärtsilä's strategy.

Wärtsilä's vision, mission and strategy set the objectives for Wärtsilä's sustainable development programme. We are responsible to our shareholders for ensuring that Wärtsilä's operations are profitable, competitive and efficient. In addition to creating economic added value, corporate responsibility includes promoting the well-being of the local communities in which we operate. Similarly, developing solutions that are highly efficient, safe and environmentally sound is also a demonstration of responsibility towards our customers and the environment. Social responsibility includes good working methods, working conditions and continual personnel development. We will continue our systematic work to achieve the goals of sustainable development.

Competitiveness is our foundation

The company successfully completed the centralization of engine manufacturing in Vaasa, Finland, and Trieste, Italy. Wärtsilä continued to make inroads into the Asian market as planned. Full order books and high utilization of capacity in Wärtsilä's production units have increased the efficiency of our operations and boosted purchasing volumes from our suppliers. The value of Wärtsilä's purchases from the supply chain grew by 9% in 2005.

Wärtsilä is introducing a SAP-based enterprise resource planning (ERP) system on a worldwide scale to enhance and streamline the company's processes. Most of Wärtsilä's units are already linked to the ERP system, and global deployment is making good progress.

Continuous development of our operations and recent restructuring have contributed to the company's improved financial performance. Wärtsilä will continue to develop its operations in order to improve profitability and ensure competitiveness into the future. Sound financial performance is the cornerstone of the other pillars of sustainable development – environmental responsibility and social responsibility. Wärtsilä's order book is at a record high level, providing a good basis for further development of the company's operations and for achieving the targets we have set for sustainable development.

Environmental solutions create added value

Our main achievement last year, from the viewpoint of both technology and the environment, was the breakthrough made in DF engines as prime movers in LNG carriers. Wärtsilä believes that the use of gas will grow strongly, in both the power plant and the maritime transport sectors. Replacing oil or coal with gas will substantially reduce environmental impacts. Wärtsilä has prepared for an increase in demand for gas by developing an extensive product family for gas engine applications. The main strengths of these solutions are high efficiency and low emissions.

Wärtsilä completed the first life-cycle assessments of its products in 2005. The results confirm our belief in how important engine op-

eration and fuel refining are to environmental impacts over the product lifecycle and increase our understanding of the overall lifecycle impacts of our products.

Wärtsilä has further developed conventional engine technologies in order to reduce emissions. In the case of four-stroke engines, we have achieved a NO_x emission level of 710 ppm. The product launch will be widened during 2006. In the case of two-stroke engines, Wärtsilä's Delta Tuning can significantly reduce emissions from engines.

There has been keen interest and solid demand for Wärtsilä's bio-oil fuelled power plants. The bio-oil power plant, and extensions to it, supplied to the City of Monopoli in Italy produces 24 MW of "green" electricity, and is the largest plant supplied by Wärtsilä using liquid biofuels.

Service is playing an increasingly important role in solutions for sustainable development. Power plant operation, engine modernization and modifications, and a broad service portfolio contribute to improving the environmental performance of our customers. A good example of this is the conversion of a power plant in Pakistan carried out by Wärtsilä Service. The plant now uses light fuel oil and gas instead of heavy fuel oil.

Most of the environmental targets for 2005 were achieved. Sales of gas-powered and biofuel-powered plants, for example, were on target, and the proportion of O&M agreements in new installations has also developed favourably.

At the beginning of 2006 Wärtsilä's Board of Management set new environmental targets for future years, up until 2010. Meeting the new targets will require determined effort and systematic work in both product development and sales. Wärtsilä's management is strongly committed to reaching these targets.

Social responsibility

Wärtsilä's aim is to create and maintain a pleasant and safe working environment for its employees, as Wärtsilä needs skilled and motivated personnel to reach its objectives. Employee training and skills enhancement are a central part of the Group's HR policy. Wärtsilä's occupational health and safety practices are based on the company's Occupational Health and Safety Policy and Directive.

We use regular employee satisfaction surveys to measure implementation of our social responsibility targets. Continuous improvement of the company's operations depends, among other things, on measuring satisfaction, but the company also uses these surveys to measure how well its employees understand Wärtsilä's strategy and objectives. The next survey will be conducted at the beginning of 2006.

Implementing good practices in the Group network is extremely important. Wärtsilä reviewed local working conditions and identified deficiencies when starting its joint venture in China. The company then launched a programme that made substantial improvements in the working conditions there.

Wärtsilä's Code of Conduct creates a sound framework for guiding every Wärtsilä employee to work in a responsible manner. In future years we will ensure that all our employees know and understand the importance of our Code of Conduct and the requirements it sets, and that each employee follows its principles in their day-to-day work.

The supply chain is an important element in Wärtsilä's business operations. In 2005 we updated the requirements we set for our suppliers to conform to our Code of Conduct. The new supplier requirements took effect at the beginning of 2006 and the criteria for assessing social responsibility have been added to Wärtsilä's supplier evaluation procedure.

Active dialogue is one element of the company's responsibility towards its various stakeholders. Wärtsilä encourages open and transparent communication with its stakeholders. Feedback from them is highly important and is taken into account as we develop our operations.

Our Sustainability Report was prepared in accordance with the 2002 GRI Guidelines, and is a part of our Annual Report. As such, it represents a balanced and reasonable presentation of our organization's economic, environmental and social performance.

We hope our Sustainability Report meets the expectations of our stakeholders. All feedback is welcome, and indeed is essential to the further development and improvement of our reporting procedures.

Ole Johansson
President & CEO

Matti Kleimola
Group Vice President
Technology and Environment

Responsible corporate citizenship requires constant investment in operations and technologies that are environmentally sustainable. A central objective in Wärtsilä's strategy for sustainable development is reducing the environmental impacts of its products. For the company to meet its customers' needs, be prepared for future requirements and remain a frontrunner in the industry, Wärtsilä's product development must be continuously innovative, determined and willing to explore new technologies.

Wärtsilä's product development endeavours to increase the service life of products, improve their reliability and make the products more environmentally sound. Investing in product development benefits Wärtsilä's customers as well as the environment, both in the short-term and over a longer time span. Growth in the world's energy needs combined with increasingly strict environmental requirements creates a challenging operating climate for companies in Wärtsilä's line of business. Wärtsilä has responded to these challenges by improving the energy efficiency of its products while simultaneously reducing their emissions.

The drivers of sustainable development

From the viewpoint of sustainable development, the main themes for developing the business environment are new legislation, the availability and price of natural resources – especially fossil fuels – climate change and a general change in attitude. Technological development and the ability to apply new technology are influencing solutions to the challenges of sustainable development.

International legislation and initiatives

In Wärtsilä's business, environmental pollution is regulated at the international level mainly by the IMO (International Maritime Organization) and the World Bank. Wärtsilä's products comply with the requirements of these institutions. Other important environmental restrictions on Wärtsilä's products are the German TA-Luft regulations often applied to gas engine plants and the emission limits on diesel engines set by India and Japan.

Enforcement of the Kyoto Protocol will have a significant impact on the power generation business. Wärtsilä supplies decentralized solutions for power generation that provide high efficiency with relatively low carbon dioxide emissions. The modularity of Wärtsilä's solutions enables customers to optimize the plant size, while Wärtsilä's multifuel solutions help them switch to cleaner fuels whenever necessary. With respect to greenhouse gases, among the best solutions are power plants running on biofuels as these add no greenhouse gases into the atmosphere.

The EU Commission plans to increase the construction of CHP (Combined Heat and Power) capacity in the EU area. In CHP generation the utilization of fuel energy is highly efficient since much of the residual heat from the combustion process is also recovered and used, for instance in district heating and cooling (DHC), steam production or as heat in industrial processes. The CHP process saves global fuel resources through efficient use of the energy stored in fuels. The CHP power plants that Wärtsilä supplies offer extremely high efficiencies.

Environmental legislation has increased considerably in recent years and its focus has shifted from regulating operation to regulating the products themselves. Wärtsilä actively monitors legislative initiatives and changes in environmental legislation to ensure the company's ability to respond appropriately to the operating conditions of the future. Wärtsilä's R&D takes into account the requirements of the changing operating environment and develops products that give the company a competitive edge.

Fossil fuels and climate change

The prevailing view is that there will be little significant change in the usage of fossil fuels during the coming 10–15 years. However, declining reserves, production and refining capacity combined with growing demand have all pushed up market prices. The recent global instability and natural disasters have also contributed to the increase in prices. If these price increases are permanent, this will speed up the development and introduction of alternative fuels and, in this way, will also have an impact on the market for engines. Wärtsilä's R&D activities take this change in the range of fuels into account and the company is prepared to respond appropriately.

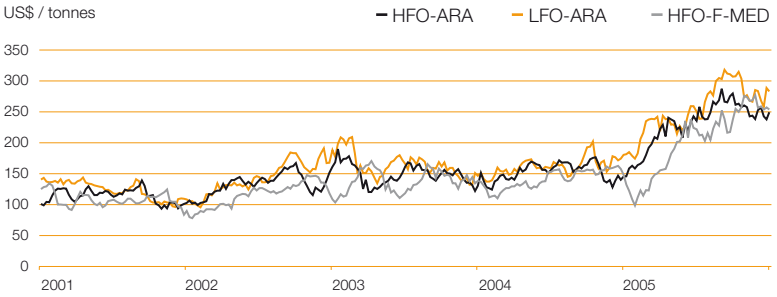
Although oil is the most important fuel, and will remain so for a relatively long time, a visible change is the increasing use of natural gas. Improved supplies of natural gas are making its use in energy production an increasingly viable option. In the past, natural gas has been used by onshore power plants, but today marine vessels are making increasing use of liquefied natural gas (LNG) for fuel on environmental grounds. International climate agreements, with their requirements to reduce carbon dioxide emissions, can be expected to boost the use of natural gas signifi-

Range of fuels for Wärtsilä engines

Liquid, oil-based fuels	Gaseous fuels	Biofuels (examples)
Light fuel oil (LFO)	Natural gas (NG)	Rape seed oil
Heavy fuel oil (HFO)	Liquefied natural gas (LNG)	Palm oil
Crude oil (CRO)	Compressed natural gas (CNG)	Coconut oil
High-viscosity base oils	Associated gas	Biodiesel (B100)
Orimulsion®	Coal bed gas (methane)	
Water-fuel emulsions		

cantly in the next few years. Carbon dioxide emissions when using natural gas are 25% lower than in the case of oil and 40% lower than for coal. An even more effective way to reduce carbon dioxide emissions is to adopt renewable energy sources such as biofuels. Increasing the use of biofuels often requires political decisions, which may slow down their introduction. At some point, however, increasing the use of biofuels will become unavoidable in order to arrest climate change and to ensure the availability of energy.

Prices of fuel oils in recent years



Source: Reuters

Wärtsilä's product development and significant R&D programmes

Wärtsilä applies new technologies that cross traditional scientific disciplines and conventional industrial boundaries to solve product development tasks, thus producing added value for its customers. Wärtsilä's R&D organization creates the basic elements that make a product both desirable and competitive. Wärtsilä's R&D activities focus on products and applications that are reliable, self-diagnostic, inexpensive to operate and produce minimal environmental impacts throughout their lifecycles. Wärtsilä's research organization collaborates with research institutes and corporate partners in fields that are of crucial importance to the well-being of society and conservation of the environment. A substantial proportion of the company's investments in product development is targeted at reducing environmental impacts. R&D expenses are shown in the Financial Review section of the Annual Report 2005.

The use of multifuel engines, which give customers more flexibility in selecting fuels and in reducing the environmental impacts of their operations, is an important part of Wärtsilä's R&D. Even now multifuel engines offer environmentally sound solutions with low running costs far into the future. Customers have the flexibility to operate the same engine with different fuels. They can, for instance, initially run an engine on heavy fuel oil, and then switch to natural gas later when the distribution network for natural gas has been built, or even switch to biofuel.

The main development programmes during 2005 related to the HERCULES project, the Advanced Engine project, the Extreme Value Engine (EVE) project and the development of fuel cells.

HERCULES project

Wärtsilä participates in the European Union's HERCULES project, which is an international industry initiative to develop new technologies for marine engines that reduce emissions and fuel consumption while improving equipment reliability. Wärtsilä also co-operates with a number of leading European universities conducting research into engine technologies.

Advanced Engine

The aim of this project is to develop the world's most efficient, modern and competitive generating set for power production as well as for propulsion and energy generation applications.

Extreme Value Engine (EVE)

The EVE Extreme Value Engine is a one-cylinder, medium-speed diesel engine incorporating a new type of injection system and a novel valve control system. It is designed to endure forces, loads and stresses beyond the range of existing medium-speed production engines. Helsinki University of Technology is coordinating the research project, and Wärtsilä is the main research partner in the project.

Reducing sulphur oxide emissions from marine engines

Annex VI of the IMO MARPOL 73/78 Convention, which deals with air pollution from ships, and the requirements of upcoming EU legislation will impose a reduction on the sulphur content of the fuels

used and stringent controls on the emissions of sulphur oxides from marine engines. The solutions for reducing SO_x emissions include the use of low-sulphur fuels and a range of technologies for cleaning exhaust gases. A sulphur dioxide scrubber offers a solution for the economic, logistic and technical problems relating to the use of low-sulphur fuels. Towards this end, Wärtsilä is participating in an extensive research programme aimed at creating applications based on scrubber technology that will reduce sulphur oxide emissions from marine diesel engines and boilers. Wärtsilä is collaborating with research institutes, ship designers, shipowners and gas scrubber manufacturers to produce a test series that will be used to determine the design criteria and adjustability of the system, and ascertain its effects on engine performance and environmental impacts. If the research results prove that scrubber technology is feasible, Wärtsilä plans to offer scrubber solutions for marine applications that will reduce the sulphur oxide emissions of both existing and new installations.

Development of fuel cell technology

Wärtsilä has been developing fuel cell technology for decentralized power generation and marine applications since 2000. Today the company's R&D is focusing on developing an SOFC (solid oxide fuel cell) system for both industrial and marine applications, and especially on the design and manufacture of the system and its integration with other technologies. Wärtsilä's extensive knowhow in combined heat and power generation, marine engine applications and the company's in-depth knowledge of its customers' needs provide a sound basis for developing fuel cell applications.

Within its existing R&D programme, Wärtsilä is currently developing the WFC20 alpha prototype, a 20 kW SOFC power unit. Wärtsilä plans to introduce its first commercial demonstration units in the 50 kW range within the next couple of years, after which the company will evaluate pre-commercial special applications. Commercialization of product units for numerous power plant and marine applications will start at the beginning of the next decade.

Wärtsilä's existing SOFC system is based on the use of natural gas or methanol and lower sulphur diesel oil. The company is also examining the feasibility of using the technology with other liquid fuels. Natural gas is an ideal fuel, which is widely available for power plant applications. Methanol can also be reformed easily and is better suited to marine applications because it is in liquid form. Biogases formed during the gasification and fermentation processes can also be utilized in SOFC units. Additionally, hydrogen is a suitable fuel for all typical fuel cells and does not require any pre-reforming processing. However, only a limited amount of hydrogen is available, and consequently the focus has been on other fuels.

A fuel cell is a clean, efficient and reliable method of producing energy, making it a highly attractive option for commercial power production. Wärtsilä is committed to supplying its customers with efficient and environmentally sustainable power generation solutions. Developing the energy generation technologies of the future, such as fuel cells, is a key element in Wärtsilä's strategy for sustainable development. Wärtsilä believes that fuel cell technology will be one of the most promising energy technologies of the future because of its substantial benefits in energy production, including its cleanness and high efficiency. Since fuel cells are suitable over a wide range of different sizes, they can be used in many different applications, ranging from small portable power units through to medium-sized industrial applications.

The Wärtsilä SOFC product concept.

Lifecycle approach and using results

Since Wärtsilä's products have such a long operational life, identifying the lifecycle impacts of the products is essential to understanding their total environmental impact. The first lifecycle assessments of the Wärtsilä 32 engine were completed during 2005. The assessments covered the entire lifetime of the diesel engine, drawing on detailed information about raw material production, through the supply chain, transportation and engine assembly, to the operating life and decommissioning of the engine. The operational phase was modelled on a supply vessel for an oil drilling rig and on a power plant application. The lifecycle analyses were verified by independent experts to ensure the integrity of the final results and conformance to standards.

Solid Oxide Fuel Cells (SOFC).

The results of the lifecycle assessments showed that most of the environmental impacts during the lifecycle of a diesel engine arise during the operation of the engine; emissions into the air from the operation of an engine and the fuel supply chain relating to its operation cause most environmental impacts. The results of Wärtsilä's first lifecycle assessments contained no surprises, but rather strengthened

the company's understanding of the environmental impacts of its engines and the priorities to address. Furthermore, thorough and reliable lifecycle information provides a stronger base for decision-making and discussion about processes and procedures in the future.

Wärtsilä manages the lifecycle of its products through product design, the selection of suppliers, production methods, optimizing transportation, maintenance and repair during the products' operational lifetime, and by training and advising customers.

Collaboration with customers

Wärtsilä has long collaborated with different stakeholders. Co-operation with customers and the supply chain creates added value for the entire supply chain as well as for the end-customer. Identifying and achieving common goals succeeds best through co-operation with the whole supply chain. Collaboration with stakeholders is also extremely important from the viewpoint of sustainable development. A good example is the Enviropax project, in which the parties involved jointly developed a concept for a vessel that can improve the overall efficiency of ships by up to 10% compared to conventional solutions.

Wärtsilä's environmental targets for 2006–2010

Ship Power	Service	Power Plants	R&D
2010 Broader gas concept, e.g. 5 non-LNG carriers	**2010** 2,000 MW diesel to gas conversions (today less than 20 MW)	**2008** Commercially available proven combined effluent treatment unit for various plant effluents to fulfil the World Bank Guidelines for Thermal Power	**2006** Full release of NO_x = 710 ppm engine concepts for power plant engines (W20, W32 and W46)
2010 The volume of environmental seals to reach 50% of total seal sales	**2010** 500 MW scrubber retrofits (nothing today)	**2010** Introduce wet techniques for optimized NO_x reduction and fuel economy to the markets for 3–4 engine power plants in operation	**2006** Compliance with upcoming US and EU marine emission regulations
2010 Improvement of propulsive performance by better design and other innovative means for seagoing ships by 3% from 2005 level	**2010** 5000 MW connected to Wärtsilä CBM (about 1,000 MW connected today)	**2010** Actively promote power plant technology based on renewable fuels with target of 500 MW_{th} of sold power plants	**2010** Fuel consumption improvement of diesel and gas engine by 3% compared to 2005 level
	2010 4500 MW installed power operated by WOM (2,440 MW today)		**2009** Realize 15% reduced fuel consumption and emissions by waste heat recovery on a 2-stroke engine
			2008 Introduce -20% NO_x option on all 2-stroke RT-flex engine types

Last year Wärtsilä started collaboration with Mitsubishi Heavy Industry in the fields of product development, manufacture and distribution. Wärtsilä also started co-operation with Hyundai Heavy Industries for developing two new types of engines.

Target	Environmental benefit	Status at end of 2005
To increase sales of gas and biofuel plants by 1,000 MW a year.	Lower emissions compared to the use of oil.	Sales in 2005 totalled 1,011 MW.
To increase number of O&M contracts to cover 20% of new installations.	Efficient and planned operation of power plants.	In 2005 O&M agreements covered 17% of new power plants and 19% of all engine deliveries. The intake of power plant orders was strong in the final quarter. O&M agreements are generally signed after a delay.
To offer a comprehensive gas engine product family for different engine room applications.	Replaces the use of steam in LNG carriers. Utilization of blow-off gas. Good efficiency and low emissions.	Engine deliveries for various vessel types.
To offer a propulsion system with 10% higher efficiency that at present.	Improved total efficiency of vessel. Lower fuel consumption and lower emissions.	Enviropax project complete. This concept has been applied in practice.
To develop a fuel cell prototype with extremely low emissions and to offer the first bio-oil engines.	Development of alternative solutions for conserving the environment.	Fuel cell prototype ready. Bio-oil engines in use in various applications.

Wärtsilä's environmental targets

At the beginning of 2006 Wärtsilä's Board of Management reviewed the company's strategic environmental targets. The results of the lifecycle assessments completed last year confirm Wärtsilä's view of the importance of environmental impacts during the operational life of its products. Consequently, the Board of Management set some very challenging targets for both the company's business operations and its R&D. Wärtsilä's mission, vision and strategy are presented in the Business Review and the environmental targets in the table above.

