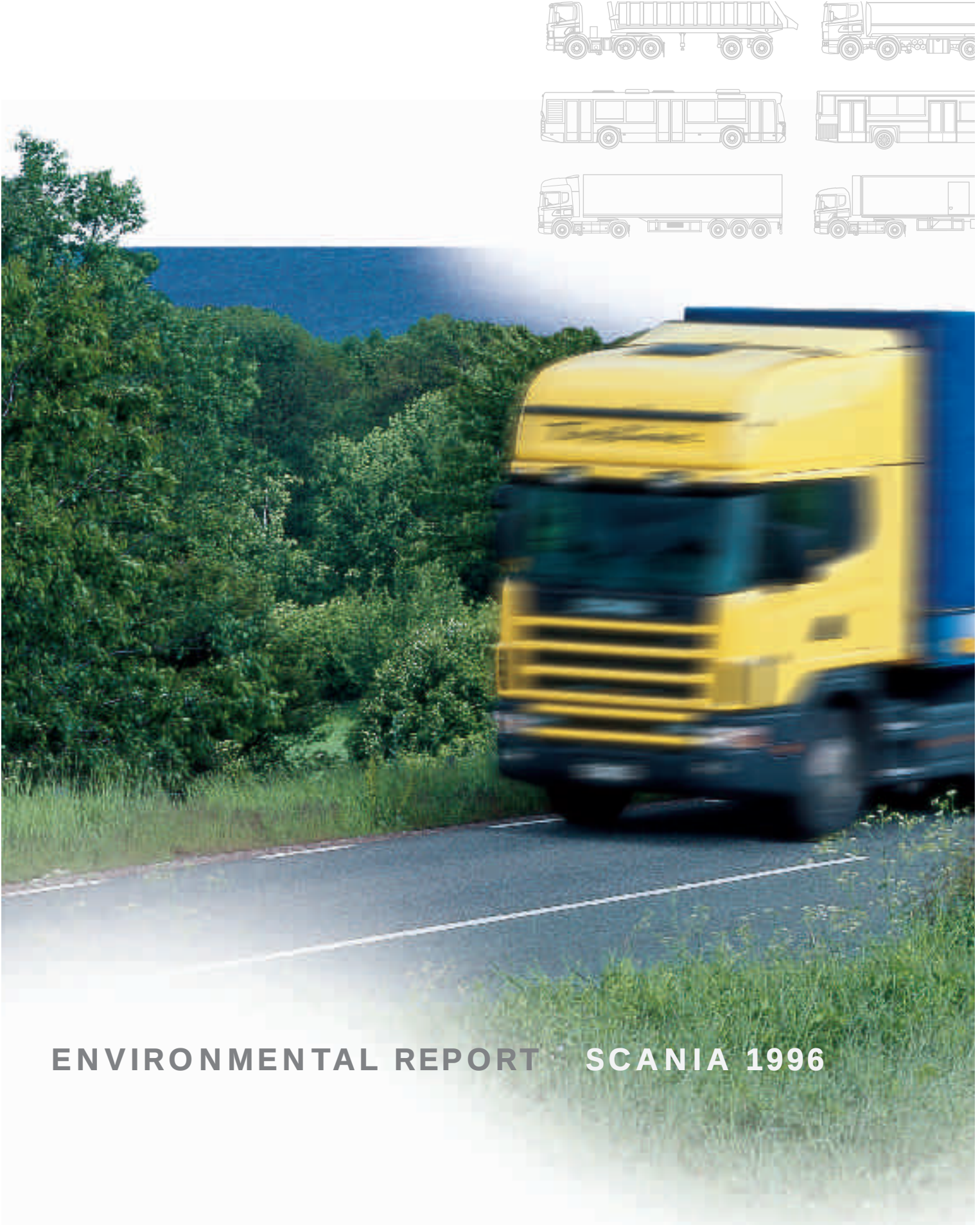

ENVIRONMENTAL REPORT SCANIA 1996

CONTENTS

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STATEMENT OF THE PRESIDENT AND CEO

What you are now holding in your hand is Scania's first separate Environmental Report. We compiled this report to demonstrate how our processes and products affect the environment and what we are doing to minimise negative effects. We at Scania consider it our responsibility to work continuously to improve the environment, both at the local and global level. The purpose of an annual Environmental Report is to provide ourselves and the general public with an overview of our goals and efforts related to environmental work.

We have demonstrated both our willingness and ability to achieve results in the environmental field. The latest example is the introduction of a new generation of trucks, the 4-series. In conjunction with the changeover of our production system to manufacture the new trucks, we continued to modernise our production and assembly plants. Among other things, this enabled us to further reduce negative environmental effects of manufacturing operations. The development of Scania's new 12-litre engine led to a product that consumes less fuel and emits smaller quantities of environmentally harmful substances than its predecessors.

The environmental impact of the transport sector will nevertheless remain in focus for many years to come. Environmental performance will become an increasingly high-priority factor for our customers – and their customers in turn – when choosing ways to transport both goods and passengers. In order to maintain our position as one of the world's most successful manufacturers of heavy vehicles, we must therefore compete on the basis of the environmental performance of our products. We are investing aggressively in preventive environmental work. Our ambition is to continuously be better than the world demands of us.

To achieve this, everyone at Scania must feel a responsibility for environmental work and a commitment to it. Today all Scania managers are already responsible for integrating environmental issues into their operations. But pursuing coordinated environmental work at a company of Scania's size and nature is a complex, difficult process. We still have a long way to go before we can begin to feel satisfied. To facilitate this task, we have chosen to introduce an environmental management system. This will enable us to create environmental goals for our operations that are comprehensive as well as concrete and measurable. We have also begun a large-scale environmental training programme for all our employees. The ambition is that all of Scania's more than 20,000 employees will have undergone environmental training by 1999 at the latest.

Scania must continuously improve its environmental work. Our goal is for people to associate Scania with good environmental work as spontaneously as they now associate us with quality. Please regard this publication – our first Environmental Report – as an invitation to a dialogue aimed at attaining this goal.

Södertälje, Sweden, April 1997

Leif Östling
President and CEO

SCANIA TODAY

Scania is one of the world's leading manufacturers of trucks and buses for heavy transport work. Its strategy is to grow with sustained profitability. Some 95 percent of the company's production is sold outside Sweden.

Scania's mission statement

Scania's operations are focused principally on the field of heavy vehicles designed for the transport of goods and passengers. Its products shall lead the market in terms of quality, performance and environmental characteristics, enabling the company to assure its customers of the best possible transport economy.

Scania's strategy is to grow with sustained profitability by means of high cost-effectiveness in product development, production and marketing, as well as by maintaining a strong global market position.

Scania operates worldwide

Scania is represented in about 100 countries at 1,000 distribution points and 1,500 service points. The company has production facilities and assembly plants in eight countries in Europe and Latin America: Sweden, the Netherlands, France, Denmark, Poland, Brazil, Argentina and Mexico. In addition, there are plants in about a dozen more countries in Europe, Asia, Africa and Latin America that perform local assembly from knocked-down kits.

The number of employees at the close of 1996 was 22,206, down 4 percent from a year earlier. Women represented about 10 percent of the total. Scania has employees in more than 40 countries, about half of them in Sweden.

Products

Heavy trucks

Trucks with a gross weight of more than 16 tonnes (Class 8), designed for long-distance haulage, regional and local distribution of goods and construction haulage.

Buses

City buses, inter-city buses and tourist coaches for more than 30 passengers.

Industrial and marine engines

Engines with power outputs ranging from 225 to 750 horsepower for use as a power source in generator sets, earth-moving and agricultural machinery, ships and pleasure craft.