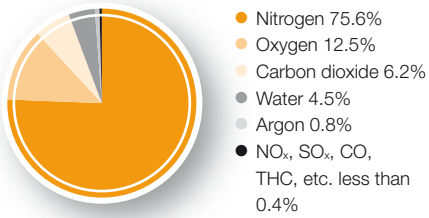
Left: achievement of the environmental targets for 2005 set by Wärtsilä's Board of Management in 2002.

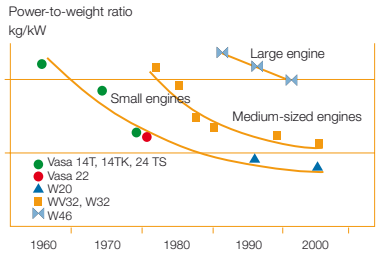
PRODUCTS AND ENVIRONMENTAL ASPECTS

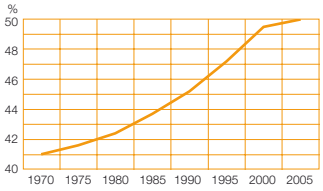
Environmental aspect and product	Component	Environmental impact
Emissions into the air		
Engines	Carbon dioxide (CO_2)	Climate warming
	Sulphur oxides (SO_x)	Acidification
	Nitrogen oxides (NO_x)	Acidification, eutrophication, lower atmosphere ozone formation
	Particles, smoke (PM)	Human health impacts, visual impact
	Carbon monoxide (CO)	Reduces oxygen uptake in the lungs
	Hydrocarbons (THC, VOC)	Climate warming (CH_4), ozone formation in the lower atmosphere, some carcinogenic compounds
Consumption of raw materials		
Engines	Cast iron, alloy and structural steel, aluminum alloys Main chemical elements of engines: Fe 90.8%, Al 2.7%, C 2.2%	Depletion of natural resources
Propulsion systems, seals	Metals, bronze, Main chemical elements of propulsion systems: Cu 80.1%, Al 9.3%, Ni 4.9%	Depletion of natural resources
Power plants	Several different materials such as steel, concrete, seals, water	Depletion of natural resources
Secondary cleaning technologies	Alloy and structural steel, different types of catalyst materials, reagents (e.g. ammonia, urea), water	Depletion of natural resources
Consumption of fuel and lubricating oils		
Engines and power plants	Liquid oil-based fuels (e.g. LFO, HFO, Orimulsion), gas fuels (e.g. LNG, NG, CNG) and biofuels (e.g. rape seed and palm oil, biomass), lubricating oil	Depletion of natural resources
Propulsion systems	Lubricating oil	Depletion of natural resources
Solid and liquid waste		
Engines	Lubricating oil used, filters and components, waste oil	Increased waste at landfill sites
Power plants	Construction waste, ash, waste water, waste oil, office waste	Increased waste at landfill sites
Secondary cleaning systems	End products and catalysts of flue gas decontamination	Increased waste at landfill sites
Noise and vibration		
Engines and power plants	Structure-borne noise, flue gas noise, airborne noise	Discomfort
Heat emissions		
Engines	Waste heat from exhaust gases	Warming of the atmosphere
Electric and thermal energy		
Engines and power plants	Electric and thermal energy	Increased well-being

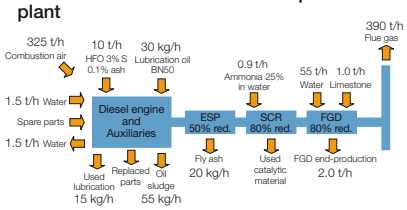
The environmental aspects of Wärtsilä's products are mainly related to their use. The most significant environmental aspects concern engines. In order to produce mechanical and thermal energy engines use fuel and lubricants, which results in various kinds of exhaust emissions and waste. Engine running also results in waste heat from the exhaust gases and cooling water. The main environmental aspects and impacts of Wärtsilä's products and applications, as well as Wärtsilä's solutions to these, are explained in the table below and on Wärtsilä's Sustainability internet pages.

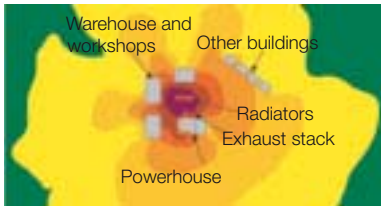
Wärtsilä's solution	Customer's options	Indicator
Increasing engine efficiency, multifuel engines	Using a different fuel	**Typical composition of the exhaust emissions of a large diesel and gas engine**
Increasing engine efficiency, several emission reduction technologies, multifuel engines	Using a fuel with a lower sulphur content	
Low NO_x combustion, air humidification technologies, SCR, multifuel engines	Using a different fuel	
Optimizing the combustion process, common-rail fuel injection, electrical filters	Using a different fuel	
Optimizing injection, compression, and the shape of the combustion space, oxidation catalysts (gas engines)	Planned or optimized maintenance and correct operation	
Oxidation catalysts in gas engines for VOC emissions, optimizing the combustion process	Planned or optimized maintenance and correct operation	
Long product life, using recycled materials, material efficiency, automated filters, modernizing engines, overhauling and recycling components	Planned or optimized maintenance and correct operation, personnel training, overhauling and recycling components	**Power-to-weight ratio of Wärtsilä's medium-speed engines for 6-cylinder in-line engines**
Long product life, using recycled materials, material efficiency	Planned or optimized maintenance and correct use	
Prefabricated modules, material efficiency	Efficient and planned operation of power plant, personnel training, recycling catalysts	
Developing primary technologies; developing secondary technologies in collaboration with equipment manufacturers	Proper operation and maintenance, optimizing process parameters	
Improving energy efficiency, reducing the consumption of lubricating oil, multifuel engines, utilizing biofuels and alternative fuels in power production	Planned and optimized maintenance and correct operation, personnel training, using environmentally benign fuels	**Development of the shaft efficiency of Wärtsilä's best engines**
Improving the total operating efficiency of ships, increasing the service life and reducing the consumption of lubricating oil, preventing oil leakages	Using environmentally favourable lubricating oils, using environmentally favourable seals	
Using recyclable materials and optimizing the use of materials, automated filters, long service intervals, overhauling components, reducing the consumption of fuel	Planned and optimized maintenance and correct operation, personnel training, recycling	**The material balance of a diesel-powered plant**
Prefabricated, ready-to-install modules	Recycling, planned maintenance and correct operation, personnel training	
Evaluating the potential uses of end products, developing dry primary technologies	Proper waste disposal, recycling catalysts, evaluation of the potential uses of end products, optimizing process parameters	
Efficient noise reduction solutions and damping systems, e.g. re-positioning wall structures and noise-generating sources	Planned maintenance and correct operation of power plant	**Image depicting the typical noise level of an engine-powered plant, created using noise simulation software.**
Heat recovery systems	Optimizing process parameters	
Energy-efficient solutions	Correct operation	More information available on Wärtsilä's Sustainability internet pages.











SHIP POWER SOLUTIONS

Wärtsilä's engine room and propulsion solutions for marine applications are reliable, economical and environmentally sound. Wärtsilä tailors its solutions to the precise needs of its customers by optimizing the entire ship machinery, propulsion and control system.

This approach is encapsulated in Wärtsilä's concept The Ship Power Supplier. Wärtsilä also provides lifetime support to ensure the high availability and reliability of the vessel throughout its service life. Wärtsilä's service portfolio includes training, spare parts, technical support, and continuous technology upgrades and improvements. Wärtsilä maintains a global network of service professionals who are competent and equipped to carry out maintenance and repair tasks in a timely manner.

Solutions for:	Product range	Brand names
• Containerships • Bulk carriers • Tankers • Ferries • RoRo vessels • Cruise ships • Car ferries • Refrigeration vessels • Naval vessels • Dredgers • Fishing vessels • Offshore vessels • Tugs, etc.	• Main and auxiliary engines in the output range 60 kW – 80,080 kW • Generating sets • Reduction gears • Propellers • Thrusters • Rudders • Control systems • Seals and bearings	• WÄRTSILÄ®, • SULZER® • LIPS®, • Auxpac™, • Propac™, • Deep Sea Seals • JMT.

EFFICIENCY IMPROVEMENT

Machinery solutions efficiency

The marine business is facing new challenges as the public eye becomes ever more focused on ship emissions. Since onshore industries have been able to cut certain emissions, the share of these pollutants contributed by shipping has grown proportionally to become a very significant part of total emissions – this despite the fact that transport by ship remains the most efficient means of transportation. The marine industry therefore needs to look at new ways of reducing the environmental impact from ships.

Wärtsilä is continuously seeking to find better propulsion machinery solutions for ships. This involves looking at the entire shipping concept, not only the engines and propellers. Wärtsilä has gained promising experience working with its partners in the design of various vessel types. Examples include the LNG Carrier equipped with Wärtsilä DF dual-fuel engines and the environmentally advanced Enviropax RoPax vessel, both of which were thoroughly described in the 2004 Sustainability Report. As part of its development work, Wärtsilä has developed new concepts for: Waste Heat Recovery, Delta Tuning and an LNG cruise ferry.

Waste Heat Recovery concept

Current interest in reducing emissions and engine operating costs is leading to the use of more effective waste heat recovery. Adapting the

Enviropax

Enviropax is a joint project involving Wärtsilä, ABB and Kvaerner Masa-Yards (Aker Yards Finland) and set up with the purpose of designing a new concept for RoPax ferries offering environmental and economic advantages. The vessel's hull, machinery and propulsion system are optimized to meet the criteria set for this application. Compared to a conventional twin-shaft vessel, the Enviropax achieves a 6–10% saving in fuel consumption depending on the power distribution of its pair of contra-rotating propellers.

Features	Benefits
CODED – new combined diesel-electric and diesel-mechanical machinery concept.	• Lower power demand. • Optimal and flexible use of the engine power and load. • Lower lifecycle costs. • Increased cargo space. • Flexible use of the engine room.
Wärtsilä EnviroEngine™, including • Common-rail technology • Compact SCR units	• Minimum fuel consumption, smoke and NO_x emissions.
The propulsion system featuring one contra-rotating propeller pair. • One conventional mechanically driven Controllable pitch propeller (CPP) • The other, mounted directly aft of the CPP, is an electric pod (Azipod) with a smaller fixed pitch propeller rotating in the opposite direction.	• Improved propulsion efficiency. • Allows hull form with lower resistance. • Optimized dimensioning of the propellers.

LNG Carrier machinery concept

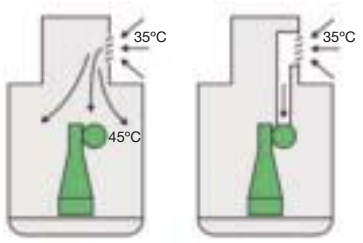
Features	Benefits
Multi-engine installation with Wärtsilä dual-fuel (DF) engines	• Lower fuel consumption through use of flexible engine load • Higher efficiency compared to the steam turbine • Smaller fuel tanks can be used
Flexible engine room design	• Reduces the overall volume of the engine room, due to engines smaller size and weight • Freeing space for a larger payload
Use of gas and 1% marine diesel oil	• Lower exhaust emissions
Flexible design of LNG carriers	• Lower cost and emissions per transported ton • Optimized vessel design with increased cargo capacity and operating speed.

Dual-fuel-electric machinery for LNG carriers is starting to get established as a standard for LNG carrier propulsion and electric power generation. By end of September 2005, Wärtsilä has received orders to supply the engines for 16 LNG carriers from 4 different shipyards for 6 different shipowners. The 64 Wärtsilä 50DF engines that are required to power these 16 ships have an aggregate output of 621 MW. The first three LNG carriers are scheduled to enter commercial operation in 2006.

tuning of the Wärtsilä low-speed 2-stroke marine engines to increase exhaust gas energy, and employing both steam and exhaust gas turbines in a Waste Heat Recovery Plant, has made possible an electrical output of about 11% of engine power. Such savings can make a major contribution to improving both plant efficiency and engine emissions.

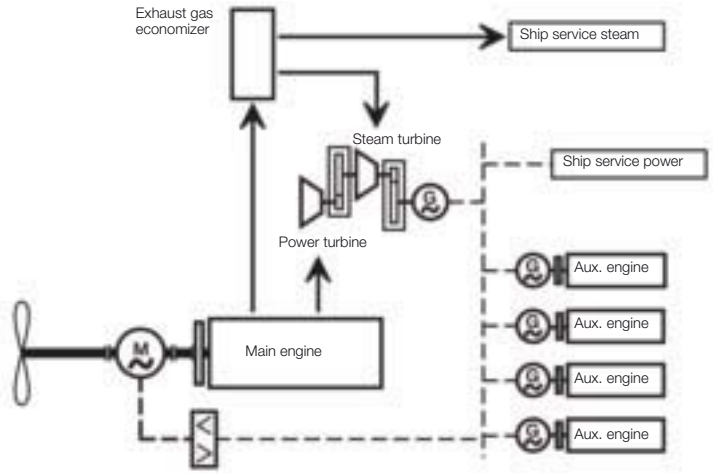
This Waste Heat Recovery Plant is attracting much interest from shipowners interested in saving fuel costs and reducing emissions. It must be remembered that modern large, low-speed marine engines are very highly developed and there is little potential for achieving significant reductions in CO_2 emissions by engine development alone. Thus the proposed Waste Heat Recovery Plant represents a practical path forward.

The engine is tuned for waste heat recovery. In the engine's exhaust gases about 25% of the input energy is available at a fairly high temperature, which can be used for heat recovery. The engine is adapted for ambient suction air intake, instead of from the engine room. A re-matched engine supercharging system gives an increased exhaust gas temperature and allows a good amount of exhaust gas to be branched off before the turbocharger, to drive a power turbine, thereby allowing a worthwhile heat recovery potential to be achieved.

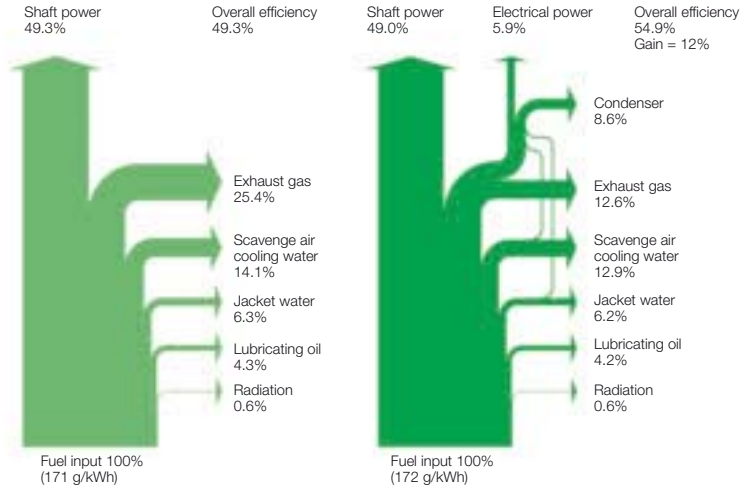


Left: engine room air section.
Right: ambient air suction.

Schematic diagram of the Total Heat Recovery Plant



Comparison of heat balances for Wärtsilä 12RT-flex96C engines



Without heat recovery (left) and with the Total Heat Recovery Plant (right) showing the 12% gain in overall efficiency for the Total Heat Recovery Plant.

The number of auxiliary diesel generating sets can be reduced by employing a heat recovery system. The system offers considerable flexibility in optimizing plant operation to minimize operating costs or maximize propulsion power. Improved utilization of fuel energy results in both lower fuel costs and lower emissions. The application of a waste heat recovery system is therefore threefold. The operator:

- Profits from lower annual fuel costs
- Contributes to reduced emissions, such as CO_2 and NO_x
- Benefits from a "green image" and improved competitiveness in the freight market.

The recoverable power depends on engine conditions. In this case, normal operation is assumed to be between ISO conditions and Tropical conditions for an average aged engine.

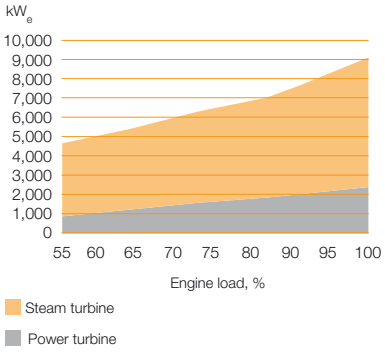
For a Wärtsilä 12RT-flex96C engine, as widely applied in today's large container liners, with a maximum continuous rating (MCR) of 68,640 kW, this results in a turbogenerator output as shown in the figure at right. At 85% engine load, the turbogenerator output is then 7,000 kW_e, or 11% of the engine power. The engine fuel saving relative to the engine without heat recovery tuning is therefore 10.5%. The comparison of the heat balances with and without waste heat recovery can be seen in the figure below centre.

For a ship propulsion plant consisting of a Wärtsilä 12RT-flex96C main engine with an MCR of 68,640 kW and four Wärtsilä 8L32 diesel generating sets, each rated at 3600 kW, the annual savings in fuel, maintenance and lubricating oil costs represent a net present value of US$ 4.6 million, assuming an interest rate of 6% and a payback time of four years. It is very feasible to finance the additional investments for the Waste Heat Recovery Plant on this basis. The first 12RT-flex96C engine with the Waste Heat Recovery Plant was delivered in June 2005.

Delta Tuning – reducing part-load fuel consumption on the Wärtsilä RT-flex

Delta Tuning has been introduced in Wärtsilä RT-flex engines to provide lower fuel consumption in the effective operating load range. It is offered as an alternative to the original tuning, thereby allowing shipowners and operators to choose the BSFC (brake specific fuel consumption) curve which best suits

Recovered power from a Wärtsilä 12RT-flex96C engine



Average age of engine, average ISO/tropical conditions.

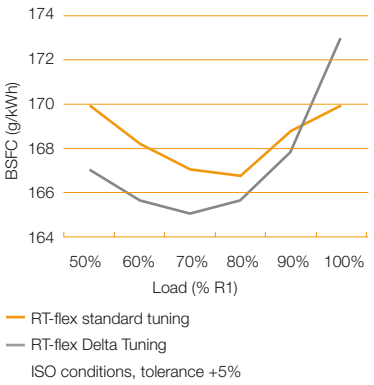
their ship's operating pattern. This is made possible by the flexibility in engine settings provided by the computer-controlled common-rail systems of the RT-flex engines.

The flexibility of the RT-flex system has been utilized to reduce fuel consumption in the effective operating range of most engines. At 75% load, the fuel saving can be up to 2 g/kWh depending on the engine model and the rating point selected. No changes in hardware are involved; the development only requires changes in the RT-flex software to adjust the respective engine setting parameters.

Two fuel consumption curves are now available as standard for RT-flex engines: the original and the new alternative, which is a lower curve with reduced BSFC throughout the load range up to 90%. It has been achieved by adapted engine tuning – termed Delta Tuning. In both the original tuning and Delta Tuning, the RT-flex engines comply with the NO_x regulation of Annex VI of the MARPOL 73/78 convention.

Delta Tuning involves tailoring the firing pressure to engine load by adapting injection timing, injection pressure and exhaust valve timing. The firing pressure is kept as high as possible at 75% load to observe a minimum required margin to the NO_x limit, and is increased above 75% load to reach the maximum firing pressure at about 90% load.

Delta Tuning, RT-flex60C



Then it is reduced again for higher loads. Below 75% load, the firing pressure is kept as high as is possible within the limit of the allowable firing ratio (firing pressure/compression pressure).

The result is that the BSFC is significantly lowered in the mid- and low-load range, at all loads less than 90% load, but then increased at high engine loads (90–100% load). This emphasis on mid-load reductions in BSFC brings a real benefit to engine users while allowing a higher BSFC at full load to enable the engines to comply with the IMO NO_x regulation.

Delta Tuning, however, is only offered for Wärtsilä RT-flex engines whose contracted maximum continuous rating (CMCR) is in the upper region of the engine model's rating field, and it yields the greatest benefit close to the R1 rating point, i.e. nominal maximum continuous rating (MCR). This is because there is a decreasing margin in NO_x emissions against the IMO limit with greater derating.

The first engine employing Delta Tuning is this 45,760 kW Sulzer 8RT-flex96C engine seen here in the course of erection at HSD Engine Co Ltd., Korea.

LNG Cruise Ferry – a truly environmentally sound ship

Wärtsilä has developed a new concept for a coastal cruise ferry using liquefied natural gas (LNG) as fuel. Usage of LNG is a very efficient way of reducing emissions. All SO_x emissions are eliminated and the NO_x and CO_2 emissions are reduced by about 80% and 20% respectively. LNG is not only an environmentally sound solution, but it is also becoming economically interesting as oil prices continue to rise.

The new environmentally sound ferry is designed for cruising along the Norwegian coast between small coastal communities in an environmentally sensitive region. The same ship and machinery concept could also be applied easily to other passenger ship operations, such as short route ferries and expedition cruise vessels.

The ferry features a machinery consisting of two Wärtsilä 6R32DF propulsion engines and two 9R32DF generating sets. These give a total installed power of 10.5 MW. The engines use LNG as primary fuel and MDO as pilot and back-up fuel.

A conventional ferry propulsion setup with two open shaftlines has been used in this concept. The two W6R32DF propulsion engines drive controllable pitch propellers (CPP) each via a reduction gear, which constitutes the mechanical propulsion power of the machinery. Two 2 MW generator/motors are connected to the PTO/PTIs on the gears. Together with the two large W9R32DF generating sets, they form the ship's electrical power plant. The electric generators/motors can also drive the propellers and are equipped with frequency-converters for variable speed operation. The total propulsion efficiency has been improved by applying Wärtsilä Efficiency Rudders. The

LNG-fuelled cruise ferry.

normal tunnel thruster in the stern has been replaced with a new steerable thruster integrated into the skeg.

This machinery combines the lower investment cost of mechanical propulsion with the good characteristics of diesel-electric machinery. The machinery principle offers extra flexibility and allows a smooth switch between the different operation modes. Furthermore, all engines can usually be run at constant speed, close to the optimum load to achieve lower fuel consumption. Low engine loads can be avoided by switching between the various power generation options. This machinery concept is ideal for ferries when designing the vessel for cost-effective operation in various operation modes.

LNG offers a new alternative energy source for ships. The new ferry concept shows how LNG can be efficiently integrated into the ship design and the environmental benefits that it offers. Some extra space is required for LNG storage which has to be taken into account at the outset of the design process. On the other hand, this is a small price to pay when considering the enormous reduction in emissions that can be achieved with this concept.

Very few ships, other than LNG carriers, are currently using LNG as fuel. Norway has been the forerunner for LNG-fuelled ships. The country currently has two offshore supply vessels and one double-end ferry in operation, and a further five double-end ferries are on order. There is a clear rise in the interest for LNG among ship operators, partly fuelled by the increasing oil prices.

PROPULSION SYSTEM EFFICIENCY

The propulsive efficiency of a propeller is affected both by the open-water efficiency of the propeller and, on the other hand, by the interaction between the hull and the propeller. Overall propulsion efficiency, therefore, can be enhanced by improving the efficiency of the propeller, the hull, or both.

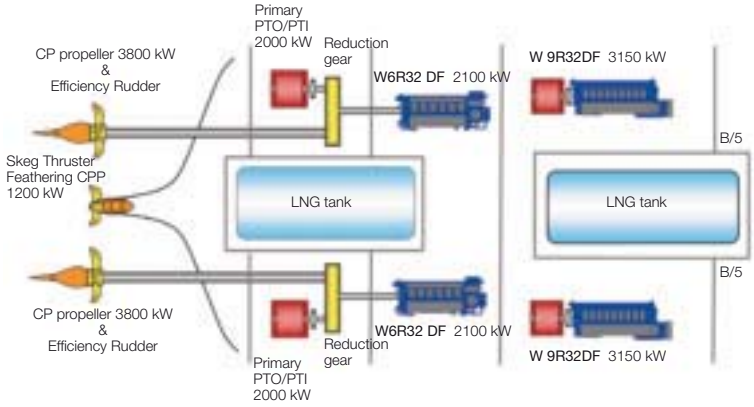
Solutions for improved propulsion system efficiency

Wärtsilä is actively promoting products which in themselves improve the propulsive efficiency. These products are: the Efficiency Rudder, the HR nozzle, the E hub Controllable Pitch Propeller, which was introduced in 2005, and control systems, without forgetting the propeller design tailored to the application.

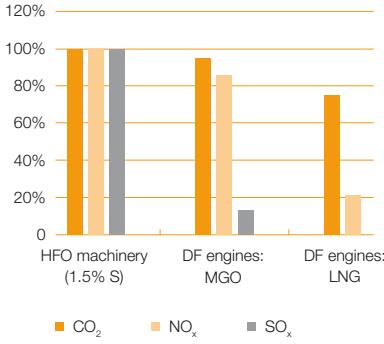
Improving the performance of propellers remains a major target for Wärtsilä. The maximum efficiency of a propeller depends on the kinetic and frictional losses behind the propeller. The flow close to the tips is very important as the formation of vortices introduces kinetic energy which is lost. For this reason the effect of changes in the blade tip geometry are subject to detailed investigations. These investigations are not very easy as model tests do not give an accurate answer and most calculations are based on methods which do not include viscous drag and therefore do not give the complete answer.

The specially developed blade tip geometry called tip-rake concerns a very local displacement of blade sections close to the propeller tip. The effect resembles a blade tip with a tip plate.

Schematic machinery arrangement



Exhaust emissions

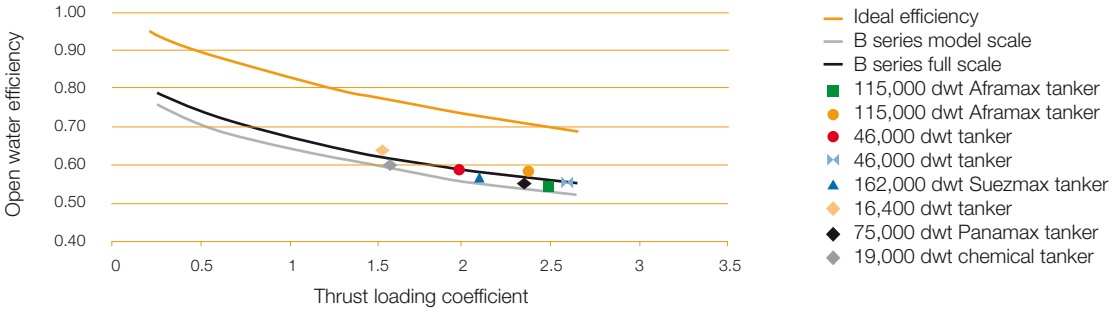


Propulsion arrangement with integrated skeg thruster.

Solutions for improving propulsion efficiency

Product	Features	Benefits	Typical applications
The Efficiency Rudder	Optimized design in combination with the propeller	Optimum performance for both steering and fuel consumption. Reduction of power required to obtain a certain ship speed. The power reduction ranges from 6 to 9% for single-screw vessels and from 3 to 5% for twin-screw vessels.	Controllable pitch propeller installations. The installed base with efficiency rudders is gradually being extended.
The HR nozzle	Change in the behaviour of the trailing edge flow compared to conventional nozzles	Larger thrust and increased bollard pull: • Calculations have been validated with actual measurements.	Fixed pitch propeller, steerable thrusters and controllable pitch propeller installations. Every year more than 100 nozzles for inland vessels and a growing number of steerable thrusters are fitted with the HR nozzle.
The E-hub	A better balance between the actuating forces and blade bearing strength.	Minimum hub size can be selected. Improved efficiency of ice-strengthened controllable pitch propellers: • Conventional design normally leads to reduction of efficiency compared to fixed pitch propellers • Model test results evaluated in a non-dimensional manner for these CPP projects indicated that the efficiencies obtained are comparable with a fixed pitch propeller without ice class	Container vessels, Ropax vessels and ice-strengthened tankers of various sizes. In 2005 several projects for controllable pitch propellers were introduced. For five vessels the E-hub was selected as the best hub (this adds up to nine hubs). The first deliveries will take place in 2006.

Thrust loading versus open water efficiency



Achieved efficiency of ice-strengthened controllable pitch propeller in model tests compared to B series (fixed pitch propeller with no ice strengthening).

HMS Endurance fitted with CoastGuard AC Enviroseals

HMS Endurance was retrofitted at Falmouth in July 2004 with 470 mm AC Enviroseals and has since returned to full operation.

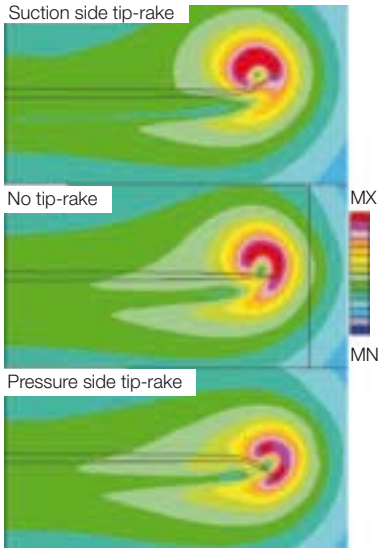
HMS Endurance, a Class 1 Icebreaker, was built in Norway in 1990 and her Mission is "to patrol and survey the Antarctic and South Atlantic, maintaining Sovereign presence and defence diplomacy and supporting the global community of Antarctica". This involves close links with the Foreign Office, United Kingdom Hydrographic Office and the British Antarctic Survey. She deploys to the Antarctic for 7 months of the year.

In June 2005 she was the base from which Her Majesty Queen Elizabeth II reviewed ships from over 34 nations, including the Royal Navy, International Navies and Tall Ships, who were taking part in the International Festival of the Sea.

The Ship's motto, "Fortitudine Vincimus" – "By Endurance We Conquer" originates from Sir Ernest Shackleton, the Antarctic explorer, who made history in "Endurance" in his expedition in 1914–15.

By courtesy of the Ministry of Defence, UK.
Crown Copyright

Example of tip-rake on a small fixed pitch propeller.



Effect of tip-rake on the suction side tip-vortex calculated by CFD. The strength of the tip vortex can be seen to reduce from top to bottom.

In order to gain more insight into the physical behaviour it was decided to calculate the viscous flow around different tip geometries. To obtain a basic understanding several different propeller tips were modelled. A straight tip (no rake), as well as bend tips both towards the pressure side and the suction side, were modelled. Systematic variations were studied of the shape of the tip-rake. This resulted in a clear picture of the most effective local tip shape. Tip-rake appeared to influence the drag as illustrated by the figure above where the tip vortex strength is reduced by the different shape of the blade tip. Typically the reduction in drag could result in a 2–4% improvement in propeller efficiency.

The application of tip-rake is seen as a positive contribution to a more efficient and quiet propulsion system for shipowners. Tip-rake has been applied in the last several years on about 40 demanding applications with fixed and controllable pitch propellers. In 2005 the application of tip-rake was expanded for use in combination with a nozzle but with the focus on reducing vibration and noise.

EMISSIONS REDUCTION

Emissions to the air

Most harbours in the world are located close to densely populated areas and for this reason the demand for no visible smoke under any circumstances has become increasingly important in recent years. Common-rail injection technology now makes it possible to provide smokeless engines. Wärtsilä has the widest range of products available with common-rail technology for heavy fuel operation.

The focus on reducing NO_x emissions continues to be of importance within the marine business. Also existing Wärtsilä and Sulzer engines can be modified with NO_x reduction technologies i.e. common-rail injection, WETPAC, DWI and SCR.

Emissions to the water

Any oil loss to the environment from the ship's sealing system is unacceptable. Wärtsilä's CoastGuard EnviroSeal and Airguard 3AS environmental sterntube sealing system offers an environmentally sound alternative and is available in different designs for retrofitting to existing vessels or for use in new tonnage. Both systems prevent the spilling of lube oil from the sternshaft into the sea. These sealing systems prevent both the leakage of bearing oil into the seaway and the ingress of water into the bearing system. They ensure continuous operation between planned maintenance periods, with no unplanned dry-dockings for emergency repairs.

COMPLIANCE WITH REGULATIONS

NO_x emissions

The minimum environmental requirement set by Wärtsilä for its Wärtsilä brand marine engines is compliance with the NO_x emissions limits stipulated in MARPOL 73/78 Annex VI.

Sulphur content in fuel

A range of new regulations related to the sulphur content in fuel is presently being prepared or at the implementation phase. Due to new regulations, the shipping community is faced with new challenges on a large scale, especially those ships that will operate both inside and outside restricted areas, switching over from one fuel to another, in some cases to a distillate fuel. For a long time the traditional approach to operation on heavy fuel oil (HFO) has been "pier-to-pier". The recommendation is not to change over between HFO and light fuel oil, except in emergency or in preparation for maintenance.

MARPOL 73/78 Annex VI contains a global cap of 4.5% m/m on the sulphur content of fuel oil and calls on the IMO to monitor the worldwide average sulphur content of fuel. It also contains provisions allowing for special "SO_x Emission Control Areas" (SECAs) to be established with more stringent controls on sulphur emissions.

"Directive 2005/33/EC of the European Parliament and Council modifying Directive 1999/32/EC as regards the sulphur content of marine fuels", entered into force 11th of August 2005. It provides new sulphur limits in marine fuels for "fuels used" and for "fuels placed on the market" and permits emission abatement technology as an alternative. The directive provides a special clause for warships and invites a new proposal to be submitted by the EU Commission by 2008, possibly with a second stage

Emission reduction technologies

In use or on order from Wärtsilä (January 2006)

Area of concern	Technology	Principle	Benefit	Engines	Output (MW)
Smoke	Wärtsilä common-rail engines	Keeping the fuel's injection pressure high and stable throughout the load range. Optimal engine operation has been achieved at all speeds and loads.	Smokeless operation	52	457
	Wärtsilä RT-flex engines	Precise control of the injection, high injection pressures at low engine speeds and the sequential shut-off of the injectors combine to give steady running at very low running speeds without smoking, down to 10–12% of nominal speed.	Smokeless operation Reduced operating costs	242	9,957
NO_x	WETPAC humidification system	Introduction of pressurized water into the combustion process to dampen NO_x formation. The pressurized water is added to the intake air after the turbocharger compressor. Due to the high temperature of the compressed air the water evaporates instantly and enters the cylinders as steam, reducing the combustion temperature and thus NO_x formation.	Reduction as much as 50%, when the water consumption is approximately two times the fuel oil consumption.	11	35
	DWI (Direct Water Injection)	A DWI valve, through which the water and fuel is injected into the cylinder, typically in a water-to- fuel ratio of 0.4–0.7.	Reduction of 50–60% without adversely affecting power output	53	515
	SCR (Selective Catalytic Reduction)	A reducing agent, such as an aqueous solution of urea, is injected into the exhaust gas at a temperature of 290–350 °C. The urea in the exhaust gas decays into ammonia, which is then put through a catalysing process that converts the NO_x into harmless nitrogen and water.	Reduction 85–95%	88	441

MARPOL Annex VI

In SECA areas the sulphur content of the fuel oil is not permitted to exceed 1.5% (m/m). Alternatively, vessels must be fitted with an exhaust gas cleaning system or else some other technical method of reducing SO_x emissions must be used.

Marpol Annex VI entry into force:
- 19 May 2004: Ratified.
- 19 May 2005: Entry into force as such
  - Sulphur cap 4.5% worldwide
  - Bunker delivery notes required
  - Local supplier register
  - Statutory fuel sampling.
- 19 May 2006: Baltic Sea SECA effective.
- 2007: North Sea and English Channel SECA effective.

Annex VI prohibits deliberate ozone-depleting emissions of substances containing halons and freons (chlorfluorocarbons, CFCs). The Annex also prohibits the onboard incineration of certain substances such as dirty packaging materials and polychlorinated byphenyls (PCB).

of sulphur limit values (possibly down to 0.5%) and additional sulphur emissions control areas.

In the USA the Environmental Protection Agency (EPA) and the Californian Air Resources Board (CARB) are working on new legislation for ships based on automotive fuels with very low sulphur content (15 ppm).

Locally, ports and local authorities may offer reductions in port and fairway fees depending on the sulphur content in the fuel. In Sweden new sulphur-related fairway dues have been differentiated with the following limits from 1 January 2005:
- 0.2 and 0.5% for passenger vessels
- 0.2, 0.5 and 1.0% for other vessels.

In the new directive 2005/33/EC the maximum permitted sulphur content of marine fuels is:

Fuels used

Ship type	Area	% S	When
All	Baltic SECA	1.5	11 August 2006
All	North Sea + English Channel SECA	1.5	11 August 2007
All[1,2]	All EU ports[3]	0.1	1 January 2010
Passenger ships	All EU[3]	1.5	11 August 2006
Inland waterway vessels	All EU inland waterways	0.1	1 January 2010

[1] Except for ships due to be at berth less than 2 hours.
[2] Derogation for 16 Greek ships operating within Greece until 1 January 2012.
[3] Not applicable in the outermost regions of the Community (French overseas departments, Azores, Madeira, Canary Islands)

Fuels "placed on the market"

Fuels	% S	When
Marine diesel oils	1.5	11 August 2006
Marine gas oils	0.1	1 January 2010

All new Wärtsilä engines are already designed and optimized to run on fuels with any sulphur content. For existing ships, Wärtsilä can offer engine checks and modifications, as well as tank and system modifications onboard ships expected to operate inside or outside SECAs.

For newbuildings expected to operate purely within SECAs, fuel and lubricating oil filling, storage, transfer, separation, and supply systems can in principle be arranged as on a traditional HFO ship. However, to enhance the flexibility and second-hand value of the ship, consideration could be given to designing these systems also for alternating operation inside and outside SECAs.

Smoke

Alaska enforces regulations governing the permitted smoke levels from ships. Wärtsilä has demonstrated its compliance with these regulations in a number of projects.

OPERATION AND MAINTENANCE OF SHIP POWER APPLICATIONS

Wärtsilä supports the business operations of its customers by developing and optimizing the lifecycle performance of its technologies, solutions and products.

Operation and maintenance training

To help customers maintain their installations at optimum performance levels, Wärtsilä offers its customers training in operation and maintenance specific to each product type through the Wärtsilä Land & Sea Academy. Statistics show that this sort of training can clearly reduce the incidence of operation-related problems.

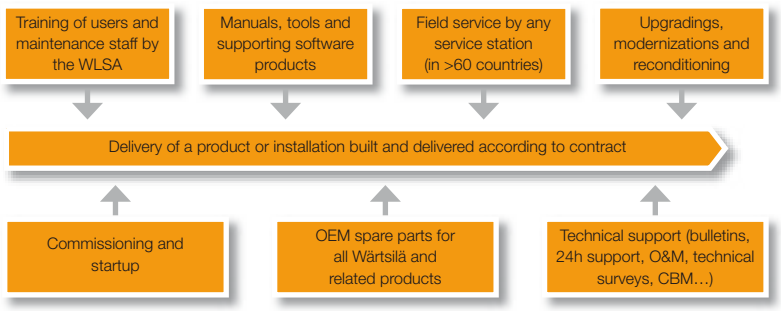
Wärtsilä Land & Sea Academy also provides general seafaring training related to the ship's engine room and other ship handling and design needs. The curriculum includes basic courses in sea safety and load handling, as well as search and rescue courses, and navigation and management courses (resources, environment and safety). The Academy also arranges advanced or refresher courses as well as tailored training for specific customer needs. Participants can also attend accredited training programmes at the Academy to obtain IMO/STCW-95 certification.

Service network

Wärtsilä provides professional service assistance for both Wärtsilä's products and other brands at more than 130 centres in some 60 countries. Maintenance and repair are performed either onboard the vessel or at the service centre, where entire engines or their most valuable core components such as piston crowns and cylinder heads are reconditioned. Wärtsilä has developed safe component reconditioning methods for 2-stroke and 4-stroke engines that can even double component lifetimes.

Propulsion systems need servicing as well because propeller blades in good condition save fuel costs and help to reduce exhaust emissions. As a propeller's average surface roughness (0.1 µm) increases by a factor of ten, the relative power loss also increases from 0.25% to about 3.3%. Hence propeller polishing can achieve tangible cost savings. Also propellers showing "heavy running" characteristics for other reasons, and which hamper

Services during the product lifecycle



the engine's operation and increase wear and service costs, can be modified for each type of vessel without the need for drydocking, simply by trimming the propeller to the water surface. Wärtsilä's Flying Squad teams can even repair or recondition damaged propellers in situ under water.

Technological development is making it possible to apply new technical advances to old engines. Engine upgrades are made to improve the economic and environmental performance, safety and reliability of the engine. Besides developing new engines, another important priority in Wärtsilä's research and development work is to come up with modification and modernization solutions designed to restore old engine types to almost the same performance levels typical of new engines.