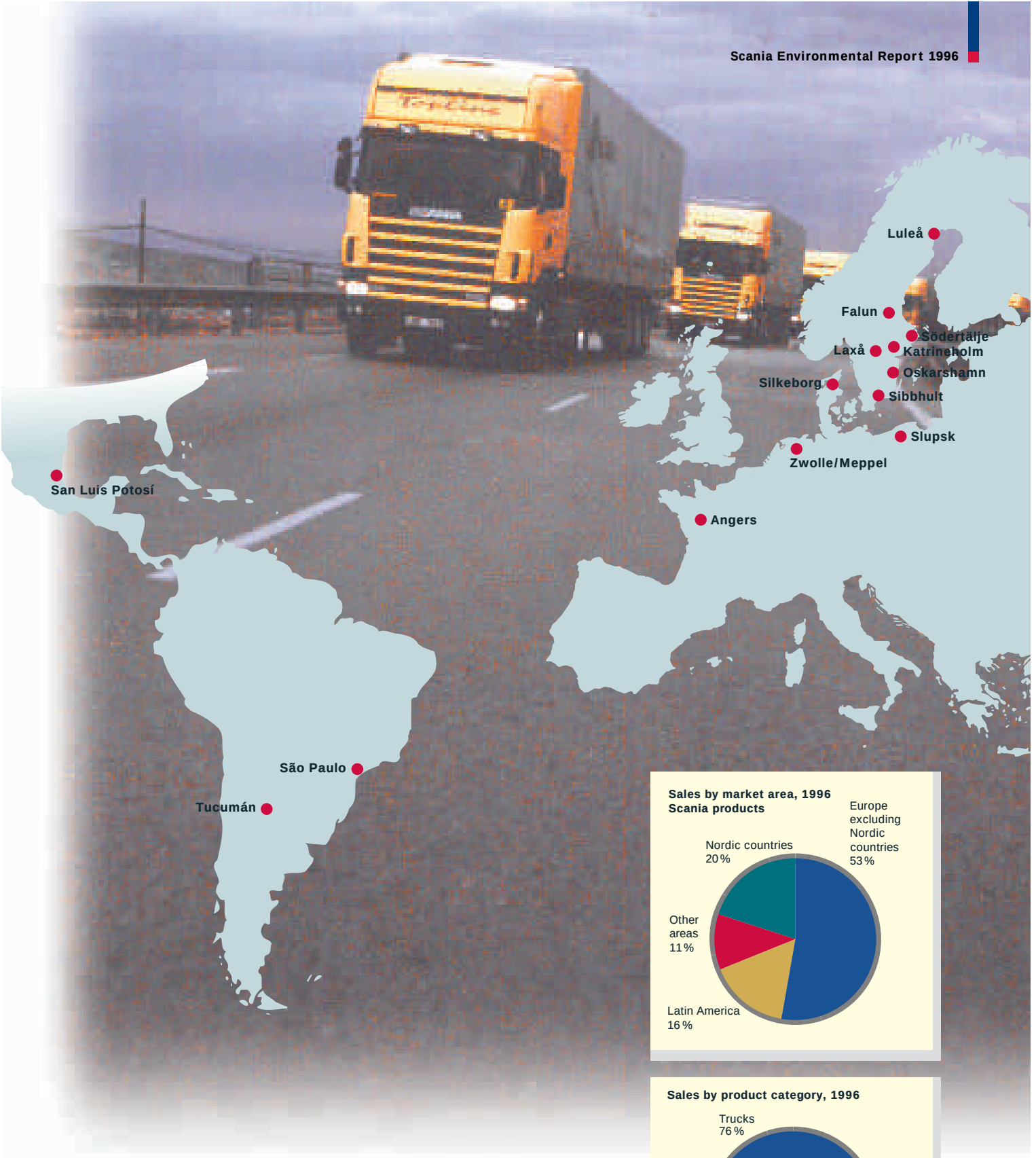
Half-owner of Svenska Volkswagen

Scania and Volkswagen AG each own 50 percent of Svenska Volkswagen AB, which markets Volkswagen, Audi, Seat, Skoda and Porsche cars (and light commercial vehicles) in Sweden.

1996 stock market listings

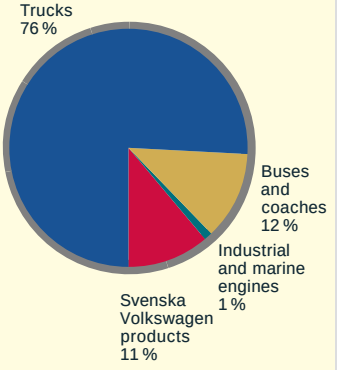
On 1 April 1996, Scania's shares were floated on the Stockholm Stock Exchange and also became the first Swedish shares to gain a listing on the New York Stock Exchange. The listings were a natural consequence of the fact that in May 1995, Scania once again became an independent company after having been part of Saab-Scania for 26 years.

At the close of 1996, Scania had about 50,000 shareholders. The ten largest shareholders accounted for 67 percent of voting power and 66 percent of share capital. The largest shareholder is Investor AB, a listed Swedish investment company in the Wallenberg sphere, with 45 percent of share capital and 45 percent of voting power. Of Scania's share capital, about 16 percent is owned by investors outside Sweden.



Sales by market area, 1996
Scania products

Sales by product category, 1996



Scania is represented in about 100 countries. Its production and assembly plants are located in eight countries in Europe and Latin America.

SCANIA'S ENVIRONMENTAL POLICY

Caring for the environment and active environmental work are crucial to Scania's long-term growth and profitability. Scania's environmental policy provides a framework and guidelines for this growth.

Scania's revised environmental policy was adopted on 2 July 1996. The heads of all Scania Group companies and units are responsible for integrating this policy into their respective operations.

Scania's environmental policy is based on the 16 principles for environmental management issued by the International Chamber of Commerce (ICC). They are summarised in four objectives that are important to Scania.

1 Scania shall achieve and maintain leadership within its field of competence in order to promote a better environment.

This means that Scania will take the lead in environmentally adapting products and production processes. Scania is introducing an environmental management system to ensure continuous improvement of the reporting and management of environmental work. All employees will become closely involved in this environmental work through continuous human resource development and training. Scania also requires that its suppliers and contractors environmentally adapt their operations. It informs its vehicle users of environmental issues in order to enhance their environmental awareness.

2 Scania shall by foresighted research and development continuously reduce the environmental impact coming from its production, products and services.

Scania's research and development work is aimed at preventively reducing the environmental impact of its products. Priorities include reducing quantities of materials used, increasing the share of more environmentally sound materials and fuels, and improving fuel efficiency. Production processes are being optimised by means of detailed audits and follow-up work. The company promotes reuse and recycling of materials in Scania vehicles at the end of their service lives and reduction of the quantities of wastes generated during servicing and maintenance.

3 Scania shall actively promote internationally harmonised and effective environmental legislation – for Scania current legislation is the minimum standard.

Effective and internationally harmonised legislation for the transport industry can be achieved through dialogue with public authorities in all countries where Scania operates.

4 Scania shall increase the confidence in its environmental work through openness and regular environmental reporting.

Scania is engaged in a continuous dialogue with customers, suppliers, shareholders, legislators and the general public to increase confidence in its environmental work. It also actively and openly reports on its environmentally-related goals and achievements and publishes a separate annual Environmental Report.

A summary of ICC's 16 principles for sustainable development

To recognise environmental management as among the highest corporate priorities; to establish policies, programmes and practices for conducting operations in a environmentally sound manner.

To integrate these policies, programmes and practices fully into each business as an essential element of management in all its functions.

To continue to improve corporate policies, programmes and environmental performance, taking into account technical developments, scientific understanding, consumer needs and community expectations, with legal regulations as a starting point.

To educate, train and motivate employees to conduct their activities in an environmentally responsible manner.

To assess environmental impacts before starting a new activity or project and before decommissioning a facility or leaving a site.

To develop and provide products or services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused, or disposed of safely.

To advise, and where relevant, educate customers, distributors and the public in the safe use, transportation, storage and disposal of products provided; and to apply similar considerations to the provision of services.

To develop, design and operate facilities and conduct activities taking into consideration the efficient use of energy and materials, the minimisation of adverse environmental impact and waste generation, and the safe and responsible disposal of residual wastes.

To conduct or support research on the environmental impacts of raw materials, products, processes, emissions and wastes associated with the enterprise.

To modify the manufacture, marketing or use of products or services or the conduct of activities, consistent with scientific and technical understanding, to prevent serious or irreversible environmental degradation.

To promote the adoption of these principles by contractors acting on behalf of the enterprise, encouraging and, where appropriate, requiring improvements in their practices; and to encourage the wide adoption of these principles by suppliers.

To develop and maintain, where significant hazards exist, emergency preparedness plans in conjunction with the emergency services, recognising potential transboundary impacts.

To contribute to the transfer of environmentally sound technology and management methods throughout the industrial and public sectors.

To contribute to the development of public policy and to business, governmental and intergovernmental programmes and educational initiatives that will enhance environmental awareness and protection.

To foster openness and dialogue with employees and the public, anticipating and responding to their concerns about the potential hazards and impacts of operations and products, including those of transboundary or global significance.

To measure environmental performance; to conduct regular environmental audits and assessments of compliance with company requirements, legal requirements and these principles; and periodically to provide appropriate information to the Board of Directors, shareholders, employees, the authorities and the public.

INTENSIFIED ENVIRONMENTAL WORK

Scania's environment-related work is a natural and integral part of its operations. During 1996 Scania further intensified its environmental efforts in order to certify the Group as complying with ISO 14001 international environmental management standards by 1999.

Overseeing Scania's environmental network

Overall responsibility for environmental matters rests with Scania's Environmental Board, which establishes the Group's environmental policy and other guidelines for its environmental work.

Scania's Environmental Coordinator oversees and coordinates an internal "environmental network" that constitutes the company's environmental organisation. This network consists of employees from management staff units and the line organisation who are responsible for internal and external environmental work.

The heads of all Scania companies and units are responsible for adapting the Group's overall environmental policy to local conditions. This policy is then translated into goals and strategies for each respective operation.

Scania's Environmental Coordinator Ronnie Klingberg (left) oversees the company's environmental work together with Urban Wästljung (Environmental Strategist) and Marcela Petkov (Environmental Communications Officer).

Introducing environmental management systems

To effectively translate the Group's mission and environmental policy into local measures, Scania is working towards certification under the ISO 14001 environmental management system.