IMO MARPOL Annex VI

IMO MARPOL 73/78 Annex VI (Regulations for the Prevention of Air Pollution from Ships), which came into force in May 2005, requires vessels built on or after 1 January 2000, or whose engines have undergone a major conversion on or after the same date, to have an International Air Pollution Prevention (IAPP) certificate. This, in turn, requires an Engine International Air Pollution Prevention (EIAPP) certificate specific to each engine. EIAPP certification makes it mandatory for the engine manufacturer to produce a Technical File on the engine that includes an emission measurement report on the engine verifying that the engine's emission levels are below the NO_x emission limits stipulated in Annex VI.

Most engine types can be modified and/or tuned to meet these NO_x limits. The critical components of all engines with respect to the production of NO_x emissions must be listed with their codes, and the relevant spare parts must have the same codes. The engine manufacturer determines these so-called component-specific IMO codes and includes them in the Technical File on the engine that the manufacturer prepares. Wärtsilä has precertified all its new engines since 2000, well before Annex VI came into effect. Precertification can subsequently be changed to EIAPP certification without the need for new emission measurements.

Spare parts services

The availability of high-quality spare parts and technical service is essential to maintaining reliability and operational safety. To optimize reliability and safety, parts made by the original engine manufacturer (OEM) are tested by the OEM in laboratory and field tests for compliance with the OEM's criteria. Wärtsilä's Parts Logistics is a global system designed to ensure the correct timing of parts deliveries to customers. The system handles deliveries of parts for more than 50 engine types covering both existing and former Wärtsilä and Sulzer engines (including Nohab Diesel, GMT, Wichmann, SACM, Stork SW Diesel, Bolnes etc.). Since April 2005 Wärtsilä has also handled OEM service and spare parts deliveries for medium-sized and large Deutz marine engines.

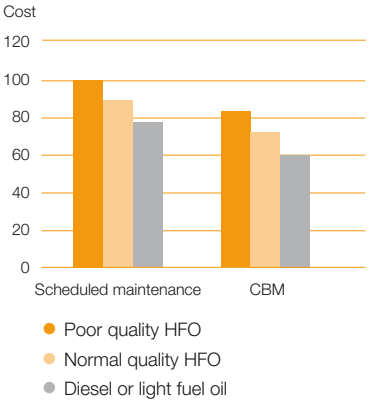
Services based on service agreements

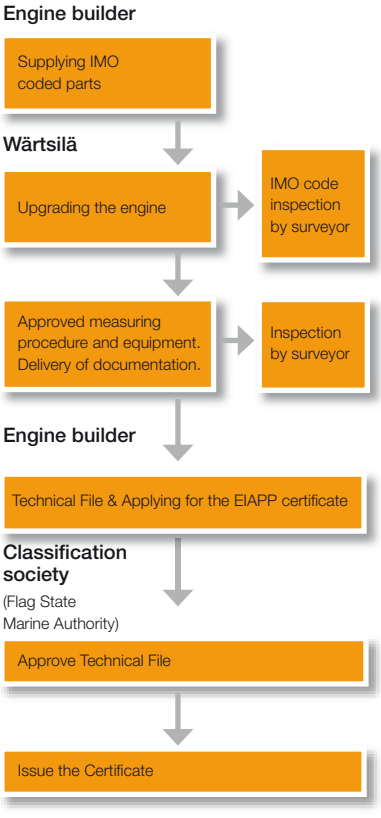
A spare parts agreement guarantees the availability of parts at the right time, while maintenance agreements ensure that service is performed at scheduled intervals. Support agreements include customer service onboard vessels. An operations & maintenance agreement allows the shipowner to hand over responsibility for operation and maintenance of the full engine room to Wärtsilä.

Condition-Based Maintenance (CBM), which has been applied in many industrial sectors for years, is also gaining in popularity in the marine business. CBM is a system that enables engine inspections and remote monitoring of operating data. More than 130 marine engines are currently covered by this form of agreement and the first offshore CBM agreement has been signed with an oil drilling company. Units linked to the CBM system are not serviced at regular intervals; instead service is based on real need. Experts compare and assess reports and remotely measured data on the installation and recommend specific service action based on the results.

Cost comparison of maintenance system

Maintenance cost, parts and work for 50,000 operating hours on different fuel qualities at 2002 price level.





POWER PLANT SOLUTIONS

Wärtsilä's power plant solutions are based on diesel, gas or dual-fuel engines that are designed to run on various types of oil and gas. Wärtsilä BioPower offers boiler plants designed primarily to burn solid biomass fuels. Wärtsilä's Power Plants business focuses on the decentralized power generation market, supplying power plants mainly for baseload and peak shaving operation.

Wärtsilä supplies power plants to utilities or to independent power producers (IPPs) for conventional electricity generation. The company also has industrial customers who want to safeguard their production with a reliable source of power. An increasingly important market segment is the oil and gas industry, in which power is needed for drilling, transportation and refining.

Wärtsilä's global service network offers complete customer support covering the entire lifecycle of the plant for all of the power generation solutions it delivers. This is achieved through versatile and sophisticated service products and agreements, including full plant operation and maintenance.

In addition to reducing emissions, Wärtsilä's Power Plants business places high priority on developing diversity and flexibility in its emissions reduction techniques. Since emissions requirements and the fuels used differ widely in different market areas, this requires a wide range of products as a basis for packaging competitive solutions for these varying needs.

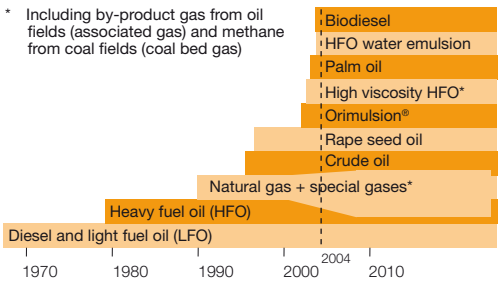
Wärtsilä's overriding aim is to develop and offer its customers reliable, cost-efficient and environmentally sound power plant solutions.

Multifuel solutions

Recent years have seen the development and commercialization of new types of power plant utilizing various biofuels as well as heavy, high-viscosity fuels – a trend that will continue. Nonetheless, Wärtsilä's main products today are die-

Applications	Customers	Fuels
Baseload	Utility	NG, LNG, CNG
Peaking	Industry	Special gases
Standby	IPP	LFO, HFO
Pumping	Oil & Gas	Orimulsion®
		Bio-oils

Types of fuel used in Wärtsilä's engine-driven power plant



sel engine power plants running on heavy fuel oil (HFO) and gas power plants fuelled by natural gas. The market potential for gas power plants has increased significantly with the spread of gas pipeline networks and this trend is expected to continue in the years ahead. The proportion of power plants fuelled with light fuel oil (LFO) and biofuels is still relatively minor.

Wärtsilä's power plant solutions provide flexibility in the choice of fuel. Customers frequently choose a diesel power plant which for its first years of operation runs on fuel oil. As natural gas becomes an option, the engines are converted for operation on gas. A more flexible alternative, however, is to choose at the outset a multifuel engine, such as the DF (dual-fuel) or GD (gas-diesel), as these can be run either on gas or fuel oil depending on fuel availability, price and other criteria.

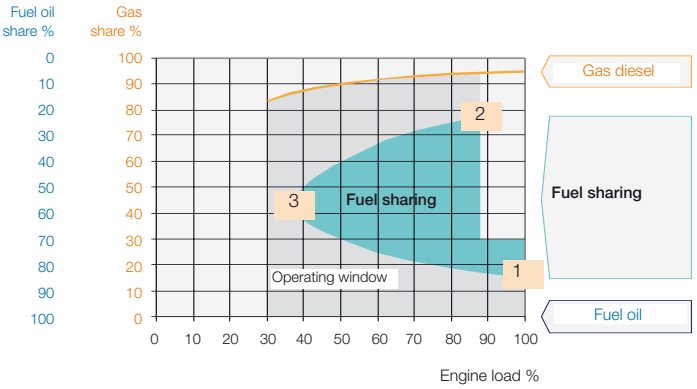
Relative sales of different types of Wärtsilä's engine-driven power plants

(June 2004-May 2005)

- LFO / BIO 8%
- HFO 56%
- NG 37%

Also worth mentioning is the Fuel Sharing concept developed by Wärtsilä specifically for the oil industry. Here, the Wärtsilä 32GD engine can be run on various gas/fuel mixtures simultaneously, which offers considerable benefits in applications where gas availability, for example, can vary temporarily. The operator can freely change the setpoint of the fuel mix within a specified operating window, or alternatively choose to run the engine entirely on either natural gas or liquid fuel.

Operating windows of fuel sharing concept

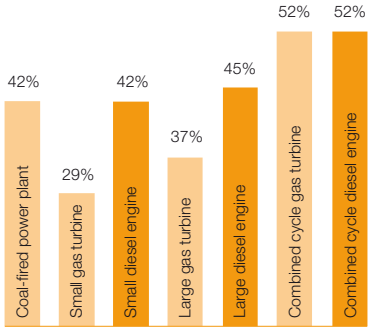


Energy efficiency

Wärtsilä's engine-driven power plants offer certain benefits in energy economy compared to many other types of plant. Energy efficiency is an extremely important aspect, not only in terms of energy economy but also because it reduces the use of limited natural resources as well as the emissions produced per unit of energy. For example, specific emissions of sulphur and carbon dioxide per unit of energy produced with the same fuel depend purely on how efficiently the plant operates.

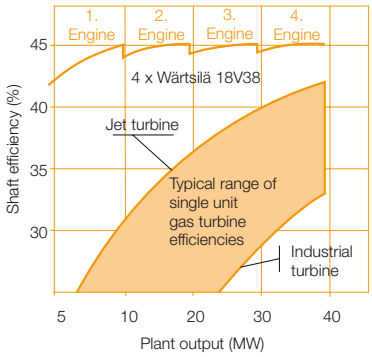
Wärtsilä's multifuel power plants also ensure a high level of efficiency in extreme conditions and at low loads. It is an advantage from the perspective of total power plant efficiency that power plants built around reciprocating engines can consist of several smaller units rather than just one large unit (as in the case of turbine-driven plants). This concept improves the reliability and availability of the plant since maintenance needed on one engine generally does not prevent the plant's other units from operating. Furthermore, the output of engine-driven power plants can be regulated by varying the number of units in operation and optimizing their individual outputs. This keeps the plant's total efficiency very high even at low turndown ratios (loads).

Typical plant electrical efficiency



- Wärtsilä product
- Non-Wärtsilä product

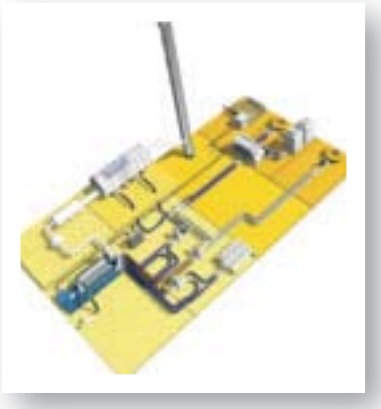
Shaft efficiencies of gas turbine and engine-driven power plant versus power output



Combined heat and power production

In combined heat and power (CHP) generation, also called co-generation, the residual heat from the engine cooling water and flue gas is used to produce thermal energy in the form of steam or hot water. This thermal energy is typically used in a district heating network, an industrial process or a chiller. CHP typically achieves 75–90% overall efficiency, thereby significantly reducing emission levels per unit of energy.

A concept that maximizes energy efficiency and versatility in many applications, notably airports, is "trigeneration". Here, the thermal energy produced in addition to electricity is used for either heating or cooling, depending on the need, or for both simultaneously in different proportions.



The tri-generation concept.

Regarding emissions reduction, CHP comes into its own through its high energy generation efficiency. The emission levels of a CHP plant with an overall efficiency of 90% are, in proportion to relative energy output, less than half those of a coal-fired power plant with an efficiency of 35–40%, even though the emission content stays unchanged. Furthermore, even compared to the same level of efficiency, the CO_2 emissions of a gas-fired CHP plant are roughly 40% lower than in the case of a coal-fired plant.

Decentralized energy generation

Decentralized power generation means using small energy production units that are located close to where the energy is consumed. Today's deregulated electricity markets favour decentralized power generation as opposed to centralized generation in large installations. The short delivery times for small plants combined with the ability to increase their production capacity in stages, and often to easily combine heat and power generation, are definite advantages compared to the centralized model. Decentralized power generation also makes it possible to minimize problems such as transmission losses caused by long transmission lines, and land reservations for the lines. Wärtsilä power plants are ideally suited to decentralized power generation.

Reducing emissions

Methods of reducing emissions fall into two main categories: primary and secondary. The purpose of primary methods is to prevent the emissions from arising in the first place, whereas secondary methods remove the already formed emission component from the engine's exhaust gas. One of the principal aims of Wärtsilä's Power Plants business is to maintain a high level of expertise in cleaning methods and to keep in its product range a variety of tested emissions reduction technologies for different market needs.

The use of primary methods is often recommended as these are effective means of eliminating the need for additional investments and possible additional environmental loads. In Wärtsilä power plants the first priority in emissions reduction is to use dry primary methods, which in practice means optimizing the engine, while at the same time guiding the customer in choosing the right quality of fuel.

Secondary methods comprise various types of flue gas cleaning methods. Their use and the need for them depend very much on the location of the plant and local fuel availability and fuel prices. Wärtsilä co-operates actively with different equipment suppliers. An important element of this development work is to raise the efficiency of the cleaning equipment in terms of both emissions reduction and cost.

In developing its engines Wärtsilä takes emissions reduction and regulatory requirements into consideration also by anticipating future needs.

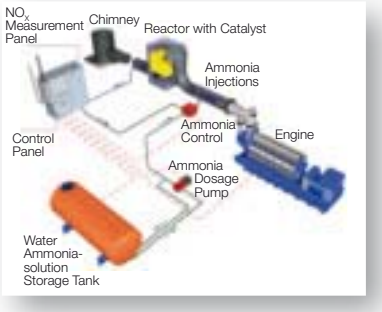
In certain applications wet primary methods achieve the best overall result because the reduction efficiencies achieved with dry methods are limited when fuel consumption and other emissions are factored in. In the power plants business Wärtsilä considers the most potential wet reduction technologies to be controlled humidification of the combustion air and the use of water-in-fuel emulsions.

Over the years Wärtsilä has supplied emissions reduction equipment for several hundred engines used in its power plants. SCR (Selective Catalytic Reduction) systems have traditionally been used in diesel power plants but nowadays these are being increasing-

Flue gas emission control equipment delivered or currently on order January 2006

	No of engines	Output (MW)
SCR	153	972
Oxidation catalyst	253	1.124
ESP	10	160
FGD	59	683

SCR equipment



Emission reduction technologies

Emission component	Technology	Classification	Principle	Advantage	Typical use
Reducing particle emissions	Choosing a better fuel type (ash / sulphur)	Primary	Using a fuel with a smaller ash and sulphur content reduces the particle emissions produced during combustion.	Fuel-specific.	Diesel engine / heavy oil
	Electrostatic filter	Secondary	In an electrostatic filter, the particles in the flue gas are charged with an electric current and the charged particles are collected on the surfaces of the filter's collector plates. Typically, the electrostatic filter used with a diesel engine is either a single- or double-field model. The particle content achieved also depends on the type of fuel used. A smallish amount of flue ash is generated as an end product.	The particle content of gas discharged through the filter normally varies between 20–50 mg/nm^3 (dry, 15% O_2).	Diesel engine / heavy oil
Reducing NO_x emissions	WETPAC - H (humidity control)	Primary	The combustion air is humidified by injecting water into it, which lowers the combustion temperature and reduces emissions of nitrogen oxides. The amount of injected water required is determined according to air humidity, thus minimizing water consumption.	Typically emissions are reduced by approx. 15–20% at the minimum air humidity level.	Diesel engine
	SCR (Selective Catalytic Reduction)	Secondary	Nitrogen oxides (NO_x) are deoxidized into nitrogen (N_2) and water vapour (H_2O) using ammonia or urea at a suitable temperature on the surface of the catalyst. Process control enables the amount of inactive ammonia in the flue gas to be kept low.	Collection efficiency 80–90%. Larger collection efficiencies are possible, but not cost-effective.	Diesel or gas engine
Reducing SO_2 emissions	Lower sulphur content in fuel	Primary	The sulphur content of fuel is directly proportional to the sulphur dioxide emissions generated. Thus using a fuel with a lower sulphur content produces less SO_2 emissions.	Fuel-specific.	Diesel engine / heavy oil
	NaOH FGD (flue gas desulphurization)	Secondary	Sulphur dioxide is removed from flue gas in a tower washer. Sodium hydroxide is used to neutralize the washing fluid. The plant produces waste water as an end product, which should be treated. As an investment, this cleaning method is more economical than a limestone cleaner but its operating costs are higher due to the higher price of sodium hydroxide.	A typical collection efficiency for SO_2 is approx. 90%.	Diesel engine / heavy oil with low sulphur content
	Limestone FGD (flue gas desulphurization)	Secondary	The limestone cleaner is based on a wet tower washer in which sulphur dioxide is absorbed from the flue gas. As an investment it is more expensive than a sodium hydroxide cleaner, but its operating costs are lower even in the case of high-sulphur fuels. Calcium, for which a disposal procedure should be determined, is produced as an end product.	A typical collection efficiency for SO_2 is approx. 80–90%.	Diesel engine / heavy oil with high sulphur content
Reducing CO emissions	Oxidation catalyst	Secondary	Carbon monoxide is oxidized into carbon dioxide on the surface of the catalyst using the oxygen in the flue gas.	Depending on the amount of catalyst used, discharge efficiency is 30–90%.	Gas engine
Reducing hydrocarbon emissions	Oxidation catalyst	Secondary	Hydrocarbons are oxidized on the surface of the catalyst into carbon dioxide and water vapour using the oxygen in the flue gas.	Discharge efficiency depends on both the catalyst chosen and the hydrocarbons involved.	Gas engine
Emissions monitoring					
Monitoring of gaseous emissions	Secondary method – fuel and process parameters		The secondary method is based on periodical flue gas measurements as well as on the systematic monitoring and reporting of certain process and fuel parameters. The secondary method is often the most efficient means of emissions monitoring.	Reliable measuring, minimal need for expertise at the plant, suitable for different market areas.	Diesel engine – typically e.g. sulphur dioxide emissions
	Constant emissions monitoring (CEMS / AMS)		Emissions levels can be monitored constantly using automatic equipment. The operation and maintenance of equipment requires personnel expertise to ensure reliable performance. The results reported may be uncertain if the necessary expertise is not available.	Actual emissions level is monitored constantly and any limits exceeded are registered automatically.	Diesel or gas engine – typically e.g. NO_x emissions
Monitoring of particle emissions	Secondary method – fuel and process parameters		The secondary method is based on periodical flue gas measurements as well as on systematic monitoring and reporting of certain process and fuel parameters. The secondary method is often the most efficient means of emissions monitoring.	Reliable measuring, minimal need for expertise at the plant, suitable for different markets.	Diesel engine
	Constant emissions monitoring		Constant particle measurement is usually based on secondary monitoring, e.g. analysers monitoring opacity or light diffusion. Calibration based on reference monitoring gives a correlation with the parameter monitored. If the fuel and load conditions vary, the monitoring may not yield reliable results.	The apparent emissions level is monitored constantly and any limits exceeded are registered automatically.	Diesel engine

ly applied in the largest gas power plants in certain markets, an example being the USA. Oxidation catalysts are used primarily in gas power plants, whereas electrostatic filters and flue gas desulphurization systems are normally used in HFO-fired diesel plants.

EMISSIONS REDUCTION TECHNOLOGIES

SCR

Almost the only method able to reduce nitrogen oxides in the exhaust gas is Selective Catalytic Reduction. The other few methods available today are not cost-competitive with SCR.

SCR is an effective method. Wärtsilä's power plant portfolio includes SCR products for both diesel and gas power plants. A filter element with a honeycomb structure can be used when running on light or heavy fuel oil with a sulphur content below 2%, which ensures a highly compact structure. With poorer-quality fuel oils, a less dense filter element structure and efficient dust blowing are required to minimize the impact of clogging.

In gas engine applications the density of the SCR element can be larger than for diesel engine applications and no dust blowing is required. An oxidation catalyst is often fitted to the SCR system in Wärtsilä gas engine applications, in which case the overall system is called a ULE (Ultra-Low-Emissions) concept. This system was introduced several years ago with the aim of reducing NO_x emissions to < 10 ppm (15% O_2) along with significant reductions of CO and VOC emissions. Development and monitoring of a next-generation ULE concept is now under way. An example of such an installation is the Western 102 project in Nevada, USA, where each of fourteen Wärtsilä 20V34SG engines is fitted with an efficient ULE system. The power plant has been given a guaranteed NO_x value of approx. 5 ppm (15% O_2). Preliminary control and performance measurements carried out in September 2005 showed that the NO_x emissions using the new system were well below the guarantee levels. The effects of ageing of the filter on emissions levels will be monitored.

SCR reactors at Barrick Western power plant.

FGD

The Flue Gas Desulphurization (FGD) method is used when the sulphur contents of the applicable fuels are not sufficient to meet sulphur dioxide limits. Typically two types of FGD systems are used in Wärtsilä power plants: sodium hydroxide (NaOH) and limestone ($CaCO_3$) FGD, both of which are wet systems. Where flue gas desulphurization is concerned, either the investment or operating costs generally have a significant effect on the plant's economy and for this reason it is always important to first compare fuel qualities and costs. Plants with FGD systems are also challenging with respect to the handling and disposal of the end product, and the spread and visibility of the flue smoke.

ESP

No competitive alternative to the electrostatic filter has yet been found for reducing particulate emissions from an HFO-fuelled diesel engine. Burning HFO produces sulphur oxides, particles and, contained within these, certain hazardous components. Owing to these substances the methods typically used in small diesel engines – particle traps, reactors based on particle oxidation, or a combination of the two – are not effective, or else they require extremely high-quality fuel to be effective. The disadvantages of alternative methods of reducing particle emissions, such as bag filters, are their intolerance to high temperatures, large pressure losses or extremely high investment costs.

Although using good-quality fuels (low-sulphur light fuel oil and bio-oil) can in itself achieve substantially lower particle emission levels compared with the use of heavy fuel oils, there is still perceived to be a need for secondary particle reduction in certain applications in the future. In 2004 Wärtsilä performed a study with a research institute to identify alternative techniques and their applicability. The next stage will be to test the most potential of these.

Oxidation catalysts

Wärtsilä has devoted itself to making smaller oxidation catalysts more competitive by integrating them into the exhaust gas system, thus eliminating the need for a separate reactor and its support structure.

Methane is not normally classified as a VOC (volatile organic compound) and no air quality limits have been defined for it. Nor, with few exceptions, have legal

limits been set for methane levels in power plant flue gases. Methane, however, is considered to be a factor in global warming and therefore the need for methane reduction could increase in the near future.

Removing methane from flue gases is a challenging task. Modern catalyst materials and flue gas temperatures are not up to the task and help is needed, for example, from an expensive heat exchange solution or an extra combustion process to raise the flue gas temperature sufficiently. Moreover, maintaining the oxidation process of the catalyst often also requires a regeneration process or even continuous additional feeding of a support fuel into the catalyst. Wärtsilä is currently assessing the potential methane reduction techniques available and will decide on further development when its assessment is complete.

Monitoring emissions

The legislation of some countries requires the use of automatic emission monitoring equipment for plants of a certain type or size. In India, for example, it is mandatory for large (> 50 MW) diesel power plants to use this type of equipment for monitoring NO_x emissions.

Wärtsilä has developed an innovative emissions monitoring system that is aimed at improving the reliability of emissions monitoring especially at HFO-fuelled diesel plants. Testing of the system started in the autumn of 2005 and first experience has been positive. A condition inspection will be performed on the components used in the first test period (> 500 hours). The approval tests for the equipment will be continued during 2006.

New time-shared emission measuring equipment during testing.

Noise control

A central aspect in the design of Wärtsilä power plants is noise control. Noise level criteria will depend on the plant's location; the noise limits set for a plant located close to a residential area, for example, will naturally be far stricter than for a plant in an industrial area. Efficient noise suppression requires a combination of different noise reduction methods. In 2005 Wärtsilä made a special study of the noise produced by radiators and the potential for reducing this form of noise as a means of reducing overall noise levels.

Minimizing water consumption and treating waste water

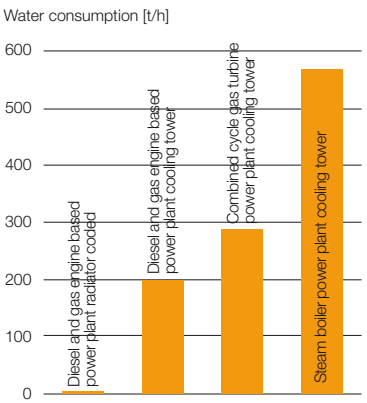
Water consumption is also an important environmental consideration in energy production owing to the world's limited reserves of freshwater. Different energy generation methods can display extremely large differences in water consumption. Minimizing water consumption and the production of wastewater is an important aspect in the design of Wärtsilä power plants. Compared to many other types of power plant, a closed circuit radiator-cooled engine-driven power plant is unrivalled in terms of low water consumption.

Water consumption is an important factor that should be considered when evaluating and choosing emissions reduction techniques. An example is the use of dry and wet methods of reducing nitrogen oxide emissions. Dry methods, i.e. those applying solely to the engine itself, can prevent an increase in water consumption, but the power plant's efficiency generally deteriorates as a result, and therefore carbon dioxide emissions increase compared to the wet method. Another example is the removal of sulphur dioxide from the flue gas, which usually results in a significant increase in water consumption. The typical water consumption of a flue gas desulphurization plant is 0.6 – 1.0 m^3/kWh, whereas the entire water volume needed in an air-cooled engine-driven power plant is in the order of 0.02 m^3/kWh.

Minimizing the impact of wastewater requires a combination of two factors: minimizing the use of water, and treatment of the wastewater produced. Wastewater treatment is an essential aspect of diesel power plants whereas the wastewater produced by gas power plants largely corresponds in quality to domestic wastewater and is easily treated using existing small-scale methods.

Treating the oily wastewater produced by a diesel power plant has long been a challenging task. No reliable method is yet available because the oil content of the wastewater varies considerably between different power plants and even within the same plant at different times. The traditional answer has been to use space-consuming multistage solutions that are often a burden to use. Wärtsilä has been

Water consumption of different types of power plants



New-generation portable automatic oily water treatment system.

collaborating in research and development with a couple of suppliers for a number of years to develop a modular, reliable and automatic oily water treatment system. A key aspect of this work has been the application of sensor technology. Since the form and content of the liquid needing treatment can vary over time from almost clean water to a highly viscous oil-water emulsion, it is important that the method can recognize the amount of oil in the water and ensure that process control takes this into account.

As a result of this work, Wärtsilä had now introduced a compact, reliable and automatic oily water treatment system that is mounted on a single skid-mounted baseframe and can be transported in a normal container. Alternatively, the system can be a fixed installation in the container, which is suitable for outdoor installation. Both options are fast and easy to install at a power plant.

Legislative requirements

A core principle applied by Wärtsilä for years in the development of its power plants and equipment is to meet the guidelines of the World Bank. In recent years compliance with these guidelines has become increasingly widespread in power plant projects around the world because more and more financing institutions and export credit organizations have committed themselves through their environmental policies and general agreements to complying with the World Bank Guidelines. An example of this trend is the Equator Principles document of leading financial institutions in which the signatory parties confirm their commitment to compliance with the World Bank Guidelines in their financing activities.

World Bank limits for NO_x, SO_2 and particle emissions from new power plants

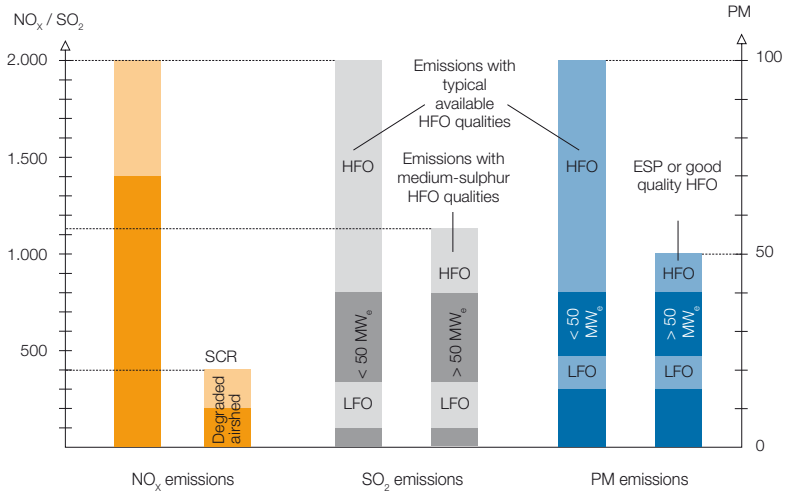
An important element in determining the air emission limits of the World Bank Guidelines is assessing the quality of the ambient air. If the air quality in the area is qualified by certain criteria as "moderate" or "poor", rather than "good", the Guidelines call for considerably stricter flue gas emission limits. It is the responsibility of the power plant owner to establish the quality of the ambient air, and to assess the spread of emissions from the plant and their impact. Air quality, and changes in it, should be established as exactly as possible using air quality studies and atmospheric dispersion modelling, both of which are central elements in the environmental impact assessment of the plant.

Wärtsilä power plants are designed to enable the plant's emission levels to be lower than the World Bank limits using a suitable choice of fuel, assuming that the local ambient air quality does not require stricter limits. Secondary and wet primary emissions reduction methods can be used either to permit the use of poorer-quality fuels, or to enable lower emission levels, or to reach better fuel economy.

European Union stipulations for engine-driven power plants

The general European guidelines governing the permitting of engine-driven power plants in the EU were introduced during 2005 in the BREF document (Reference Document on Best Available Techniques

World Bank Guidelines and typical emissions of Wärtsilä diesel power plants (shaded); good air quality, if not otherwise stated; emission unit mg/nm³ (dry, 15 % O_2)



for Large Combustion Plants). This document sets recommended emission limit values for various types of power plant based on BAT (Best Available Technique) thinking in emissions control. BAT is based on the idea of using the best technique available while bearing in mind cost feasibility. Wärtsilä considers the values to be sensible in principle but goes along with the general opinion in industrial circles on evaluating the need for using SCR, for example.

Country-specific requirements

German TA-Luft atmospheric emissions regulations have been widely applied to engine-driven plants in other European countries apart from Germany as a basis for regulating emission levels from engine-driven plants. Compliance with the TA-Luft requirements for nitrogen oxide reduction is a minimum requirement in the design of Wärtsilä's gas engines.

India has long been an important market for Wärtsilä. Changes in Indian legislation on emission limits applying to diesel engines call for a new generation of diesel engines that meet the 710 ppm (dry, 15% O_2) NO_x requirement with either no or a very minor increase in fuel consumption. Turbocharger technology in particular has set limits on this development work in the case of engines running on heavy fuel oil. Wärtsilä is supplying a large number of power plants to India incorporating Wärtsilä 20 and 32 engines that are well within the new NO_x limits.

In the USA, the Environmental Protection Agency (EPA) is currently drawing up country-wide emission norms for both diesel and gas engines. These are scheduled to come into effect in 2005 for diesel engines and in 2006 for gas engines. As yet, the country has no such guidelines and limits.

EU BREF – BAT levels for diesel and gas engines[1]; (mg/nm³ (dry, 15% O_2) as unit

	NO_x (as NO_2)	PM (dust) [2]	SO_2 [2]	CO	Hydro-carbons
Diesel engine	No emission level defined	< 30 (LFO/ diesel) < 50 (HFO)	No emission level defined	No emission level defined [5]	No emission level defined [5]
Gas engine	20–75 [3]	No emission level defined	No emission level defined	30–100 [4]	< 23 formaldehyde [6]

Comments:
[1] Degree of Consensus: Full consensus between Industry and Member States was not reached and hence split views in certain contexts are presented. In particular the deviations involved BAT associated efficiency, certain emission levels as well as the use of SCR for economical reasons.
[2] The use of low-sulphur/low-ash fuel when available is regarded as the first choice BAT.
[3] Industry claimed that these ranges are not according to the BAT approach but reflect a LAER level (USA) that does not take into account cost aspects. The industry opinion about the BAT emission levels is 90–190 mg/nm³ (dry, 15% O_2) and the local environment and air quality must also be considered when setting the limitations.
[4] Similarly there is a difference in the BAT level for CO emissions. Industry proposes a value of 100 and 110–380 mg/nm³ (dry, 15% O_2) as the BAT level due to fuel related issues. (dry, 15% O_2).
[5] Good maintenance of the engine is regarded as BAT with fuels containing sulphur for liquid-fired engines.
[6] NMVOC emission depends on the composition of the natural gas and hence the possible need for its reduction is case-dependent. The BAT emission level is defined only for formaldehyde.

India's emission limits for diesel power plants

	1 July 2003 - 30 June 2005	1 July 2005 -
NO_x (ppm) Big cities ≤ 75 MW and other areas ≤ 150 MW	970	710
NO_x (ppm) Big cities > 75 MW and other areas > 150 MW	710	360
NMHC (as C, mg/nm³)	100	100
PM (mg/nm³), light fuel oil	75	75
PM (mg/nm³), heavy fuel oil	100	100
CO (mg/nm³)	150	150
S content of fuel oil (%) big cities	2	2
S content of fuel oil (%) other areas	4	4

Reference oxygen concentration 15% O_2, nm³ 25 °C / 101.3 kPa

POWER PLANT LIFECYCLE MAINTENANCE AND SUPPORT

Correctly operated and maintained, any power generation unit will perform best in terms of reliability, long service, energy efficiency and low emissions. Wärtsilä's professional service personnel examine and test the power plant before commissioning and provide the customer with all the manuals, documents and instructions necessary for its basic operation and maintenance. Training specific to products and plant types is also provided for the customer's power plant staff as required.

Although responsibility for the plant's operation and maintenance is handed over to the owner after commissioning, Wärtsilä nevertheless guarantees basic service for its products throughout their lifecycle. In providing lifetime support to its customers, Wärtsilä's Service organization not only provides various service products; more particularly, it aims to optimize the power plant's performance parameters, operation and maintenance.

Maintenance

Wärtsilä has developed a broad range of diagnostic and control software products to support the plant's operation and maintenance. When Wärtsilä takes responsibility for the plant's maintenance and operation from the owner, it brings the requisite professional competence to the task with a comprehensive range of service agreement models:

- Operations & Service Agreement: Wärtsilä is responsible for ensuring the plant meets its performance, profitability and lifetime criteria, freeing the operator to concentrate on his core business
- Maintenance Agreement: Wärtsilä services the equipment at regular intervals and provides technical support including parts inspection and service recommendations.
- Technical Support Agreement: Wärtsilä provides a technical expert at the plant responsible for design, training, reporting and management in addition to expert services.
- Supply Agreement: guaranteed supply of parts and materials, parts guarantees and information on available upgrades. An optional extra to the agreement is monitoring of the plant's parts stock with replenishment recommendations.

Pakistani paper mill benefits from power plant conversion:

A power plant owned by Century Power Generation Ltd. (CPGL), which supplies power and heat to one of Pakistan's largest paper and board mills, was converted from a heavy fuel oil (HFO) burning plant into a plant burning light fuel oil (LFO) and gas in a dual-fuel (DF) specification. The HFO plant, built in 1996, now runs on natural gas with LFO as the pilot and back-up fuel. CPGL benefits in both business and operation terms through lower fuel costs and lower emission levels.

The project scope included the DF conversion of three Wärtsilä 12V32 HFO engines with an output of 4050 kWe each, plus a maintenance contract for three years. In natural gas mode the engine runs according to the Lean Burn Otto principle, while in LFO mode the engine works according to the diesel process. The engines can be started either in gas mode or in diesel mode. In gas mode the engine is started only with LFO pilot fuel injection, and gas admission is activated only when combustion is stabilized in every cylinder. The engines are designed for continuous operation either on natural gas with LFO as pilot fuel or on LFO only.

Converting the diesel engines to dual-fuel engines required replacing many parts of the engine such as the pistons, cylinder liners and cylinder heads, injection valves and fuel pumps. Moreover, many new parts were added such as gas valves, gas pumps and gas feed pipes. DF engines are more technically advanced than the traditional diesel engines, particularly with respect to the control equipment. For this reason the existing basic control system was replaced with a PLC (Programmable Logical Controller) based control and automation system custom-made for the DF engines. The PLC automation system is designed for safe, reliable, efficient and easy operation of the generating units plus their associated auxiliaries and electrical systems. The power plant is now operated, managed and monitored largely from a central control panel using the Wärtsilä Operator Interface System (WOIS).

A WOIS workstation visualizes all the general plant control functions. A second important feature of this system relates to its fault diagnostic capability. The system handles alarm and event lists, the plant's historical trends, and printing of process data reports. The converted engines were also fitted with new monitoring equipment, which is used by the updated control and automation system for maintenance purposes.

In this DF conversion, both the customer and market benefited. Pakistan is a booming market for gas and dual-fuel engines as the availability of gas is growing and its price is low compared to HFO. Since gas is a cleaner fuel than fuel oil, the government of Pakistan is encouraging gas-based power generation. Power companies are either replacing HFO engines with gas or DF engines or will be doing so in the future.

Condition-Based Maintenance (CBM) is a system based on a unique combination of local inspections and remote control of the plant's mechanical condition and operating data. The system makes predictive maintenance possible with minimum interruptions to operation, added safety and optimized plant performance. More than 170 power plant engines have so far been connected to this expert reporting service.

Wärtsilä is continuously developing new support products. Recent examples include a system for monitoring lubrication oil levels in real time, and a wireless temperature monitoring and alert system for the big end bearing of the connecting rod. Both solutions increase the plant's operational reliability and safety. Also under development is a predictive maintenance system based on acoustic spectrum changes in the engine.

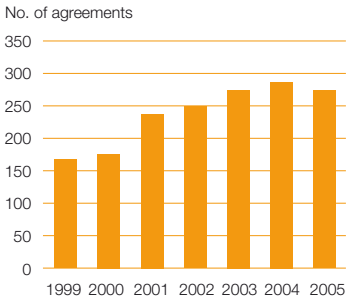
Modernizations and conversions

Exhaustive laboratory and field tests are carried out for new solutions resulting from Wärtsilä's own R&D or technical advances in general before these solutions are taken into operation. Feasibility studies are carried out to establish if new technology can be used in old products. Such "modification products" can help bring old power plants to almost the same level of performance as plants equipped with the latest technology. An example is conversion of a power plant's fuel system. Such changes are increasingly being made in response to changes in fuel availability and fuel prices, and to the introduction of ever stricter emission requirements. The reference on the opposite page is described in an article published in Asian Power Magazine in conjunction with an award (Best Power Plant Project of the Year) granted to the plant.

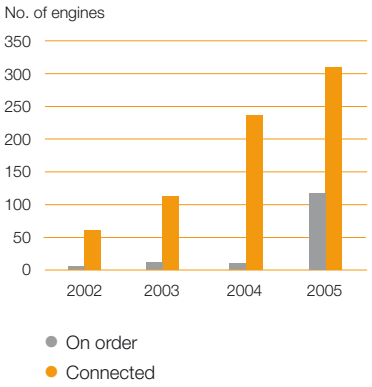
Technical support

Technical product support, in addition to providing diagnostic services, is responsible for establishing any problems and their causes associated with Wärtsilä products used in an installation, and for providing solutions to rectify them. Wärtsilä's technical support experts perform emission, noise and vibration measurements, as well as chemical and metallurgical analyses, to correct any problems. If such problems and their solutions are of benefit to other product users, technical support will inform these users appropriately. Technical support also informs customers of product enhancements resulting from research and development.

Service agreements in force



Engines connected to CBM



BOILER PLANTS

Wärtsilä BioPower manufactures and supplies heat and power plants that use biofuels, oil and gas for fuel. Boiler plants operating on biofuels have a capacity of 2–17 MW_{th}. Boiler plants that operate on oil and gas have a unit size of 1 MW_{th}–15 MW_{th}. With these fuels the plants can produce hot water, steam and electricity according to customer needs.

BioPower focuses on biomass-fired heat and power plants, which it supplies to selected market areas. Deliveries are currently in progress in Scandinavia – principally Sweden – as well as Central Europe and Russia. Wärtsilä's patented BioGrate technology enables the power plants to use various wood-based biofuels such as bark, sawdust, wood chips and also peat as their source of energy. The company's BioEnergy (BE) plants produce hot water and steam, whereas BioPower (BP) plants produce heat and electricity. At present 81 BioEnergy and BioPower plants are in operation around the world.