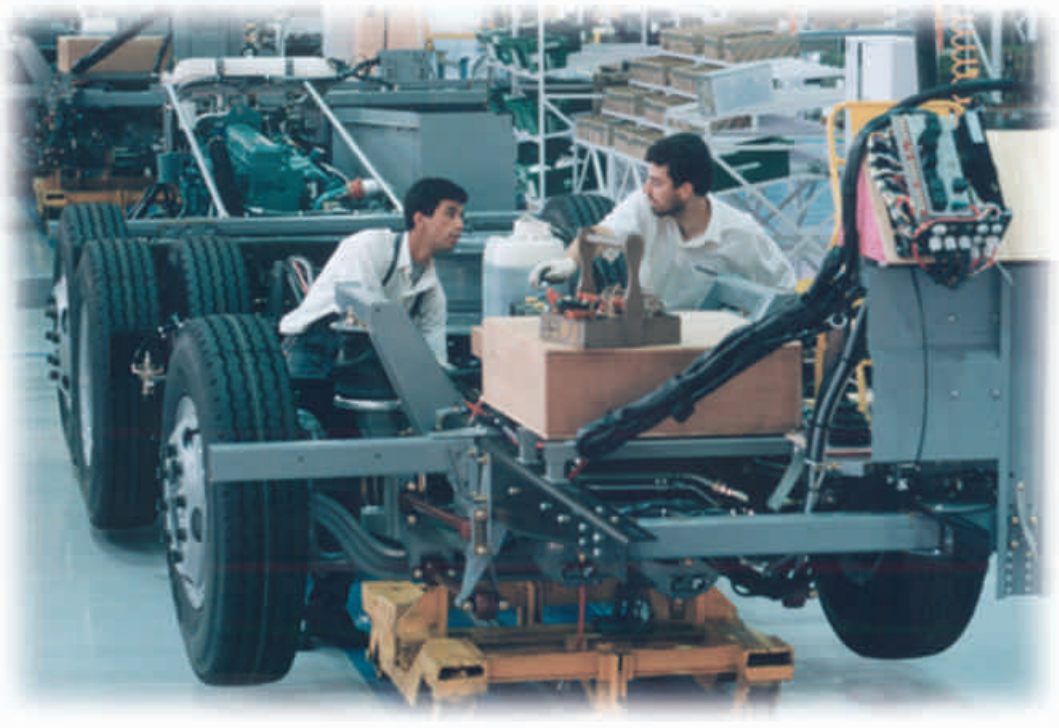
As part of this task, initial environmental reviews were initiated at all Scania facilities during 1996. These reviews have already been completed at three Swedish facilities – in Luleå, Katrineholm and Södertälje – as well as in Brazil.

According to plans, ISO 14001 certification will go into effect in Latin America during 1998 and in Europe during 1999. Scania's efforts to introduce ISO 14001 standards will also enable it to register its facilities according to the Eco-Management and Audit Scheme (EMAS) of the European Union (EU).

Parallel with the introduction of the environmental management system, during 1996 Scania began an environmental training programme for all Group employees. Training is expected to be completed in 1999.

Cooperation with suppliers and contractors

One important aspect of Scania's environmental work is its cooperation with suppliers and contractors. In 1996 Scania brought together its 50 largest contractors at Head Office in Södertälje to inform them of its environmental policy, future legal requirements and the introduction of ISO 14001. Scania's goal is to more efficiently



Scania's Brazilian plant has progressed furthest in the Group in its efforts to introduce ISO 14001 environmental management principles.

apply the new environmental standards to its suppliers and contractors as early as the purchasing stage. The task of developing a checklist for assessing the environmental work of its suppliers and contractors is continuing.

During 1996 Scania also audited all transport flows from suppliers to, as well as between its European production plants. As a result, in the spring of 1997 Scania will reduce the number of hauliers it uses from 20 to five, which also means a reduced total need for vehicles to pick up and deliver freight for Scania. This will also lead to a decline in the number of collections from Scania's suppliers and a consolidation of deliveries to its respective production sites.

At-source waste separation at the plant in Tucumán, Argentina, within the framework of the municipal pilot programme for waste management.

Cooperation with local authorities

Cooperation with public authorities and politicians is another aspect of Scania's environmental work. In Sweden, Scania works together with Södertälje, Katrineholm, Luleå and other municipalities in their Agenda 21 work. In Luleå, for example, Scania Chassis Components works closely with the municipality in improving waste management.

In Tucumán, Argentina, Scania runs the municipal pilot programme for handling residual products and wastewater, among other things.

LIFE CYCLE PERSPECTIVE CONVEYS THE BIG PICTURE

The objective of Scania's environmental work is to reduce the effects of its products on the environment throughout their life cycle. Scania estimates that more than 90 percent of a heavy vehicle's environmental impact occurs during its service life, not during manufacture.

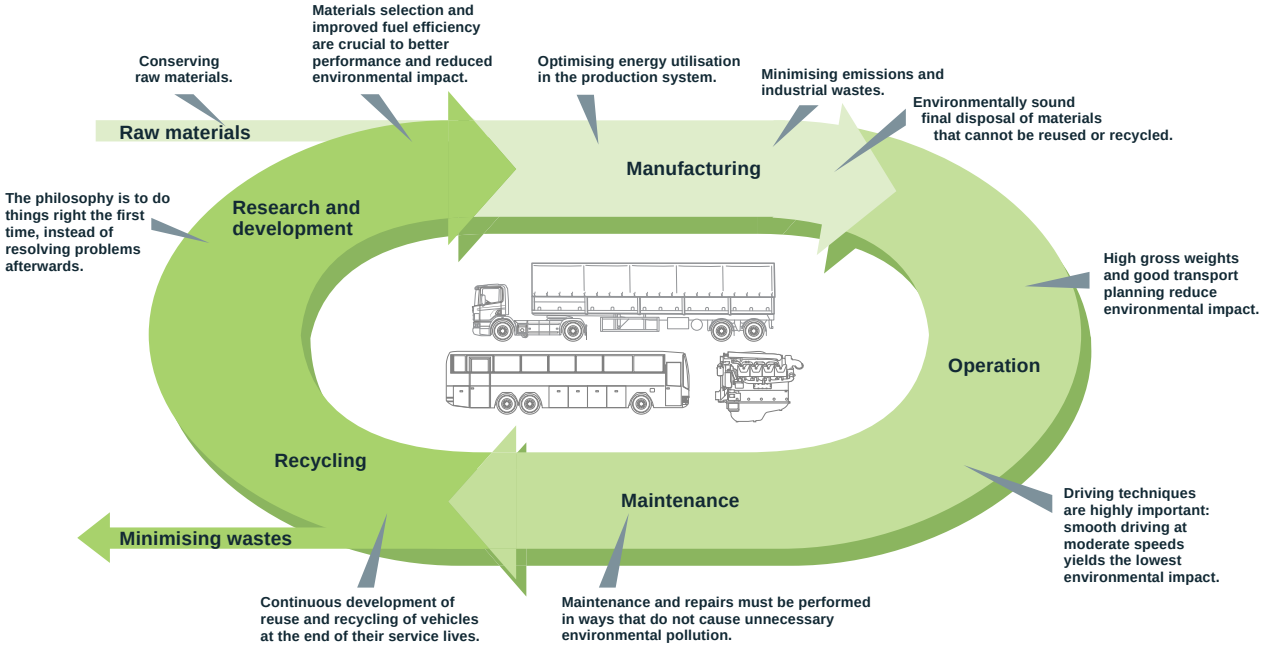
To correctly assess a vehicle's environmental impact, it is necessary to look at its entire service life – from manufacture to final dismantling.

Life cycle assessment and life cycle cost calculation – important tools

Life cycle assessment (LCA) is a central tool of environmental work. A life cycle assessment involves describing and evaluating a vehicle's environmental impact at all stages, from manufacture through operation to final disposal as waste. Scania uses life cycle assessments to improve its decision making process, for example in product development work.

Life cycle cost (LCC) calculation is a tool Scania uses to estimate the total costs of energy-intensive equipment, in order to reduce both costs and adverse environmental effects. Besides investment costs, LCC also takes into account costs related to maintenance, energy and environmental pollution. During 1996, 80 employees at Scania's Swedish facilities received LCC training. Employees at all production units are scheduled to participate in this training programme during 1997.

The life cycle of a Scania vehicle



RESEARCH AND DEVELOPMENT

Scania's strategy for minimising the environmental impact of its vehicles is to prevent problems at source – during the development stage of a new vehicle. Scania is actively engaged in research and development work together with Sweden's institutes of technology.

During 1996, Scania invested more than SEK 1 billion in research and development. A large proportion of this was directly related to the environment. High-priority investment areas included engine development – reduced emissions and fuel consumption – and use of new, more environmentally sound materials.

Engine development prioritised

For Scania, engine development work related to the combustion process is highly important. Scania aims to increase an engine's efficiency rating, in other words reduce fuel consumption while lowering nitrogen oxide emissions.