BioPower, BioEnergy and oil/gas boilers: deliveries completed or in progress 2005

Products	MW_{th}	MW_e
BioEnergy	20	
BioPower	54.8	16
Oil/gas	93.7	

Energy production

Wärtsilä's bioboilers are designed for wood-based fuels that are typically generated as by-products from forest industry processes.

Biofuels have the following distinctive characteristics:

- High and variable moisture content, up to 65% m/m
- Variable heat value on arrival at the plant, at its lowest only 5 MJ/kg
- Fairly low, variable energy density: 0.5 $MWh/m^3 < q < 1.2$ MWh/m^3
- Low sulphur content < 0.05% m/m dry
- Low ash content 0.5–3% m/m dry
- Low chlorine content < 0.05% m/m dry.

BioPower 5 (BP5) products

In BP plants, electricity is generated with a steam turbine generator. The low-pressure exhaust steam from the turbine is used to produce hot water in a steam condenser. This combined heat and power (CHP) generation process optimizes production to the heat requirements with electricity generated as a by-product. Given what is financially and technically feasible in each case, BP products are dimensioned for relatively low steam pressure and temperatures (23–52 bar and 450–480 °C), giving a total energy efficiency of 85–86%. If required, a BP plant can produce just electricity, in which case the energy efficiency in electricity generation is 25%. The low-pressure exhaust steam from the turbine is then condensed using either air or water. The main operational values of the BP5 plants either already delivered, or under delivery, are given in the table at the top of the next page.

BIOPOWER 5 50 BAR(A), 480 °C (450)			Boiler output 17 MW
Power plant type	**MW_e**	**Thermal power**	**Other data**
BioPower 5 DH	3.7	13.0 MW	90/50 °C DH water
BioPower 5 HW	3.1	13.5 MW	115/90 °C hot water
BioPower 5 CEX	4.4	17 t/h steam	up to 2 bar(a)
BioPower 5 CEX	3.6-5.2	as required	460 °C steam temp.

Flue gas emissions of bio-boilers

The flue gas emissions from bio-boilers consist mainly of NO_x, SO_2, CO, CO_2 and particle emissions. Since the sulphur content of a clean biofuel is low, and the plant's CO_2 emissions are assumed to derive from the renewable carbon cycle, boiler plant decisions concentrate on emissions of dust, NO_X, and CO. The most typical values of these emissions in the BE and BP plants delivered are as follows:

NO_2	70...90 ...120[1]	mg/MJ_{fuel}
CO	100 ... 150	mg/MJ_{fuel}
[1]Particles	15 , 50, 500[2]	mg/m^3_n
		O_2 =6%

[1] Value depends on nitrogen content of the fuel.
[2] Value depends on local emissions regulations.

Air emissions from oil- and gas-fired boilers

Air emissions from oil and gas boilers are reduced using efficient combustion technology (a modern burner with an appropriate boiler structure) and with precise, advanced regulation of the combustion air. The following are typical emission levels from boilers fired using light fuel oil and gas:

- CO < 20 mg/MJ
- NO_x emissions < 60 mg/MJ
- SO_x < 10 mg/MJ
- C_xH_x < 7 mg/MJ
- Particle emissions < 10 mg/MJ.

Noise emissions

Noise disturbs those in the neighbourhood, and increasing attention is being paid to the problem of noise when designing structures. Noise emissions within the plant are for the most part below 85 dB(A) at a distance of one metre from machinery, and outside below 50 dB(A) at a distance of 50–100 metres from the wall of the plant. To meet the strictest noise emission requirements, tailored solutions can be implemented that meet lower noise level limits.

Ash, water and lubricating oil

Ash is a typical by-product of BE and BP plants. The solid matter in biofuel includes 1–3% of inorganic substances. The fuel also often contains sand and soil and consequently the amount of solid matter, ash, remaining after combustion can actually total more than 5% of the dry solid matter in the fuel fed into the boiler.

Ash is mainly recovered in two separate systems. Bottom ash is recovered after it has been extinguished (wet) under the grate. Fly ash is recovered dry either from the multicyclone or the electrostatic precipitator, depending on the cleaning method, and it can be kept separate from the grate ash.

The calculated water consumption varies in BP (CHP) applications running on typical fuels between 15 g/MJ_{fuel} and 25 g/MJ_{fuel} provided there is no steam consumption in the process. Correspondingly the calculated water consumption in BE plants relates principally to ash treatment unless water is consumed elsewhere in the process. Consumption varies typically in the range 3–7 g/MJ_{fuel} depending on the ash content of the fuel.

In BP and BE plants lubrication oil is used in the fuel handling systems and in the grate's hydraulic system. Roughly 500 l/a of oil is needed. BP plants also consume roughly 500 l/a of lubrication oil in the turbine.

Compliance with legislation

Wärtsilä's BioEnergy and BioPower plants are designed to meet all local emission requirements. These are usually set for:

- Non-combusted gases such as CO
- Nitrogen oxides
- Sulphur oxides
- Particle emissions
- Noise emissions
- Water separated by flue gas condenser
- Condensate from the steam boiler.

OPERATIONAL PERFORMANCE

Wärtsilä's mission, vision and sustainable development strategy create the framework for developing the company's activities and products. They are supplemented by Wärtsilä's Operative Excellence System (OpExS), a tool for continuous improvement of the company's operations and products. Wärtsilä harmonizes its operations worldwide through its global environment, quality and occupational health and safety policies and the company's operating principles (Corporate Manual, Code of Conduct).

Wärtsilä's sustainable development is based on three closely interrelated pillars: economic, environmental and social performance. Wärtsilä has endeavoured to integrate responsible conduct into its business processes.

Economic performance

Economic performance involves meeting the expectations of shareholders and contributing towards the well-being of society. This requires the company's operations to be efficient, profitable and competitive. Besides creating economic value-added direct to the company's stakeholders, economic performance also calls for promoting well-being in the local communities where the company operates. Good economic performance establishes a foundation for the other aspects of sustainability as well as safeguarding the company's future operating capabilities.

Environmental performance

Good environmental performance means sound management of natural resources and operating on the environment's own terms. Protecting the air, soil and water as well as combating climate change and us-

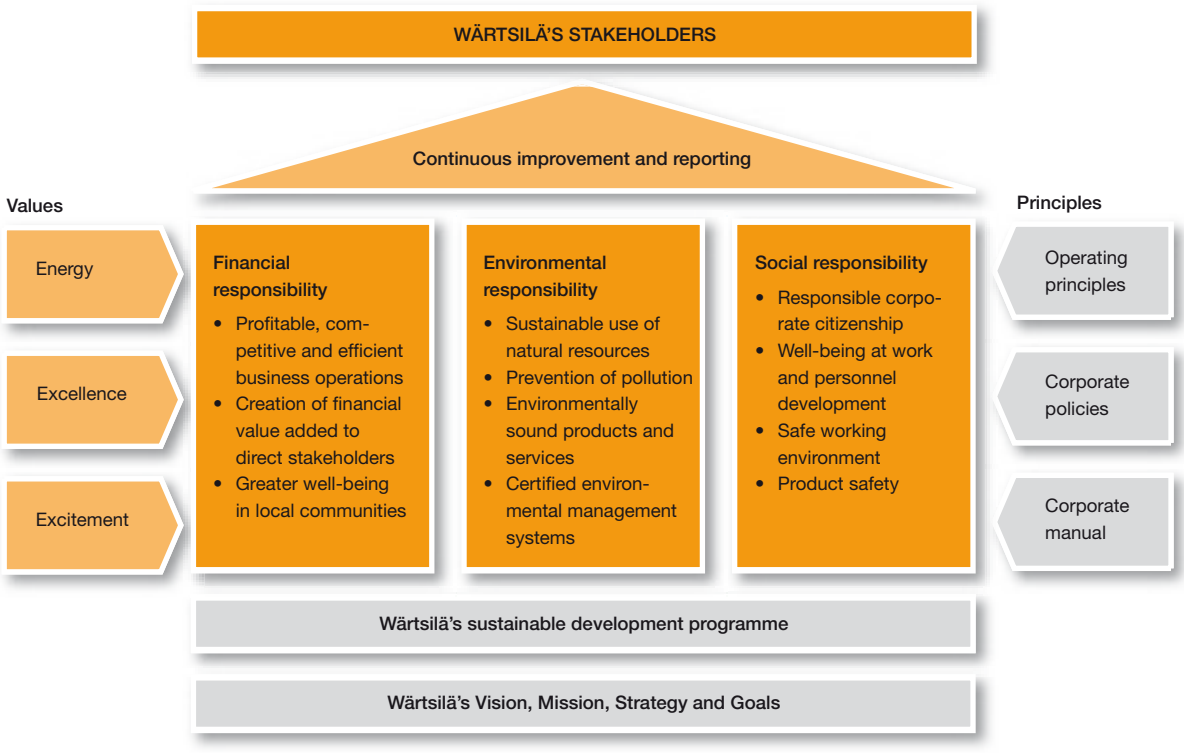
ing natural resources in a sustainable way are all important objectives, whether these apply to Wärtsilä's own operations or the use of its products. Environmental performance also requires the company to identify the lifecycle environmental impacts of its products and to reduce these impacts through proactive research and development.

Most of the environmental impacts from Wärtsilä's operations relate to manufacturing. The main environmental aspects of manufacturing concern the use of energy and natural resources, and thus also the emissions that manufacturing produces. Product development also requires the testing of products and individual components which, alongside manufacturing, also loads the environment. However, the positive impacts of product improvements on the environment far outweigh the negative impacts of testing when taking the product's entire lifecycle into account.

Wärtsilä continuously develops and improves its operations with the help of certified environmental systems. Wärtsilä's environmental systems cover all the operations of its subsidiaries, which means that the Group is able to promote environmental protection and reduce negative impacts on a wide front. Wärtsilä has not set targets for operational environmental aspects at the corporate level because the activities of its subsidiaries vary widely. For this reason the company does not consider it appropriate to set common objectives. Nonetheless, achieving energy efficiency and reducing emissions are central goals for all Wärtsilä companies and factories.

Social performance

Social performance involves following good practices and procedures in stakeholder relations. This requires continuous co-operation with suppliers, partners and local organizations. Wärtsilä has defined its operating principles (Code of Conduct) specifically to improve its social performance. The Code of Conduct sets the boundaries for Wärstilä's business operations and their development in line with the Group's strategy. Other important aspects of good social performance are creating a safe working environment and operating procedures, ensuring the well-being of the company's employees and the development of personal skills and competencies. These aspects maintain the ability of the employees to do their work, as well as raise efficiency and improve Wärtsilä's position as a desirable employer. Product safety means responsibility towards the company's customers and its own personnel. Alongside compliance with safety requirements, essential aspects of product safety are product support and training. Promoting good social performance requires seamless collaboration throughout the Group network.



ECONOMIC PERFORMANCE

Economic performance involves meeting the expectations of shareholders and contributing towards the well-being of society. This requires that the company's operations are efficient, profitable and competitive. Good economic performance establishes a platform for the other aspects of sustainability – environmental and social responsibility.

Creating economic value-added

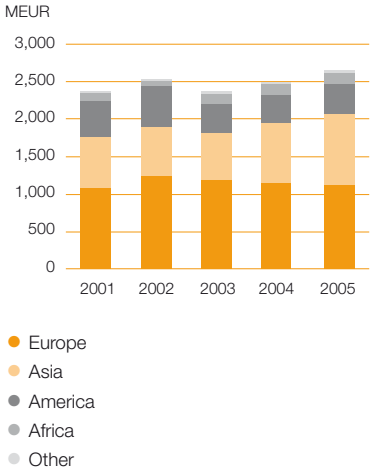
Wärtsilä's purpose is to create value for its various stakeholders. The focus is on profitability and generating a good long-term return on investment for shareholders. Achieving this depends on Wärtsilä's ability to satisfy the expectations of its other stakeholders as well. This includes providing customers with high-quality products, solutions and services, building long-term partnerships with suppliers, offering employees competitive compensation and working conditions, and contributing to the well-being of the local communities in which Wärtsilä operates.

Customers

Wärtsilä creates value for its customers by providing products, solutions and services that fulfil their needs and expectations. The development of high-quality, reliable and environmentally sound solutions depends on long-term collaboration and continuous interaction with customers. Wärtsilä provides its customers with service throughout the product lifecycle, thus ensuring optimal performance during the product's lifetime. The modernization of installed products can also extend their service life.

Wärtsilä's net sales totalled EUR 2,638.8 million in 2005. Europe contributed 42%, Asia 36%, the Americas 15% and Africa 6% to Wärtsilä's overall net sales.

Geographical breakdown of markets



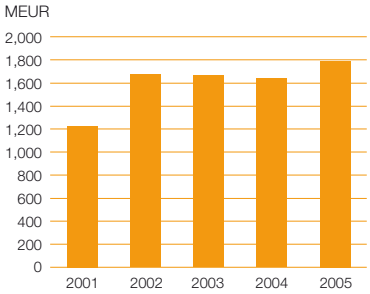
Suppliers

Suppliers play a significant role in Wärtsilä's delivery process. Wärtsilä aims to deepen the partnerships with its suppliers in order to ensure that both parties have a mutual understanding of Wärtsilä's strict process and product requirements. Apart from financial benefits, partnerships create added value for suppliers through the knowledge and development support Wärtsilä offers them. Successful partnership can also assist a local supplier in expanding internationally by becoming a part of Wärtsilä's global supply chain.

In 2005 the value of goods, materials and services purchased by Wärtsilä was EUR 1,791 million.

Wärtsilä has more than 3700 active suppliers, most of whom are located in Europe where Wärtsilä has its main production units. Wärtsilä also has a significant number of suppliers in Asia.

Cost of all goods, materials and services purchased



Value-added distributed to Wärtsilä's shareholders

MEUR		2001	2002	2003	IFRS 2004	2005
Customers	Net sales	2,358.7	2,519.0	2,357.5	2,478.2	2,638.8
Suppliers	Cost of goods, materials and services purchased	-1,227.1	-1,676.7	-1,666.4	-1,639.6	-1,791.4
	Value-added	1,131.6	842.3	691.1	838.5	847.4
	Distributed to stakeholders					
Distribution of value-added						
Employees	Wages and salaries	382.5	434.2	447.7	456.6	434.3
Public sector	Taxes and social dues	302.2	162.2	110.8	183.9	149.7
Creditors	Interest on debt and borrowings	15.2	18.5	15.9	3.7	23.4
Shareholders	Dividends	237.8	104.1	106.4	83.3	141.2
For business development		193.9	123.2	10.3	111.0	98.8

Employees

At the end of 2005 Wärtsilä had 12,008 employees worldwide. Wärtsilä also employed thousands of people indirectly through its supply chain. In order to be able to recruit competent and motivated people, Wärtsilä endeavours to offer employees competitive salaries, opportunities for continuous personal development and a good working environment. Developing employee skills and competences is of critical importance both for Wärtsilä's business performance and for the development of the company's employees.

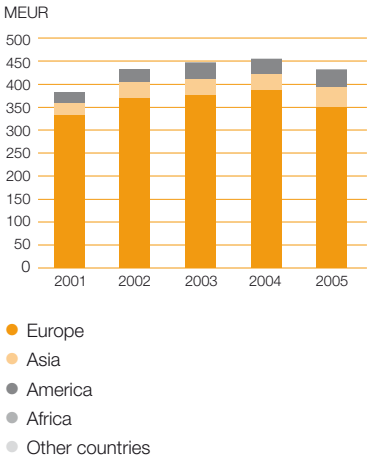
Salaries totalled EUR 434.3 million in 2005. This sum includes basic salaries as well as payments based on various incentive schemes, which cover some 54% of the total personnel.

Public sector

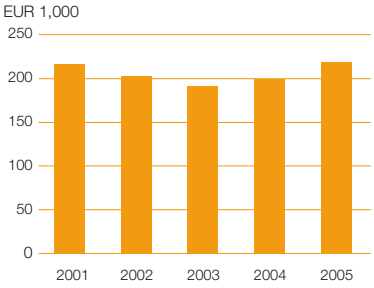
Wärtsilä pays various social dues and taxes to the governments of various countries. Income taxes and social dues in the financial period 2005 were EUR 149.6 million. The social costs for employees that Wärtsilä pays in most countries contribute to the funding of pensions, unemployment and other social benefits that provide security and improve the quality of life for the company's employees and their families.

Wärtsilä companies also receive subsidies from the public sector. The value of the subsidies received in 2005 was EUR 3.7 million and they were mainly related to R&D projects.

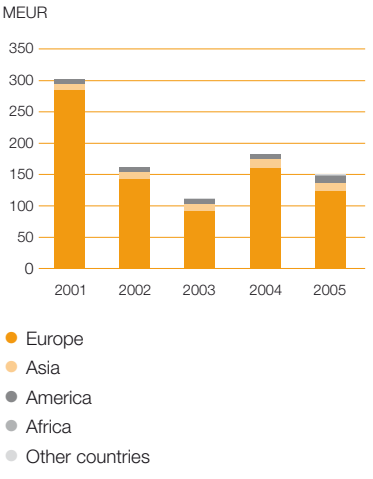
Geographical breakdown of wages and salaries



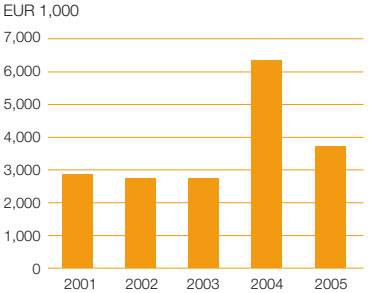
Net sales/person



Geographical breakdown of taxes and social dues



Subsidies received from public sector[1]



[1]The 2002-2003 figures include the data from 10 major Wärtsilä companies and the 2003-2005 figures from 12 major Wärtsilä companies.

Creditors and shareholders

In 2005 Wärtsilä's net financial items totalled EUR 23.4 million. Dividends totalling EUR 141.2 million were paid to the company's shareholders. Wärtsilä's dividend policy is to pay a dividend equivalent to 50% of its operational earnings per share. In recent years the company has distributed an extra dividend based on the sales of certain non-core business interests. The dividends paid per share are presented in notes to the financial statements.

Community support

At the national level, Wärtsilä provides financial support for a number of national, cultural and social activities. The Board of Directors has supported activities focused on children and young people, national defence, disabled war veterans, and medical and technical research. Wärtsilä's Board of Directors contributed altogether EUR 70,000 to these activities in 2005.

Donations to good causes by the Board of Directors

EUR 1,000	2003	2004	2005
Total	55	77	70

At the local level, Wärtsilä has provided financial support to cultural, educational, sports and other activities as shown in the table below.

Donations to local organizations[1]

EUR 1,000	2003	2004	2005
Total	306.8	385.0	343.5

Wärtsilä in sustainable development indexes

Wärtsilä has been admitted to the Kempen/SNS Smaller Europe SRI index and the Ethibel Investment Register and the Ethibel Pioneer Sustainability Index.

Continuous improvement of environmental performance in the company's operations require the organization to work systematically year on year. In developing its operations, processes and products, Wärtsilä endeavours to use the latest technology available for improving efficiency in materials and energy consumption, and for reducing and managing emissions and wastes.

Wärtsilä's principle is to apply certified Environmental Management Systems based on ISO 14001 in all Group companies. The company's environmental system focuses especially on compliance with legal requirements, identifying and reducing environmental aspects, impacts and risks, training personnel and clearly defining their responsibilities, full documentation of activities and procedures, action in emergencies, and continuous improvement of environmental performance. At the end of 2005 32 Wärtsilä companies had operated with a certified environment system. These certified environmental systems cover roughly 75% of Wärtsilä's total workforce.

Wärtsilä's main environmental aspects relate to the use of materials and natural resources, energy consumption, and emissions and wastes generated by the company's operations. The company's subsidiaries set their own goals and targets covering significant environmental aspects of their operations.

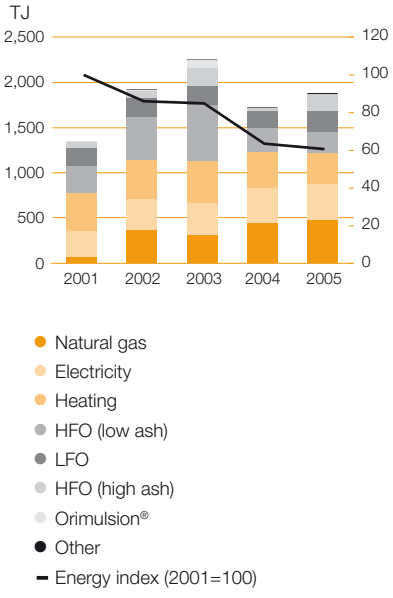
The company's environmental records cover production, maintenance and sales units. The coverage of environmental reporting has changed since the 2002 Environmental Report and 2004 Sustainability Report. The figures for 2003, 2004 and 2005 include a higher proportion of Wärtsilä companies than in earlier years. For this reason certain indicators in this report show an absolute increase in the figures for those years.