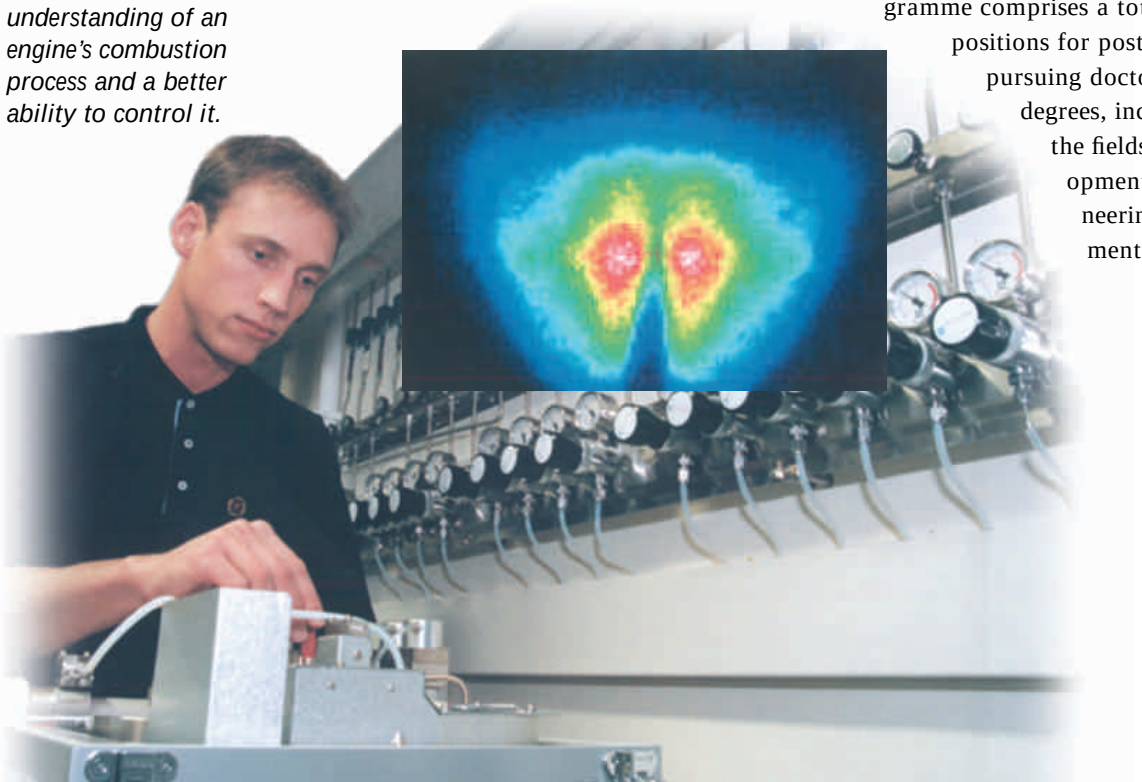
One of the major challenges facing engine development is the fact that in a diesel engine the ratio between nitrogen oxide emissions and fuel consumption (in other words, carbon dioxide emissions) is, in principle, inversely proportional. Measures that lower nitrogen oxide emissions reduce the engine's efficiency rating, thereby also raising fuel consumption.

Cooperating with institutes of technology and universities

Continuous development work is needed to further reduce the environmental impact of diesel engines, primarily by lowering nitrogen oxide emissions at the same time as fuel consumption is reduced. Methods for catalytic conversion of gaseous emissions or better control of the combustion process are among Scania's R&D priorities. In 1996 – as part of its development work and in addition to its regular research programme – Scania invested SEK 5 million in a joint research project with the Lund Institute of Technology.

Scania's industrial research programme

In 1996, Scania established an industrial research programme together with Sweden's institutes of technology. The programme comprises a total of 10 research positions for postgraduate students pursuing doctorates and licentiate degrees, including research in the fields of product development, production engineering and the environment.



With the help of advanced laser technology, it is possible to depict the concentration and distribution of various substances during a single combustion cycle. This technology is highly important for achieving a greater understanding of an engine's combustion process and a better ability to control it.

EFFICIENT PRODUCTION METHODS REDUCE ENVIRONMENTAL IMPACT

The strategy at Scania's production plants is to continuously implement improvements to minimise environmental impact and create a good working environment. Reducing raw material and energy use and switching to less environmentally hazardous materials are important goals.

Scania manufactures its products in Sweden and at facilities elsewhere in Europe and in Latin America. In this first Environmental Report, the ambition is to describe the manufacturing process and to report on Scania's European plants. In the 1997 Environmental Report, Scania intends to provide information on all its facilities, and with a broader scope than has been possible in this 1996 report.

Many parts of Scania's operations use advanced energy management and heat recovery systems. This photo is from the foundry in Södertälje.

Advantages of the modular system

Scania designs its vehicles and plans their production on the basis of a unique modular system. In this way, Scania has been able to reduce the number of components in its product range. This, in turn, also reduces the need for storage space, heating and haulage to production plants. The guiding principle in Scania's product development work is to avoid increasing the number of parts and, if possible, continue to reduce the existing number.

Lower energy use – an important goal

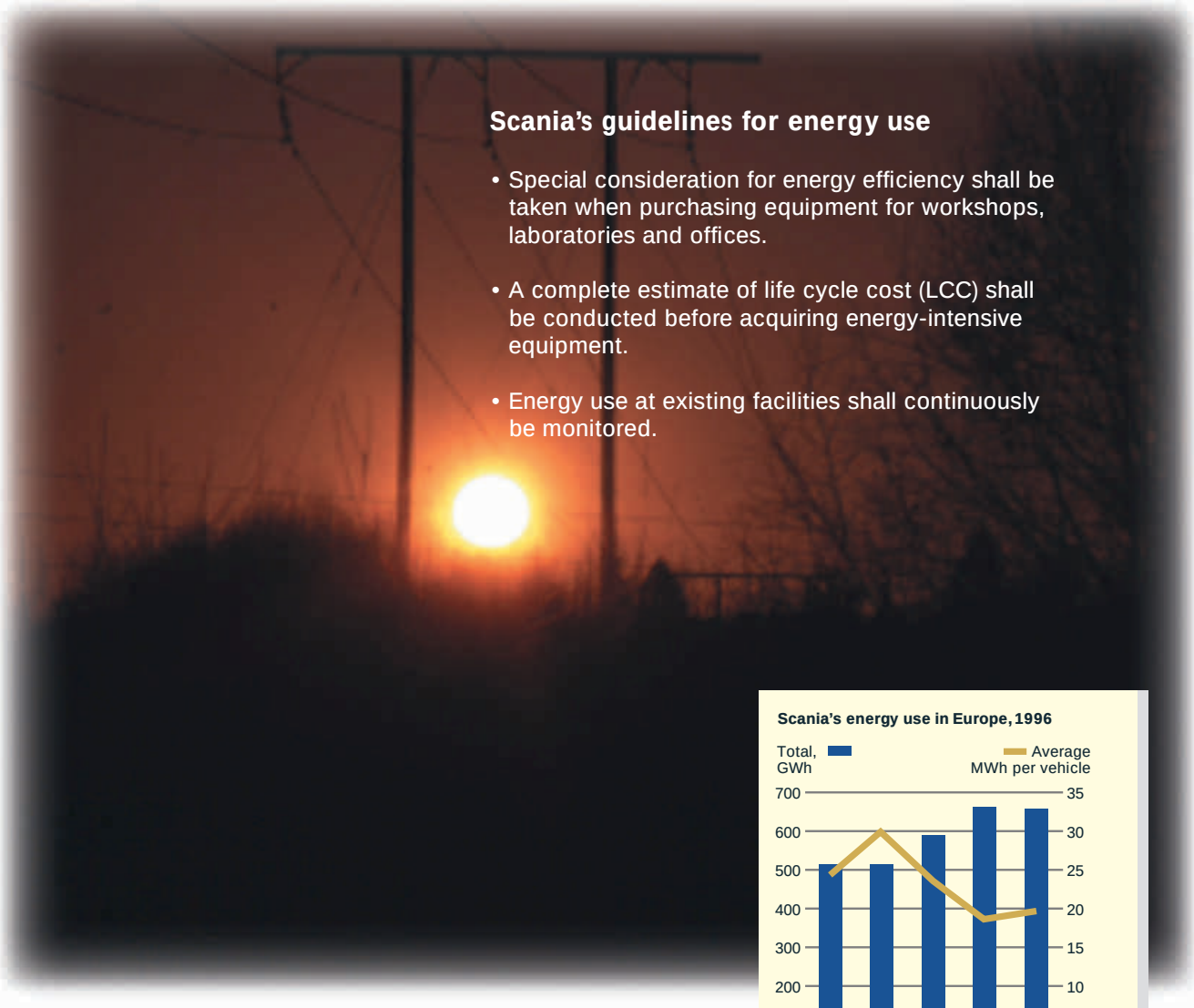
The production of vehicles and engines is energy-intensive. For reasons of cost as well as environment, Scania has for years taken steps to reduce total energy use.

Today large portions of its operations use advanced systems of energy management and heat recovery. For example, the engine development laboratory in Södertälje recycles heat and electricity. Scania's foundry in the same city has a waste heat boiler for recovering heat via a recuperator. Together with higher production capacity utilisation, these are some of the measures that have helped lower energy use per manufactured vehicle by 20–35 percent in recent years.

Scania's goal is to reduce energy use by a further 10 percent per manufactured vehicle by the year 2000, using 1995 as a base year. Another important goal for Scania is to lower base use of energy, in other words the portion of energy use that remains the same regardless of how many vehicles are produced.

Energy use in 1996

In 1996, energy use at Scania's European plants amounted to 660 GWh, or 20 MWh per vehicle. The plant in Södertälje, where most manufacturing takes place, accounts for more than 50 percent of total energy use.



Scania's guidelines for energy use

- Special consideration for energy efficiency shall be taken when purchasing equipment for workshops, laboratories and offices.
- A complete estimate of life cycle cost (LCC) shall be conducted before acquiring energy-intensive equipment.
- Energy use at existing facilities shall continuously be monitored.

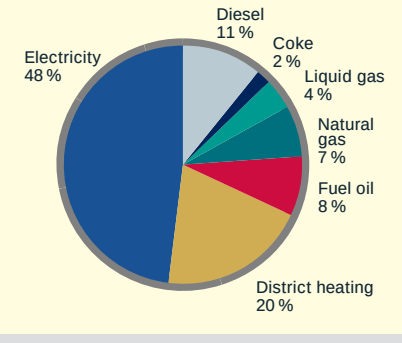
Scania's energy use in Europe, 1996

The majority of this consists of electricity, district heating, fuel oil and natural gas. Large quantities of diesel fuel are also used for laboratory and acceptance tests of components and products.

EKO energy project in Södertälje

Scania is now conducting a thorough audit of its production units aimed at further reducing their energy use. During 1995 and 1996, Scania signed agreements with the Swedish National Board for Industrial and Technical Development (NUTEK) to

Scania's energy use in Europe by type, 1996



In powder painting, no solvents are used and less than 5 percent of the paint is wasted. This should be compared to 50 percent waste in spray painting, a method used previously.

streamline energy use at ten of Scania's Swedish plants. So far, analyses have taken place at four facilities in Södertälje and in Luleå. These analyses indicate total potential electricity and heating savings of 60 GWh per year, or SEK 18 million. Overall, Scania estimates that the project will reduce energy use by 110–120 GWh per year. The EKO energy project is expected to be completed at all Swedish production plants and units within the next few years.

Installation of a central cooling plant

A central cooling plant will be installed in Södertälje in early 1997. It will replace 315 local CFC-based cooling systems. For Scania, this entails an investment of SEK 26 million during 1996-1999. Central cooling systems have many advantages. Instead of CFCs, they use ammonia, which is less environmentally hazardous than other known alternatives. Central cooling systems also facilitate heat recovery, which has not been possible with current systems. Scania expects the switchover to central cooling to result in annual savings of SEK 1.5 million.

Switching to water-borne and powder paints

Emissions of solvents (volatile organic compounds) have long been an important target of Scania's environmental protection efforts. By reducing paint consumption and switching to paints that employ less solvents or none at all, Scania has reduced its relative consumption and has thus reduced solvent emissions by around 75 percent over the past 10 years.

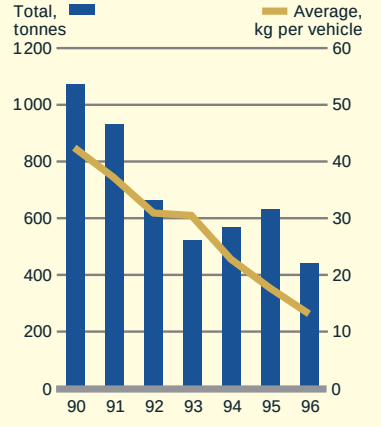
Painting concepts introduced at Scania's facilities in early 1993 have greatly contributed to this trend. At that time, several Scania plants switched from paints based

on environmentally hazardous solvents to water-borne paints and powder painting. In recent year, this has been Scania's largest single investment – SEK 330 million – in environmental improvement measures related to its manufacturing process.

In 1996, solvent consumption at Scania's European plants amounted to just over 400 tonnes, or 13 kg per vehicle.

Projects are under way to further reduce the use of solvents, for example when applying primer on chassis side members and finishing coats on engines, gearboxes and cabs.

Scania's use of solvents, Europe, 1996



Diesel exhaust emissions

In Södertälje, extensive laboratory and acceptance tests of engines generate emissions of diesel exhaust gases containing nitrogen oxides and particulates. Emissions at Scania's Södertälje facilities in 1996 totalled 105 tonnes of nitrogen oxides and 1.4 tonnes of particulates. Scania is now working to further improve engine performance and shorten engine acceptance test times.

Closed-circuit systems reduce water use

Scania's work concerning emissions into waterways has focused on reducing water consumption as well as the quantity of wastewater and other liquid wastes. In 1996, water consumption at its European production plants totaled 600,000 cubic metres, or 18 cubic metres per vehicle. Relative consumption has fallen by between 20 and 30 percent over the past five years.

A large proportion of water use and discharges is attributable to sanitary wastewater. Most of today's liquid-based production processes are closed-circuit. Used process baths are treated for recycling or discharge into the wastewater system. There are still emissions of small amounts of oil, other organic substances and metals. Scania's goal is to eliminate wastewater from its production processes by switching to completely closed-circuit systems.

Diesel exhaust emissions (Södertälje)

	Fuel consumption	Nitrogen oxides	Particulates
	tonnes	tonnes	tonnes
1992	2,922	137	2.3
1993	3,004	128	1.9
1994	3,309	135	2.1
1995	3,085	119	1.7
1996	2,885	105	1.4

Management and reuse of residual products

Disposing of residual products and wastes from production processes is both resource-intensive and costly. One special goal of waste management is to reduce the amount of hazardous industrial waste such as oils and alkaline process baths. Such residual products as shavings, scrap and wood must be recycled.

Residual products from Scania's European plants totaled 50,000 tonnes in 1996. Of this amount, 75 percent, mostly

shavings and scrap, was recycled while 5 to 10 percent, mainly waste oil, was disposed of as hazardous waste. To reduce the amount of waste sent to landfills today, Scania aims to further develop a system for separation of paper, wood, plastic waste and other materials.

Environment-related insurance

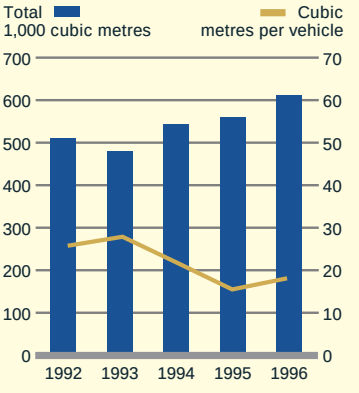
Like most other Swedish companies, Scania makes payments to a national environmental damage consortium. This fee is used to cover the costs of any measures that must be undertaken to deal with environmental damage in cases where no guilty party can be determined.

Both Scania's property and liability insurance contracts cover sudden, unforeseen environmental damage at its own facilities as well as damage that affects a third party.

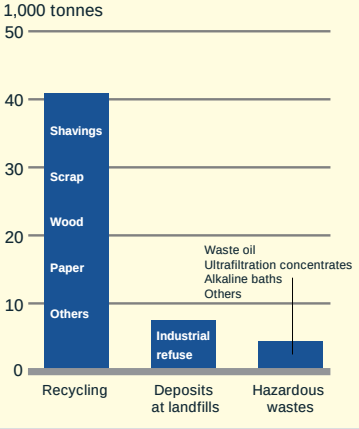
Environment Protection Act

All of Scania's Swedish plants have recently been, or will soon be, inspected to ensure their compliance with the Environment Protection Act as a condition for receiving new permits to expand production. In 1996 no violations of the Environment Protection Act were reported at Scania's facilities.

Scania's water consumption, Europe, 1996



Residual products from Scania's European production system, 1996



MAKING PRODUCTS WITH SOUND ENVIRONMENTAL CHARACTERISTICS

Most of a heavy vehicle's environmental impact occurs during its service life. Exhausts, noise and maintenance affect the environment. As a vehicle manufacturer, Scania has a major responsibility to continuously develop vehicles that combine good transport economy and low environmental impact.

Concentration on trucks and buses

Scania is the only major European vehicle manufacturer with operations that concentrate on heavy trucks designed for long-distance haulage, construction and civil engineering haulage and distribution work.

Late in 1995, Scania unveiled its new generation of trucks, the 4-series, as well as its new six-cylinder, 12-litre diesel engine. This engine is designed to provide maximum combustion efficiency, low exhaust emissions, low engine noise and a consequent reduction in environmental impact. Other features include greater ease of service for scheduled maintenance and repairs.

In the same way, Scania's bus and coach operations concentrate on the heavy segment of the market. Scania manufactures bus chassis and buses designed for more than 30 passengers. Its product range comprises urban and inter-city buses as well as tourist coaches.

In September, Scania introduced the OmniCity city bus, the first model in a new modularised generation of buses and bus chassis. This new generation of buses combines good transport economy with good environmental characteristics, both in terms of better material selection and more efficient engines.