ENERGY

Total energy consumption

The total energy consumption (in terajoules, TJ) presented below includes the electricity, heat and fuels used in Wärtsilä companies in recent years.

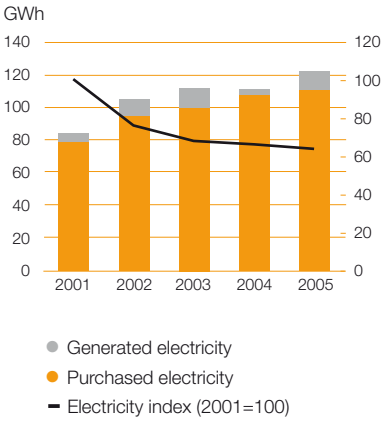
Annual energy consumption



Electricity

Wärtsilä uses electricity in its manufacturing operations – for example, in machining components – and in service workshops and offices. Both the electrical and the heat energy generated during engine test runs can be utilized. Wärtsilä's aim is to use the electrical energy for its own purposes while also selling part of this electrical energy to a local power company. Due to the nature of engine test runs, the pro-

Annual electricity consumption



Electricity balance 2005, GWh

Wärtsilä's targets to the end of 2005

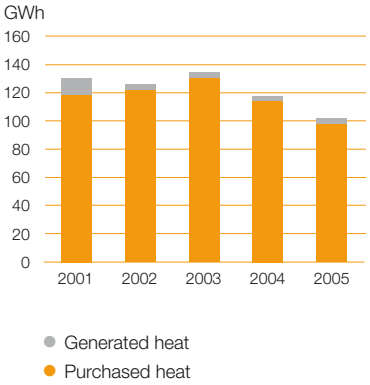
Target	Environmental benefit	Status at end of 2005
To perform energy analyses and energy efficiency programmes in all factories.	Reduced consumption of primary energy, more efficient use of natural resources, and reduced emissions.	Energy analyses and efficiency programmes performed at all factories except Trieste, where the target was not reached for production reasons.
To perform a lifecycle assessment for one Ship Power application and one Power Plant application.	A deeper understanding of lifecycle environmental impacts.	The lifecycle assessments are completed.

duction of electricity and the company's electricity demand are not equivalent; this allows the surplus energy to be sold to a local power company.

Heat

Heating for factories and offices accounts for most of Wärtsilä's consumption of heat energy. In several factories the heat generated in engine test runs is used for heating. Some factories and offices are connected to a local district heating network, some have their own heating plant, and some use electricity for heating.

Annual heat consumption



Water

The water consumed by Wärtsilä can be divided into two categories: domestic use and cooling use. Domestic water is used mainly for sanitary purposes and by industrial equipment such as machine tools and washing machines. Some factories also use domestic water to produce moulds.

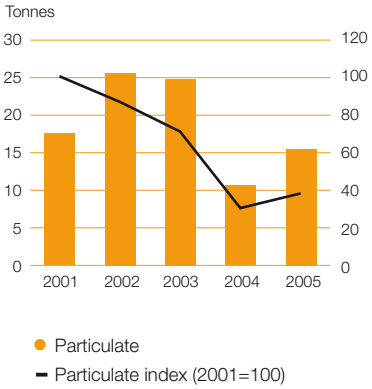
Heat emissions into water systems arise from engine cooling and process cooling water. Wärtsilä companies use water from the local watercourse for their engine and process cooling needs. In such cases, the cooling water system is kept separate so that only heat is released into the natural water system. Wastewater is sewered and piped to the local wastewater treatment plant. If effluent is not suitable for sewage treatment, it is taken away for appropriate treatment, for example to a special treatment plant for hazardous wastes.

Emissions to the air

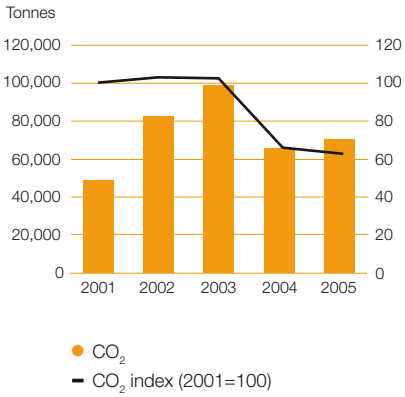
The primary source of manufacturing noise is engine test runs and ventilation machinery on factory roofs. This noise is mostly low frequency and is therefore not easily detected by the human ear. Wärtsilä has specifically addressed the issue of noise protection using technical means and we have succeeded in lowering noise levels considerably. However, noise abatement is a continuous need and requires regular monitoring.

Air emissions are mainly caused by test runs and the painting of completed engines or other Wärtsilä products. Test run emissions consist of nitrogen oxides, sulphur dioxide, carbon dioxides and particles, as well as small amounts

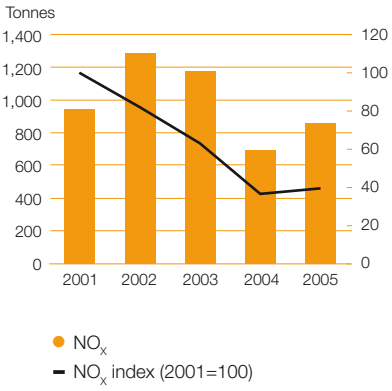
Annual particulate emissions



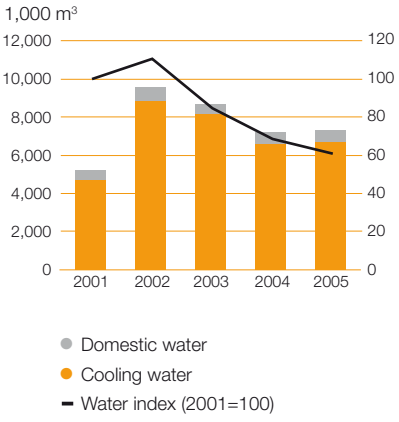
Annual CO_2 emissions



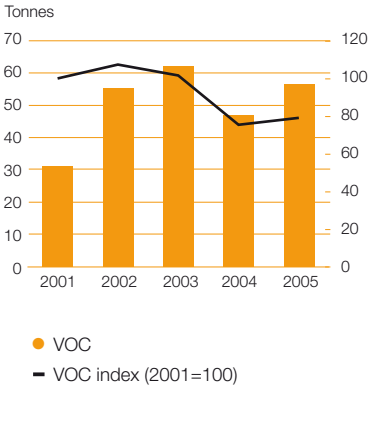
Annual NO_x emissions



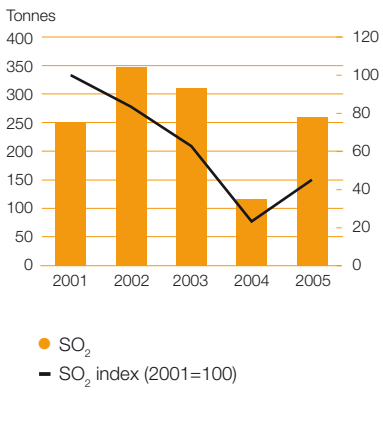
Annual water consumption



Annual VOC emissions



Annual SO_2 emissions



of other emission components. The painting of engines and other Wärtsilä products generates VOC (volatile organic compounds) emissions.

Monitoring environmental impacts

Within Wärtsilä, environmental impacts caused by operational activities are monitored as follows:

- Participation in the monitoring of air quality with other local stakeholders
- Measurement of air emissions
- Charting of noise levels
- Periodical effluent analysis
- Soil analysis
- Dispersion analyses and bio-indicator surveys.

Compliance

The operations of Wärtsilä's manufacturing companies require a valid environmental permit. Wärtsilä companies have the required environmental permits, the terms of which are generally met. Incidents of non-compliance are described below.

Environmental disturbances and complaints

The number of disturbances, complaints and incidents of non-compliance are presented in the figure. Reported disturbances cover incidents in which the Wärtsilä company concerned has usually been obliged to report the disturbance to the authorities.

The following main environmental disturbances occurred at Wärtsilä's business locations in 2005:

- 3 fires
- 5 fuel leaks
- 4 lubricant leaks
- 3 oil water leaks
- 1 chemical leak
- 2 ash emissions
- Smoke emission into a test run cell
- Dust emission
- Explosion in an exhaust duct
- Unnecessary triggering of sprinkler system.

All the above disturbances were investigated and appropriate corrective action was taken in each case.

The main reason for complaints made by occupants of neighbouring sites was noise. All complaints were investigated and appropriate corrective action was taken wherever necessary.

Cases of non-compliance

Wärtsilä Finland Oy's methane emissions exceeded the permit conditions in force. The authorities are current reviewing the new environmental permit.

The height of the flue stack at the Ciserv Europoort B.V. workshop did not comply with the permit conditions. The height was increased in conjunction with other modifications, following which the authorities approved the modifications and verified that the flue stack was in compliance with the permit conditions.

Non-compliance cases presented in previous reports

The previous cases of non-compliance in Wärtsilä France concerned its manufacturing activities. The company's environmental permit conditions were reviewed owing the termination of manufacturing at this site. The company will undertake corrective action during 2006 to meet the new permit conditions.

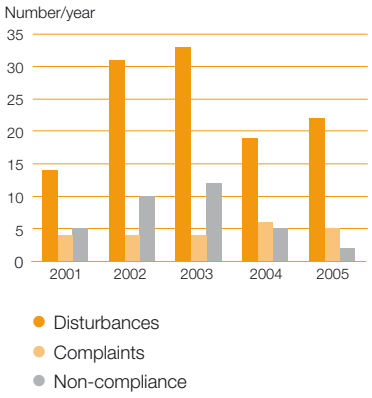
Procedures have been introduced at Wärtsilä Propulsion Norway AS for monitoring this company's permit conditions.

Waste management

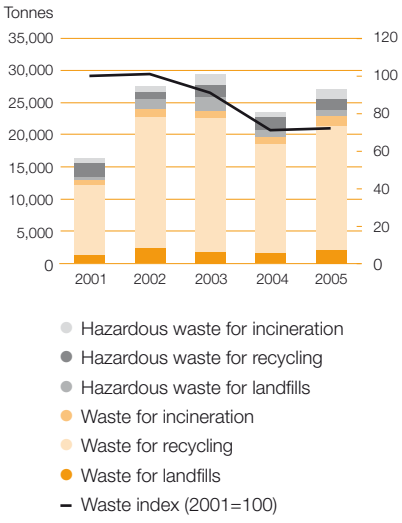
Manufacturing activities cause various wastes. These are divided into two main categories: hazardous and non-hazardous. Hazardous wastes include cutting fluids, various types of waste oil, paints and solvents, oily wastes and solid wastes, etc. Hazardous wastes are taken to a hazardous waste disposal facility for appropriate treatment.

All Wärtsilä companies sort their waste according to local municipal regulations. However, generally speaking the main sorting categories are: waste to be incinerated, crude waste for landfills, clean cardboard, and waste paper. Waste wood, scrap metal and metal swarf are collected separately. Only coarse waste and in some cases waste wood are removed for landfill disposal. Other wastes are used either as raw materials or for energy.

Disturbances, complaints and non-compliance



Annual waste



Environmental capital expenditures and operating expenses

MEUR	2001	2002	2003	2004	2005
Environmental capital expenditures	5.2	1.8	2.1	2.8	2.5
Environmental operating expenditures	2.3	4.0	4.9	2.8	3.0

Waste management in Wärtsilä has four aims:

- To reduce the amount of the waste generated in Wärtsilä processes
- To use the waste as a material
- To use the waste as energy
- To dispose of the waste in an environmentally sound way.

ENVIRONMENTAL COSTS

Environmental capital expenditure and the operating costs related to environmental protection are difficult to separate from normal operating costs in our operating environment. It is equally difficult to define capital expenditure as an exclusively environmental investment or as a machine or equipment investment in the production process.

Concerning Wärtsilä's operations, we have defined expenditures as environmental expenditures if they are related to soil, water and air pollution control, waste management, environmental management or noise control.

Wärtsilä real estate and environmental responsibilities

The real estate that Wärtsilä owns or leases is mainly located in urban areas. The company is not aware of any properties that are situated in areas where biodiversity could be endangered.

Environmental risks and liabilities are identified and reviewed as a part of overall risk management. In Wärtsilä's operations, potential liabilities are primarily related to the company's real estate. Environmental liabilities are systematically scrutinized in conjunction with every acquisition or sale of real estate. Wärtsilä has recognized certain cases where potential environmental liabilities may exist but these are not expected to have a significant financial impact on Wärtsilä.

Wärtsilä's strategy defines the central objectives for social performance in Wärtsilä's operations. Wärtsilä's intention is to act as a good corporate citizen, to offer interesting, motivating and safe jobs to its employees, and to develop its employees' professional skills and to improve supply chain management. Wärtsilä approved its Code of Conduct in 2004 and the Code is presented in the Business Review. Each Wärtsilä employee is required to act in compliance with the Code of Conduct and each Wärtsilä subsidiary must verify compliance locally.

Structural changes in the company during 2005

Wärtsilä concentrated engine manufacturing at its factories in Vaasa, Finland, and Trieste, Italy. Wärtsilä's manufacturing unit in France was sold to Mitsubishi Heavy Industries Ltd (MHI), and MHI took over the production machinery and roughly 70 Wärtsilä France employees. Wärtsilä also sold the Wärtsilä propulsion Heerlen B.V. business in the Netherlands to Smelt Heerlen Beheer B.V. at the end of the year and the company's 49 employees were transferred to buyer at the same time.

In May Wärtsilä's subsidiary Imatra Steel was moved to a new steel company called Oy Ovako Ab, which became a Wärtsilä associated company.

The Ship Power business made further investments in the growing Asian market. Wärtsilä's thruster factory in China, Wärtsilä Propulsion (Wuxi) Co. Ltd, began operations. The factory, with more than 40 employees at the end of 2005, is Wärtsilä's first wholly owned production unit in China. Wärtsilä started manufacturing in China in 2004 with the establishment of a joint venture called Wärtsilä-CME Zhenjiang Propeller Co. Ltd. In 2005 construction work started on a new factory to produce auxiliary engines. Called Wärtsilä Qiyao Diesel Company Ltd, this joint venture will start manufacturing Wärtsilä Auxpac W20 diesel generating sets from early summer 2006. Wärtsilä started production on new-generation reduction gears at its Khopol production unit in India.

Wärtsilä's Service business has expanded strongly in recent years. In 2005 Wärtsilä acquired the marine engine service business of the Germany company DEUTZ AG, gaining in the process roughly 170 employees. Wärtsilä also acquired the operations of US service company Gerhardt Holding Co. Inc., gaining a further 128 employees in this transaction. Several new Ciserv units were established as well, for example in the Baltics and China.

Personnel

Wärtsilä's personnel mainly comprises full-time employees with permanent employment contracts. The number of temporary and part-

Geographical breakdown of personnel

- Europe 62% (68)
- Asia 26% (21)
- Americas 10% (8)
- Africa 2% (2)
- Others 1% (1)

Personnel by country

- Finland 21% (26)
- Italy 10% (9)
- Netherlands 9% (9)
- India 8% (7)
- USA 5% (3)
- China & Hong Kong 4% (3)
- France 4% (5)
- Norway 4% (4)
- Others 35% (34)

Implementation of social responsibility targets approved by Wärtsilä's Board of Management:

Target	Timetable	Status
Ensuring compliance with Code of Conduct, formulation of control procedures and reporting practice	2005-2007	Training plan and timetable prepared and training material produced in 2005.
Auditing and updating of supplier requirements in line with the Code of Conduct	2005	Supplier requirements were audited and updated in line with the Code of Conduct. In particular, social responsibility requirements were added to the supplier requirements.
Introduction of occupational health and safety systems in all subsidiaries	Continuous	At the end of 2005, 25 companies had an OHS system in operation, of which 17 were certified according to OHSAS 18001.

Change in number of employees per business

- Service . . . . . 7,199 +821
- Ship Power . . . . . 1,971 +161
- Power Plants . . . . . 761 +20
- Engine Division . . . . . 1,792 -303
- Others . . . . . 285 +93

Personnel in figures 2005

- Number of employees at 31 Dec. 2005: 12,008
- Number of nationalities: 85
- Change in number of employees (net employment creation): . . . . . + 197
- Average age of employees: . . . 39.4 years
- Total payroll costs: . . . . . MEUR 434.3
- Aggregate coverage of different bonus schemes: 54%
- Development discussions held annually: 66%

time employees is relatively low. The number of Wärtsilä's employees has remained fairly stable over the past few years, despite restructuring. In addition to direct employment, Wärtsilä also uses subcontractors in its factories and units, accounting for altogether 1400 man-years of work in 2005.

In many European countries almost all employees fall within the scope of collective bargaining agreements, with the exception of senior management. The proportion of employees belonging to trade unions ranges between roughly 70% and 100%. In other countries the proportions vary so much that a Group-wide average would not give a true picture. Matters affecting personnel are also reviewed in the Business Review section of the Annual Report.

Consulting and informing in Group companies

Wärtsilä's procedures for consulting and informing within the Group are arranged in each country according to local legislation. Wärtsilä's Code of Conduct calls for ongoing and open dialogue between the company's management and employee representatives through co-determination bodies, and employees are kept informed of both the Group's situation and that of their particular company. Company management and personnel engage in open discussion also in those countries where there are no formal co-determination bodies as such. Regular briefings for personnel are an integral part of the operating procedures of Wärtsilä companies. Employee participation in decision-making also extends to occupational health and safety (OHS). Most Wärtsilä units have an OHS committee with representatives from all personnel groups.

In addition to Wärtsilä's procedures for consulting and informing employees at the local level, the European Works Council (EWC) handles issues that affect the whole Group. The EWC and its working committee play an active role in considering and pursuing corporate level issues.

Dialogue at the individual level is conducted through development discussions, which are held annually. The subjects dealt with in these discussions range from the Group's and business unit's targets, to the individual's job description, competence development, career alternatives, personal targets and feedback. Development discussions are by definition held with all employees.

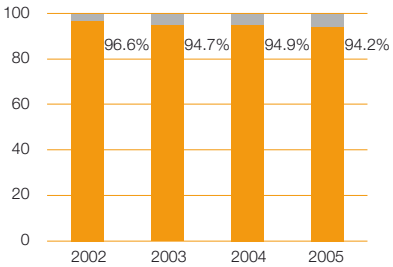
Employees are able to have a direct impact on the company's operations and their development by making suggestions. Each Wärtsilä employee can offer suggestions for improvement in operations through either the continuous improvement (CI) process or by submitting private initiatives. CI proposals are discussed jointly and need a common decision to be put into effect. Private initiatives are evaluated by experts within the company and, if found to be feasible, are put into effect.

Wärtsilä encourages its employees to be innovative by granting an annual Technology Award, either to an individual or to a team, for the best technical innovation of the year. The award criteria are that the invention must be innovative, en-

Personnel by business

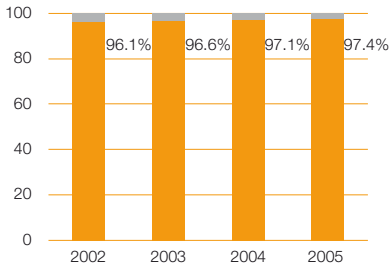
- Ship Power 16% (15)
- Service 60% (51)
- Power Plants..... 6% (6)
- Engine Division 15% (17)

Permanent/temporary employees



- Temporary contracts
- Permanent contracts

Full-time/part-time employees



- Part-time employees
- Full-time employees

vironmentally sound, representative of leading technology, improve a product or process, and offer potential for cost savings. In 2005 the award was given to an Swedish team who developed a new system for machining crankshafts.

Occupational health and safety

Wärtsilä's occupational health and safety principles are defined in the company's policy and directive on occupational health and safety (OHS). Wärtsilä's subsidiaries must have a management system in use that conforms to the OHS policy and directive. The main aspects in the management system relate to compliance with legislation, identifying and minimizing occupational health and safety risks, personnel training, providing written instructions, the use of protective equipment, and continuous improvement of OHS performance.