Industrial and marine engines

Scania manufactures industrial and marine engines used as power sources in earth-moving, forestry and agricultural machines, in generator sets and in commercial vessels and pleasure craft.

Scania's industrial and marine engines are developed from its truck engines. This also enables Scania to influence the development of efficient products outside the transport sector. The European product range of industrial and marine engines was completely updated in 1996 to better meet demands for enhanced performance, including lower fuel consumption, lower emissions and higher outputs.

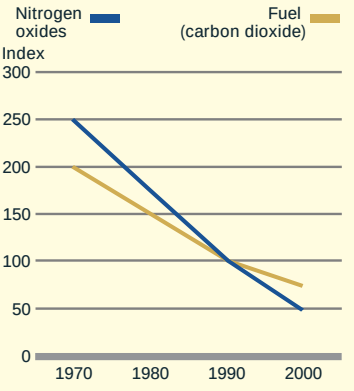
FOCUS ON THE ENTIRE VEHICLE

Scania's mission is to manufacture products that lead the market in terms of quality, performance and environmental characteristics. As a result, today's Scania products have significantly longer service lives and lower fuel consumption than in the past.

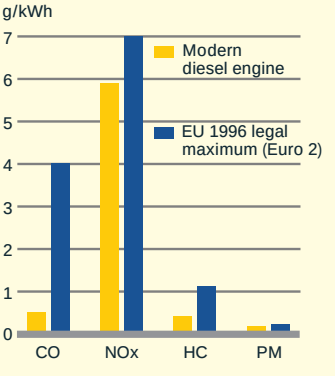
Most of Scania's vehicles are equipped with diesel engines that run on some form of diesel fuel. Nitrogen oxides, hydrocarbons, particulates and other substances with an adverse effect on the environment are formed during the combustion process. Burning fossil fuels also results in a net increase in carbon dioxide in the atmosphere.

Scania is working systematically both to reduce emissions of environmentally hazardous substances from its diesel engines and to reduce fuel consumption (in other words, carbon dioxide emissions). Over a 25-year period, the quantity of fuel required to perform a given transport task has fallen by about 60 percent owing to

Fuel consumption and emissions for a given transport task



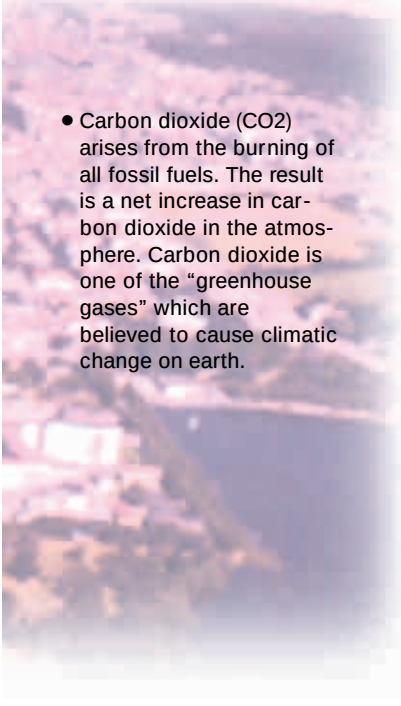
Emissions from Scania trucks and buses, compared to current legal requirements



Environmental impact of diesel fuel

- Carbon monoxide (CO) is a toxic gas formed through incomplete combustion. The gas is toxic to humans but is only present at very low levels in diesel exhausts.
- Nitrogen oxides (NOx) are formed by a reaction between oxygen and nitrogen at high temperatures. Nitrogen oxide emissions contribute primarily to over-fertilisation (eutrophication), acidification and the formation of tropospheric (ground-level) ozone.
- Hydrocarbons (HC) in diesel exhausts are residual products that are formed during combustion and that contain unpleasant-smelling compounds. At high levels, carcinogenic effects on humans and animals have been demonstrated. Along with nitrogen oxides, hydrocarbons contribute to the formation of tropospheric ozone.
- The particulate matter (PM) emitted by a diesel engine is largely determined by the quality of the fuel. The aromatic hydrocarbons in diesel fuel contribute to higher emission levels of both particulates and nitrogen oxides. Today's diesel fuel also contains a small proportion of sulphur, which contributes to acidification. This problem cannot be solved by improving engine technology, but only by eliminating the sulphur from the fuel.

Lower aerodynamic drag is an important objective in the design and body configuration of a vehicle. Drag affects fuel consumption and exhaust emission levels.



• Carbon dioxide (CO_2) arises from the burning of all fossil fuels. The result is a net increase in carbon dioxide in the atmosphere. Carbon dioxide is one of the "greenhouse gases" which are believed to cause climatic change on earth.

intensive development work. Carbon dioxide emissions, which are directly proportional to the quantity of fuel burned, have decreased at a similar rate. Nitrogen oxide emissions dropped by 90 percent during the same period. Particulates and hydrocarbons have fallen at the same rate as fuel consumption.

In recent years, the task of developing Scania's new 12-litre engine and upgrading its 14-litre engine has concentrated on lowering exhaust emissions and improving fuel economy. Emission levels have been reduced far below current legal requirements. Scania's engines meet the EU's Euro 2 standards for both trucks and buses. Today Scania's engine development efforts are focused on meeting future standards, primarily Euro 3.

Overall vehicle design is important

In discussing exhaust emission issues, the general public and legislators have largely focused on engines. It is important, however, to understand how the overall development and use of a vehicle can help lower emissions.

For example, reducing aerodynamic drag was a measure Scania prioritised when developing its new cab for the 4-series. Giving the cab a wedge shape, slightly narrower at the front than in the back and with a large radius on each front corner, has significantly reduced aerodynamic drag. Compared to previous truck generations, the drag coefficient has been diminished by up to 12 percent, thereby lowering fuel consumption.

All plastics in a Scania vehicle are marked to facilitate sorting and recycling at the time of disassembly.

Selection of materials – crucial for environmental impact

Scania's goal is to select materials with the best functional qualities and the lowest environmental impact. For example, the new OmniCity bus is made of aluminium, which can be recycled a number of times. Aluminium is also lighter, thereby lowering gross weight and fuel consumption.

A Scania vehicle consists largely of raw materials such as steel, sheet steel and cast iron. Upholstery on the cab's walls and roof is made of recycled fabrics from the clothing industry. All plastics are pre-marked so they can easily be sorted and recycled when a vehicle is dismantled. Environmentally hazardous materials such as mercury, bromine fire retardants and asbestos were completely removed from Scania's vehicles several years ago.

On the other hand, lead is still used in batteries and in the balancing weights on tyres. Lead accounts for only 1 percent of a vehicle's total material content but dominates the environmental impact of its materials. Today there is no good replacement for lead that offers both the requisite functional characteristics and a low environmental impact.

Scania vehicles less noisy than before

For many years, Scania has worked to lower vehicle noise levels. By means of new design solutions, development work, and use of new components and materials, Scania has reduced the noise level to 80 decibels (dBA). Fifteen of today's trucks are quieter than one truck 25 years ago. In the development of the OmniCity bus, external noise levels were lowered to 77 dBA. The EU's maximum permitted level of vehicle noise is 80 dBA.

The new OmniCity bus is designed for driving in noise-sensitive areas.

SWITCHING TO ALTERNATIVE FUELS

Switching to alternative fuels is increasingly discussed today. The primary objective is to lower the net increase in atmospheric carbon dioxide, thereby also reducing the risk of climate changes and improving local environmental conditions.

To Scania, it is natural and essential to work on modifications of its basic engines that enable them to run on other fuels besides diesel fuel. In the future, it will be necessary to make a systemic shift from fossil fuels to renewable fuels. With minor modifications, a diesel engine can operate on several different fuels. Scania's efforts so far have focused on ethanol, gaseous fuels such as natural gas and dimethyl ether (DME) as well as hybrid operation.

"A stable supply of raw materials and consistently high fuel quality are important factors for the success of alternative fuels," according to Lisa Fuller – one of Scania's fuel experts.

Ethanol

Ethanol is an alternative fuel that can be produced from traditional raw materials such as sugar cane and grain, but forestry waste and wine can also be employed in its manufacture. Ethanol has a lower energy content than diesel oil, resulting in higher fuel consumption. Emissions of carbon dioxide, nitrogen oxides and particulates are, however, lower when ethanol is used in place of diesel fuel.

Scania today is Europe's largest manufacturer of ethanol-powered city buses. It has delivered nearly 200 buses to the Greater Stockholm Transport Authority (SL), which has the world's largest fleet of ethanol-powered buses.

Gaseous fuels

Scania also develops engines modified for running on natural gas and biogas. The importance of natural gas as a fuel for vehicles is expected to increase. Today gas-powered engines are about 25 percent less efficient than diesel engines and thus consume more fuel. From an environmental standpoint, natural gas has about the same advantages as ethanol – low levels of nitrogen oxides and particulates – but like diesel fuel it generates a net increase in atmospheric carbon dioxide. So far Scania has delivered 100 natural gas-powered buses to Sydney, Australia.

DME is an attractive new diesel engine fuel with emission levels comparable to those of natural gas. It can be produced from both natural gas and renewable raw materials. Scania has initiated a project to increase its knowledge of DME.

Today ethanol-powered buses are used primarily in city traffic. Scania has delivered nearly 200 ethanol buses to Greater Stockholm Transport (SL).

Low demand

Today the demand for vehicles powered by alternative fuels is very low. They accounted for 0.2 percent of Scania's total sales during the period 1991 to 1996. The main reason is that most Scania vehicles operate in long-haul traffic, for which the alternative fuel supply and distribution network is very limited.

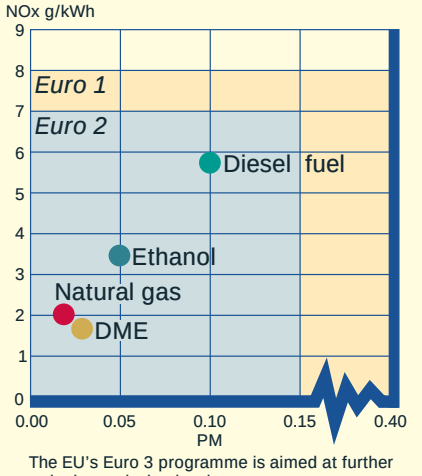
Demand for city buses powered by alternative fuels is significantly higher, accounting for 8 percent of total city bus sales. As environmental awareness increases and distribution systems for alternative fuels expand, the demand for such vehicles is very likely to increase.

Hybrid power

To meet demands for maximal environmental adaptation of buses, for some years Scania has been involved in a hybrid bus project. A hybrid bus run on its own electrical power plant. It either operates as a purely battery-powered electrical vehicle or can be connected to a generator powered by a car engine with a catalytic converter to treat exhaust emissions.

During 1996 Scania delivered six hybrid buses to SL. The company has also delivered three buses to Luxembourg.

Nitrogen oxide and particulate emissions from various fuels in relation to EU legal requirements.



The EU's Euro 3 programme is aimed at further reducing emission levels.

To meet the demand for maximum environmental adaptation of buses for city centre traffic, for some years Scania has been involved in a hybrid bus project.

Diesel fuel will remain in use

Diesel engines powered by diesel fuel will probably remain the most common alternative for heavy vehicles in long-distance haulage during the foreseeable future. This is mainly due to the superior customer benefits of diesel fuel – low price, high energy content and a well-developed distribution infrastructure.

CORRECT USE BETTER FOR THE ENVIRONMENT

To minimise a vehicle's environmental impact, optimal utilisation is important. This places stringent demands on Scania's customers in terms of driving technique, transport planning and vehicle maintenance.

Vehicle utilisation and driving technique

Efficient transport planning, high gross weights and smooth driving are preconditions for reducing a vehicle's environmental impact. Driving technique alone can affect fuel consumption by 20 to 30 percent. Scania developed the Opticruise computerised powertrain management system to facilitate long-distance driving. Used correctly, Opticruise ensures fuel efficiency and a safe driving style – the automatic control system selects the optimal gear.

During 1997, Scania will increase efforts to inform its distributors and customers about ways they can reduce the environmental impact of haulage work.

Regular maintenance

Every vehicle requires continuous maintenance to remain safe in traffic. The same is true of those systems that affect its environmental characteristics and operating economy. In developing today's trucks and buses, major resources are devoted to giving vehicles the best conceivable environmental performance, at the same time that they should operate as economically as possible. Regular maintenance ensures a vehicle's continued environmental performance throughout its service life.

Scania's service-exchange system – an environmentally friendly alternative to repairs

Scania's service-exchange system is a well-established system for reusing parts. Rather than repairing a worn-out part or

Driving technique is important. Smooth driving at moderate speeds yields the lowest environmental impact.

"A fast-expanding system for the reuse of parts," explains Roger Grebesjö, who is in charge of Scania's service-exchange operations.

buying a newly manufactured one, Scania customers can replace it with a factory-reconditioned used part – a service-exchange part. When Scania sells a new service-exchange part, it accepts the customer's worn-out part for disposal or reuse. Some of these parts are later employed in the production of service-exchange parts. Those that cannot be reused for various reasons are dealt with in an environmentally sound, controlled way.

Scania also uses a monetary deposit system when selling service-exchange parts. Customers put down a deposit when buying new service-exchange parts, and they later receive their money back when they return worn-out parts. In this way, Scania ensures that as many worn-out parts as possible will be returned and reused, instead of ending up in landfills and scrap yards. Between 1992 and 1996, Scania's service-exchange system sales rose by about 40 percent.

Service-exchange system to expand during 1997

During 1997, Scania is introducing a new system for returned parts. Until now, Scania has only allowed customers to return as many worn-out units as they had purchased in the form of service-exchange parts. Beginning in 1997, in principle Scania will offer its customers the option of returning all old worn-out parts for repurchase.

Within the framework of the service-exchange system, Scania is offering its customers in Sweden and Germany the opportunity to upgrade their engines by one or two environmental categories at a favourable price. In most cases, this involves an upgrade from Euro 1 to Euro 2 standards.

WHEN A VEHICLE REACHES THE END OF ITS SERVICE LIFE

Reuse and recycling of heavy vehicles is an area that requires major development work. Scania's goal is to make its vehicles 100 percent recyclable.

A truck consists largely of iron, steel, copper and aluminium but also of glass, rubber, lead, zinc and various plastics. After dismantling, its constituent materials and parts can be reused or recycled in various ways. However, this requires reprocessing of residual products in the form of sorting, cleaning and/or other value-adding processes. Some materials, such as rubber, are more difficult than others to reuse but their energy can instead be recovered by means of controlled incineration. Other materials should be dealt with in environmentally acceptable ways.

Today about 90 percent of the material weight of a truck can be recycled.

Increased recycling

To facilitate a high degree of recycling, Scania's goal is to manufacture vehicles that are 100 percent recyclable. But today there is a big gap between what can be recycled and what in fact is recycled. The main challenge is to build up systems and structures that increase the actual degree of recycling.

About 90 percent of a truck can be recycled*

**The figures refer solely to recycling of materials, not energy.*

ENVIRONMENT AND ECONOMICS

To Scania, there is no conflict between environmental responsibility and industrial growth. The intensifying use of more efficient production methods has not only resulted in competitive advantages but has also generated major environmental advances.

So far Scania has been able to measure its environmental progress mainly in terms of lower inputs of electricity, water etc. and lower emission levels. In the future, it will also be able to report the economic results of its environmental work. Scania is now studying various possibilities for developing an internal reporting structure that will better enable it to track and describe its environmentally-related investments, expenses and revenue.

SUMMARY
Key figures for Scania's production (Europe)

Year	1992	1993	1994	1995	**1996**
Number of manufactured vehicles	21,450	17,190	24,909	35,832	**33,642**
Energy use					
Per vehicle (MWh)	24	29.8	23.6	18.5	**19.6**
Total (GWh)	515	513	589	662	**658**
Solvent consumption					
Per vehicle (kg)	30.9	30.5	22.8	17.6	**13.1**
Total (1,000 kg)	663	524	567	630	**440**
Water consumption					
Per vehicle (cubic metres)	23.8	27.9	21.8	15.6	**18.2**
Total (1,000 cubic metres)	511	480	543	559	**612**
Residual products					
Per vehicle (kg)	—	—	—	—	**1,486**
Total (1,000 kg)	—	—	—	—	**50,000**

HIGHLIGHTS OF 1996 OPERATIONS

Amounts in SEK million unless otherwise indicated	
Sales, units	
Trucks	**39,028**
Buses	**3,963**
Total	**42,991**
Sales	
Scania products	**29,954**
Svenska Volkswagen products	**3,776**
Total	**33,730**
Operating income	
Scania products	**2,842**
Svenska Volkswagen products	**215**
Total	**3,057**
Operating margin	
Scania products	**9.5 %**
Svenska Volkswagen products	**5.7 %**
Total	**9.1 %**
Income after financial items	**2,706**
Net income	**1,981**
Earnings per share, SEK	**9.90**
Earnings per share according to U.S. GAAP	**10.30**
Return	
on shareholders' equity	**23.1 %**
on capital employed	**16.2 %**
on capital employed excluding customer finance operations	**19.4 %**
Debt/equity ratio	**0.65**
Equity/assets ratio	**27.7 %**
Capital expenditures for property, plant and equipment	**2,522**
Research and development expenses	**1,065**

GOALS FOR 1997

By the end of 1997:

- Initial environmental reviews within the framework of ISO 14001 shall have been completed at all Scania facilities.
- An even larger number of Scania employees shall have undergone environmental training.
- A checklist for assessing the environmental work of suppliers and contractors shall have been compiled and fully implemented.
- Employees at all production units shall have undergone LCC training.
- Internal reporting systems for raw material flows, electricity, water etc. shall have been supplemented.
- An energy audit within the framework of the EKO energy project shall have been implemented at most Swedish production units.
- Steps shall have been taken to further reduce energy use per vehicle.
- Steps shall have been taken to further reduce consumption of solvent-based paints.
- Informational activities for distributors and customers on the correct use of vehicles shall have continued.
- The task of writing instructions for the dismantling of all vehicles at the end of their service lives shall have begun.
- Systems for reporting environmentally-related investments, expenses and revenue shall have been created.