The objective of Wärtsilä's occupational health and safety policy is to prevent and manage health and safety risks to personnel and stakeholders. In addition to the management system, Wärtsilä companies apply OHS programmes required by local legislation, which are normally implemented in OHS committees consisting of representatives of the companies' management and personnel. Accidents are recorded and investigated in the manner required by local legislation. Altogether 60% of Wärtsilä companies have an occupational health and safety committee.

The indicators used to measure occupational health and safety performance include the number of accidents, the amount of absence due to sickness and the frequency of accidents. During the review period there was one fatal accident in one Wärtsilä unit, where a subcontractor's employee later died of injuries.

Training and personal development

The aim of Wärtsilä's training schemes and personal development is to develop, maintain and update the skills and competences needed to reach the company's strategic objectives. Critical success factors for Wärtsilä are having the correct competences at the right time and the ability to adjust to continuous change in the business environment. Employees are given training all the time at all organizational levels: from induction training for new employees, to training for the company's top executives. Wärtsilä employees attend on average 3 training days a year. The number of training days, altogether 32,532, indicates the broad scope of this function. Wärtsilä's training organization continuously holds internal courses for personnel. Most of these are tailored to the specific needs of departments.

Wärtsilä's management training path offers supervisors and senior managers training at all levels of the organization. The training programmes also emphasize the importance of Wärtsilä's values in everyday management. Wärtsilä additionally uses the training programmes and facilities offered by universities and various professional training institutions. Wärtsilä also supports studies by individuals aiming to gain a professional or academic qualification.

Trainin days

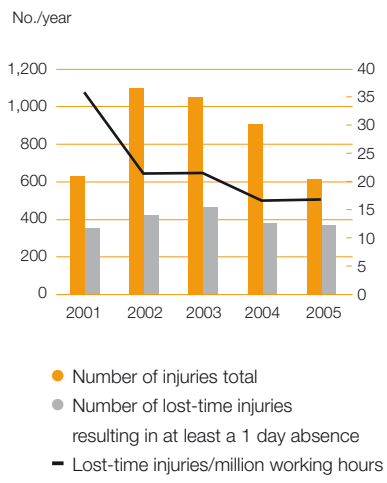
Days/employee	2003	2004	2005
Managers	3.2	2.5	3.0
Technical employees	3.5	3.4	3.5
Administrative employees	2.2	2.4	3.0
Blue-collar employees	2.6	3.3	2.3

Human rights

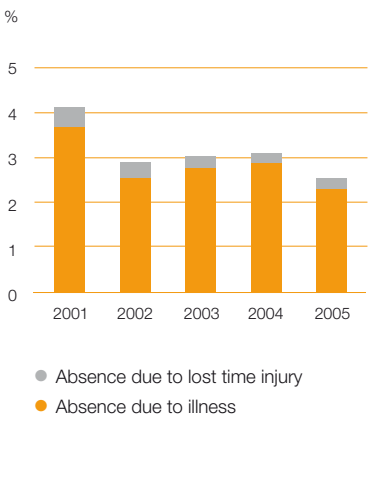
In line with the Code of Conduct approved at the end of 2004, Wärtsilä supports and respects basic human values as outlined in the UN's Universal Declaration of Human Rights.

Wärtsilä's employees represent 85 different nationalities, and the company supports equal treatment of all its employees irrespective of race, colour, nationality, gender, age or religion. The company's em-

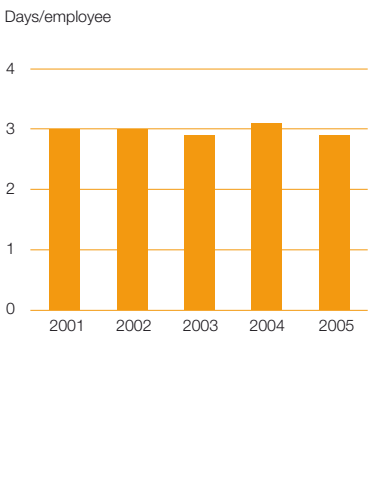
Injuries



Absence rate



Training days



Mapping of working conditions – an example

The Wärtsilä CME Zhenjiang propeller factory is a joint venture set up by Wärtsilä and the Chinese company CME:n (China Marine Equipment). It started operations in June 2004 on CME's own site where propellers had been manufactured for 30 years. The company's main products are fixed pitch propellers, and integrated propulsion packages comprising shaftlines, seals and bearings, stern tubes and fixed pitch propellers. The factory currently has a workforce of approximately 330 people.

An internal assessment of the factory was performed at its start-up. This assessment identified certain deficiencies in the working environment, occupational health and safety, and personnel facilities. The deficiencies related to the following matters:

- In general, little awareness of occupational health and safety risks among shop floor personnel
- Low-quality personal protective equipment and safety equipment
- Poor visibility and quality of air in production premises
- Poor-quality office facilities
- Insufficient personnel and sanitary facilities

After analysing the results of the assessment, the parties planned measures to rectify the shortcomings. Measures already undertaken are:

- Assigning training responsibilities to improve and monitor occupational health and safety
- Sufficient safety gear obtained and introduced
- Sufficient lighting organized in the production facilities
- Change of fuel to cleaner fuel (LPG) in foundries, which improved the quality of the air in the foundries substantially
- Office premises were renovated and office furniture replaced
- Personnel and sanitary premises extended, renovated and equipped with modern sanitary conveniences.

Development at the factory is still ongoing. The aim is to reduce noise levels and for this purpose new hand tools are being tested. The complete programme is expected to be completed during the first quarter of 2006.

ployees are selected on their qualification and competence for each specific job. Programmes and instructions related to promoting equal rights are applied in different subsidiaries.

Wärtsilä supports the work-related rights defined by the International Labour Organization (ILO) and therefore works to ensure there is freedom of association and the right to collective bargaining in the company. In those countries where local legislation does not recognize these rights, Wärtsilä endeavours to give employees other channels for expressing their opinions. Wärtsilä does not accept the use of forced labour or child labour in any form.

Wärtsilä is unaware of any cases of breach of human rights, discrimination, infringements of rights at work, or the use of forced or child labour.

Since Wärtsilä expects its partners and suppliers to act in compliance with its Code of Conduct, similar measures will also apply to them. The company sets common requirements for its suppliers and regularly monitors conformance with these requirements through numerous performance indicators and audits. All the main suppliers are required comply with Wärtsilä's requirements in order to gain Approved Supplier status.

Impacts on communities

The guiding principle of Wärtsilä's Code of Conduct is to promote openness and good interaction with its stakeholders locally. This applies as much to the families of personnel, our neighbours, educational institutions and the media as to local authorities and officials. The methods used towards this end include Open Door days, press briefings and different modes of communication for different target groups. Wärtsilä's activities for charitable purposes are described in the Economic Performance section of this report.

Supply chain

Wärtsilä has defined its processes for choosing suppliers, determining their requirements and developing the supply relationship. Wärtsilä offers its suppliers partnership that strengthens the competitiveness of both parties. A precondition of this partnership is open and continuous dialogue. Partnership thinking is also applied in Wärtsilä's research and development activities, where the company often collaborates with universities and key suppliers.

Wärtsilä's supplier requirements were updated in line with the requirements of the company's Code of Conduct. Social responsibility issues were added to the previous supplier requirements. In 2005 Wärtsilä began development of a system for managing information related to supplier selection, evaluation and performance. This will improve supplier evaluation and monitoring of their performance. Wärtsilä regularly conducts supplier evaluations. These are divided into three categories: initial examination, auditing, and inspection. An initial examination is made of potential new suppliers before the supplier relationship begins. Audits are conducted on new suppliers and on suppliers whose performance does not meet Wärtsilä's requirements. Inspections are performed to solve a single deviation from requirements. Altogether 9 supplier audits were performed last year.

The Supplier Days event in 2005 was held in Trieste. The main theme of the meeting was development of the supplier relationship. Ten suppliers participated in the event. The "Supplier of the Year" will be chosen in summer 2006.

Preventing corruption and bribery

Wärtsilä's Code of Conduct expressly prohibits the company and its employees from accepting or offer-

ing any kind of benefit considered to be a bribe. Only normal business gifts of nominal value may be given or accepted. The instructions make it compulsory to comply with local anti-bribery provisions and internationally recognized anti-corruption and anti-bribery principles, and to report any cases of bribery. The company has organized extensive training for its personnel, particularly the sales organization, on anti-corruption principles and on the instructions contained in its Broker Directive. This directive was updated during 2005.

The first decision was made on the bribery court action, mentioned in last year's report, brought against a Wärtsilä employee. The Vaasa District Court found the Wärtsilä employee not guilty on all counts. The prosecutor has appealed the decision in a higher court of appeal.

Political lobbying

Wärtsilä's policy is engage in open dialogue and discussion with both local and international public authorities and officials. An important area of co-operation in this forum is the reduction of emissions from energy production. Stakeholder co-operation with public bodies is a part of Wärtsilä's business operations and not a political activity.

Competition regulations

Wärtsilä has a compliance programme for managing risks relating to competition law, and the company's corporate management are strongly committed to implementing this programme. Wärtsilä's various subsidiaries conducted reviews of compliance with competition regulations when formulating the programme and during the course of mergers and acquisitions. No infringements of competition regulations were identified. The programme documentation includes a manual of competition law, which provides information about competition regulations and instructions for the company's internal procedures. Wärtsilä has also arranged training in competition law for key personnel.

Product liability

Wärtsilä's occupational health and safety policy defines procedures for ensuring product safety. Further information about issues relating to product safety is given in the Policies and Management System section of the Annual Report.

Customer satisfaction

Wärtsilä continuously develops and deepens relations with its customers. Wärtsilä supports its customers in the design, start-up and operation of the equipment and systems it delivers, as the requirements of each customer dictate. Dialogue with customers is vital to developing operations, products and services.

In its most important market areas Wärtsilä arranges Customer Days for existing and potential customers. These days are used to review subjects of topical interest and to discuss existing and future needs and challenges. In 2005 the Power Plants business held 16 customer events and seminars with a total of more than 600 participants. Power Plants also participated in 18 international conferences. A total of 30 customer seminars were organized by the Ship Power business. Several hundred customer representatives attended events organized by the service network companies and technology units. In China the Ship Power business arranged a product tour taking in shipyards and universities in 11 localities and attracting over 500 participants. Ship Power attended 45 international and national maritime conferences and exhibitions.

In 2004 Wärtsilä introduced a Customer Relationship On-Line (CROL) system for measuring the company's sales, delivery and service performance in individual projects. Part of the system requires Wärtsilä to make a self-assessment, the results of which are compared with feedback from customers. This enables action to be taken to rectify any issues while projects are still in progress. The management of the business units regularly monitor customer satisfaction and decide on any development measures necessary.

Wärtsilä's performance is measured using an online form in which customers are asked to comment on statements related to the quality of Wärtsilä products and solutions, the organization and the professional competence of Wärtsilä employees. The assessment has a scale of 1–10, the highest grade being 10.

Altogether 1,167 such questionnaires were received from customers in 2005, compared to 780 in 2004.

The average results for the customer satisfaction survey

	2004	2005
Ship Power	7.5	7.2
Service	7.8	7.7
Power Plants	8.0	8.1

SUMMARY OF KEY FIGURES

Performance indicators[1]	2001	2002[2]	2003[3]	2004[5]	2005[4]
ECONOMIC					
R&D expenses [EUR million][2]	82	88	70.2	73.4	70.1
Environmental investments [EUR million]	5.19	1.83	2.23	3.05	2.54
Environmental operating expenses [EUR million]	2.25	6.02	6.93	4.71	3.05
ENVIRONMENTAL: Power Businesses					
Total energy consumption [TJ]	1,348	1,923	2,251	1,723	1,881
• Electricity consumption [MWh]	85,193	106,617	112,806	112,324	123,857
• Heat consumption [MWh]	130,179	126,294	134,944	117,684	102,265
• Light fuel oil [t]	4,872	4,866	4,862	4,474	5,323
• Heavy fuel oils [t]	8,571	13,552	20,146	7,169	10,743
• Natural gas [t]	1,365	7,611	6,785	9,625	10,079
• Other fuels [t]		242	146	188	135
• Orimulsion [t]	342	232	3,275	0	0
Total water consumption [1000 m^3]	5,222	9,570	8,710	7,207	7,328
• Consumption of domestic water [1000 m^3]	530	727	576	606	626
• Consumption of cooling water [1000 m^3]	4,692	8,843	8,134	6,601	6,702
Emissions of nitrogen oxides [t]	947	1,287	1,174	696	859
Emissions of carbon dioxide [t]	49,155	83,232	98,419	66,586	70,771
Emissions of sulphur oxides [t]	252	348	310	117	260
Particulates	18	25	24	11	15
VOC [t]	31	55	62	47	57
Non-hazardous waste [t]	12,921	23,887	23,608	19,587	22,845
Hazardous waste [t]	3,533	3,644	5,835	3,913	4,296
ENVIRONMENTAL: Imatra Steel					
Total energy consumption [TJ]	1,915	1,917	1,942	2,047	
• Electricity consumption [MWh]	279,000	298,000	291,299	313,462	
• Heat consumption [MWh]	24,600	24,000	23,256	22,643	
• Light fuel oil [t]	100	320	364	247	
• Natural gas [t]	16,715	15,118	16,522	17,442	
• Liquified petroleum gas [t]	973	948	423	25	
Total water consumption [1000 m^3]	17,853	17,754	17,113	12,591	
• Consumption of domestic water [1000 m^3]	153	154	158	44	
• Consumption of cooling water [1000 m^3]	17,700	17,600	16,955	12,547	
Emissions of nitrogen oxides [t]	150	139	139	133	
Emissions of carbon dioxide [t]	62,900	58,900	57,558	62,309	
Emissions of sulphur oxides [t]	43	48	49	31	
Particulates	48	46	47	48	
VOC [t]	21	24	16	31	
Non-hazardous waste [t]	56,040	46,600	48,336	52,677	
Hazardous waste [t]	2,790	2,960	3,686	3,645	
SOCIAL					
Training days [days/employee]	3.0	3.0	2.9	3.1	2.86
Number of lost-time injuries	356	422	467	382	370
Lost-time injuries [number/million working hours]	35.8	21.4	21.5	16.6	16.8
Absence rate [% of total working hours]	4.14	2.92	3.04	3.13	2.57

[1] The operational performance data in this report has been compiled from the economic, environmental and social records of the Wärtsilä companies. Whilst every effort has been made to ensure that the information is neither incomplete nor misleading, it cannot be considered as reliable as the financial information published in the annual report.
[2] The 2002 figures include the second-phase companies, which are presented in the previous report.
[3] The 2003 and 2004 figures include the third-phase companies, which are presented in the previous report. The third reporting phase includes all Wärtsilä companies except those mentioned in the Report Scope section.
[4] The data for 2005 include all Wärtsilä companies except those mentioned in the Report Scope section. Data on Imatra Steel in 2005 has not been collected except financial data for the consolidated financial statements.
[5] The accounting principle for calculating research and development costs was changed in 2004.

REPORT SCOPE

Wärtsilä's Sustainability Reporting 2005 is prepared according to the GRI (Global Reporting Initiative) Sustainability Reporting Guidelines 2002.

Wärtsilä reports those core indicators which are of most relevance to its operations, products and stakeholders. The product performance section describes the environmental aspects and impacts of Wärtsilä's products, the measures taken by Wärtsilä to reduce these impacts, and the environmentally advanced solutions that Wärtsilä has developed. The Wärtsilä and Sustainable Development section examines the company's economic, environmental and social performance. The core indicators chosen are of importance at the corporate level.

Coverage of the report

This report covers Wärtsilä's Power Businesses. At the company level the report includes the parent company and its subsidiaries. The report excludes Wärtsilä's associated companies, joint ventures and supply chain companies.

Wärtsilä's Power Businesses comprise the Group's Ship Power, Power Plants and Service businesses and its Engine division. The first three of these generate external net sales while the fourth is an internal function.

The economic performance data covers all Wärtsilä companies. The data on environmental and social performance covers all Wärtsilä companies except the following:

- Ôu Ciserv BLRT Baltica, Ciserv China Ltd, Ciserv CGL Industries Ltd.
- Wärtsilä-CME Zhenjiang Propeller Company Ltd., Wärtsilä Propulsion (Wuxi) Co. Ltd.
- Wärtsilä Qiyao Diesel Company Ltd
- Wärtsilä Peru S.A.

These companies will be included in Wärtsilä's sustainable development reporting in 2006 and 2007. Wärtsilä's Sustainability Report is part of its Annual Report and therefore Wärtsilä publishes a Sustainability Report annually.

Significant changes in Group structure

The operations of Wärtsilä Finland Oy's Turku factory were terminated at the end of 2005 and these operations were transferred to Wärtsilä Italy's Trieste factory. The other structural changes that apply to the Power Businesses are described under Social Responsibility. They relate mainly to development of the Ship Power and Service businesses.

Wärtsilä Group's subsidiary Imatra Steel became part of a new company, Ovako, established in May 2005. Information on Imatra Steel is not reported unless mentioned to the contrary.

Coverage of operational data

Operational data	% of Wärtsilä companies				% of personnel				% of product manufacturing			
	01	02	03-04	05	01	02	03-04	05	01	02	03-04	05
Economic	100	100	100	100	100	100	100	100	100	100	100	100
Environmental	14	35	79	90	64	75	92	95	100	100	100	98
Social	12	45	79	90	53	85	92	95	100	100	100	98

REPORTING PROFILE

Data collection

The data on product environmental performance is based on measured test results. Performance data on the environmental and social aspects of sustainability has been collected from the Wärtsilä companies using a detailed questionnaire. Economic performance data is based mainly on audited financial accounts.

The sustainability data is collected and reported according to Wärtsilä's specific internal reporting guidelines that include all the definitions and instructions necessary for this purpose. Environmental expenditure and investments are reported applying the Eurostat instructions.

Each company has a nominated individual responsible for collection and consolidation of the data, and for its quality and reliability. The management of each company approves the data before it is consolidated at Group level. The companies report their sustainability data using Wärtsilä's CR Profile reporting system. The reported data is checked at both local and Group levels before its consolidation.

The content of this Sustainability Report was reviewed and approved by Wärtsilä's Board of Management on 1 March 2006.

KPMG Oy Ab has independently assessed the completeness, accuracy and consistency of the data in the report. Site audits were carried out in Drunen, the Netherlands, and in Singapore.

Additional sources of information

Wärtsilä has previously published the following reports:

- Wärtsilä Environmental Report 2000
- Wärtsilä Sustainability Report 2002
- Wärtsilä Sustainability Report 2004.

These reports and their sustainability data are available on Wärtsilä's website: www.wartsila.com.

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ASSURANCE STATEMENT

At the request of Wärtsilä Corporation, we have reviewed the sustainability reporting of Wärtsilä Corporation consisting of the economic, environmental and social data. The data are presented according to the GRI content index in the Business Review and Sustainability Report of the Annual Report 2005 of Wärtsilä Corporation for the year 2005. We have also reviewed the systems and methodologies behind the data. The presented data are the responsibility of and have been approved by the Board of Management of Wärtsilä Corporation. The inherent limitations of completeness, consistency and accuracy of the data are set out in the Sustainability Report of the Annual Report 2005 of Wärtsilä Corporation.

The assurance work was undertaken in accordance with the International Standards on Assurance Engagements (ISAE) 3000 principles. We planned and carried out our work to provide moderate assurance on the reliability of presented data that were subject to assurance.

Our review has consisted of the following procedures:

- a discussion with management responsible for compiling the report;
- an examination of relevant supporting information for data presented;
- a more detailed review of the systems for gathering and processing data at operating level at one site in the Netherlands and one site in Singapore, selected by us.

The sustainability reporting presented in Business Review and Sustainability Report of the Annual Report 2005 of Wärtsilä Corporation has been prepared in accordance with the 2002 GRI Guidelines. Based on our procedures undertaken, nothing has come to our attention that causes us to believe that the data presented according to the GRI content index in the Business Review and Sustainability Report of the Annual Report 2005 of Wärtsilä Corporation would not have been prepared according to the internal reporting guidelines, and would not describe the present state and progress of the issues presented in the Business Review and Sustainability Report of the Annual Report 2005 of Wärtsilä Corporation.

Helsinki, 2 March 2006

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Mission

We provide lifecycle power solutions to enhance the business of our customers, whilst creating better technologies that benefit both the customer and the environment.

Vision

We will be the most valued business partner of all our customers.

WÄRTSILÄ

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