GLOSSARY AND EXPLANATIONS

A

Acidification
A chemical change in nature whereby the acidity of soil and water increases (the pH value drops). One source of the discharge of acidifying compounds into the atmosphere, primarily sulphur and nitrogen oxides which form sulphuric acid and nitric acid respectively, is the incineration of fuel (see also nitrogen oxides). Plants absorb some of the nitrogen and in turn release certain compounds which neutralise the acid precipitation. Emissions of nitrogen oxides therefore do not contribute as much to acidification as do emissions of sulphur oxides. However, there is a risk that the ground will become saturated with nitrogen so that the plants are unable to absorb it all, thus giving nitrogen a more important role in acidification.

Agenda 21
An action programme for the 21st century aimed at achieving ecologically, socially and economically sustainable development. Created in conjunction with the UN Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil in 1992.

Alcohols
Organic chemical substances which contain one or more hydroxyl groups (oxygen-hydrogen, OH) bound to carbon atoms. Alcohols are produced industrially through a process of fermentation and are, among other things, used as an engine fuel.

Aldehydes
Partially oxidised hydrocarbons (HC) which are responsible to some extent for the unpleasant smell of diesel exhaust gases. The aldehyde content of exhaust gases can be reduced to an insignificant value by an oxidising catalytic converter.

Alkaline baths
Degreasing solutions containing metals.

Alternative fuels
Alternative fuels refer to fuels that do not contain petrol or diesel fuel. Alternative fuels which can be used in combustion engines of vehicles are, for example, various alcohols (methanol, ethanol), gases (hydrogen gas, liquefied petroleum gas, natural gas), synthetically produced hydrocarbons (synthetic petrol or diesel oil) and plant-oil esters (rapeseed methylester, palm oil methylester).

Aromatics (aromatic compounds)
Aromatics constitute one of the components of crude oil. They are more difficult to break down and combust in diesel engines than the common paraffins that make up the major component of this fuel. High aromatic levels result in high emissions of particulates.

B

Benzene
Hydrocarbon with six carbon atoms and six hydrogen atoms. In combustion, it gives rise to soot and polycyclic aromatic hydrocarbons.

Biofuel
Renewable fuel obtained from biomass, i.e. substances produced by living organisms, for example timber, wood chips and straw, or in refined form such as ethanol, methanol and dimethyl ether.

C

Carbon dioxide (CO_2)
A colourless gas formed by all forms of combustion and by the decomposition of organic material. Carbon dioxide contributes to the greenhouse effect, and its emissions are directly proportional to the amount of fuel burned: if fuel consumption decreases, so do CO_2 emissions. Carbon dioxide is absorbed by plants via the process of photosynthesis, so the net increase of CO_2 in the atmosphere is lower if renewable fuels are used.

Carbon monoxide (CO)
A toxic gas formed through incomplete incineration of carbon and carbon compounds owing to an inadequate air supply. In contact with air, it is quickly converted to carbon dioxide. The gas is toxic because it usurps the place of oxygen in the blood supply's haemoglobin, thus preventing the distribution of oxygen inside the human body.

Carcinogen
A substance which causes cancer. See under Polycyclic aromatic hydrocarbons.

Catalyst – catalytic converter
A catalyst is a substance which hastens a chemical process without itself being consumed. Catalytic converters in passenger cars use precious metals such as platinum. Diesel engines use oxidising catalytic converters which are basically the same as those used in petrol-powered vehicles. Due to the considerable surplus of air and thus also the high oxygen content in diesel exhaust gases, nitrogen oxides (NOx) cannot be reduced in catalytic converters, and a different method must be used (see Nitrogen oxides).The catalytic converter oxidises – incinerates – gaseous and liquid substances, including hydrocarbons (HC) present in exhaust gases. The catalytic converter substantially reduces both hydrocarbon and carbon monoxide (CO) content, and most of the typical diesel exhaust smell disappears. A low-sulphur fuel must be used to prevent the formation of sulphuric acid in the catalytic converter at high exhaust gas temperatures.

Cetane rating
Specifies the ignition properties of fuels for diesel engines (cf. octane rating for petrol engines).

CFC
(see Chlorofluorocarbons).

Chlorofluorocarbons (CFCs)
Hydrocarbons containing both chlorine and fluorine. These are used in liquid form as solvents and refrigerants, and in gaseous form in spray-cans and for manufacturing cellular plastic foam.

CNG
Compressed Natural Gas.

CO
(see Carbon monoxide).

CO_2
(see Carbon dioxide).

Combustion temperature
The temperature obtained in a combustion process, for example in an engine.

Component painting
Each component in the vehicle is painted prior to assembly.

Compressed gas
Gas compressed under high pressure to shrink in volume.

Crude oil
A mixture of hydrocarbons formed when animal and plant remains are decomposed over the millennia and deposited in sediments. Crude oil is the raw material used for producing fuel.

D

Decibel – dBA
Unit for expressing sound level. A whisper is approximately 35 dBA, the pain-threshold is about 130 dBA. The EU limit for external noise level is 80 dBA.

Density
The quantity per unit of volume, length or area. In the case of substances, the weight per unit of volume.

Diesel engine
Engine which compresses pure air under high pressure thereby considerably raising the temperature of this compressed air. When fuel is injected into this hot air, it ignites and burns at the rate at which it is mixed with the air.

Diesel fuel
Petroleum-based fuel derived from crude oil. Diesel oils of various quality can be extracted depending on the degree of refinement and after-treatment.

Diesel oil
The most common type of diesel fuel.

Drag (aerodynamic resistance)
A vehicle body designed to reduce drag assists considerably in reducing fuel consumption and lowering exhaust emissions from the engine.

E

Ecological
Designation for something which takes place in harmonious cooperation with living organisms and their environment.

EDC
Electronic Diesel Control, offering electronic regulation of the diesel engine's fuel injection.

Efficiency rating
The ratio between the energy released and the energy used, expressed as a percentage. The efficiency rating of a diesel engine may be as high as 46 percent, compared to 30–35 percent for a petrol engine.

EMAS
The abbreviation for the EU's Eco-Management and Audit Scheme. An EU scheme under which companies can certify their facilities. The aim is to stimulate companies to further develop their environmental work in a systematic and uniform manner that goes beyond legal requirements. This requires a detailed plan with clearly established goals, an action programme and an evaluation of all vital environmental factors affected by operations. Companies shall also issue a public, annual environmental report on the environmental impact of their operations and their achievements.

Emissions
Discharge of chemical matter or energy to the surrounding environment, for example air pollution.

Emissions per tonne-km
Discharge of air pollutants calculated per kilometre for each tonne of transported goods.

Engine conversion
Adjustments made to an engine so it can run on alternative fuels, for example switching from diesel to natural gas.

Esterification
Chemical reaction when an ester is formed. (see esters).

Esters
Organic compounds formed through reaction between an acid and an alcohol with elimination of water.

Ethanol
An alcohol produced through fermentation of biological material containing sugar or produced synthetically within the oil industry. Ethanol can be used as engine fuel if necessary engine modifications are carried out. Compared with petroleum-based fuels, ethanol produced from biomass can offer substantial environmental benefits.

Euro 1 and 2
Exhaust emission standards for trucks and buses within the EU.

	NOx	Particulates
Euro 1 1993	*8.0 g/kWh* (9.0 g/kWh**)*	*0.4 g/kWh*
Euro 2 1996	*7.0 g/kWh*	*0.15 g/kWh*

*) on type inspection
**) on inspection in production

Exhaust filter
(See Particulate trap)

F

Freons
Trade name for chlorofluorocarbons (CFCs).

Fuel consumption
The amount of fuel an engine consumes during haulage. At a gross weight of 60 tonnes, a heavy-duty diesel-engine truck with a full load consumes about 40 litres of diesel fuel per 100 km.

G

Gas
Biogas or digester gas consists principally of methane. Digester sludge from sewage treatment plants is one source of biogas. Other sources are refuse dumps and digester plants for organic materials from agriculture or industry.

CNG – Compressed Natural Gas. The composition of this gas varies in different geographical areas. Natural gas contains more than 90 percent methane.

LNG – Liquefied Natural Gas. Another form of natural gas which must be stored at very low temperature. CNG is therefore more common for practical reasons.

LPG – Liquefied Petroleum Gas. LPG consists primarily of propane or propane/-butane. The gas that is most common in Sweden contains 90-95 percent propane and the remainder is made up of butane, propylene and butyl.

Glow plug
An electrically heated plug inside the combustion chamber of an engine. The glow plug assists in cold starts by heating the fuel.

Greenhouse effect
Incoming solar radiation is prevented from reflecting back to space by gases in the atmosphere, which act just like the glass panels in a greenhouse. This effect is essential for life on earth. However, certain human activities have led to an increase in proportion of such gases in the atmosphere, for instance through the discharge of carbon dioxide from burning fossil fuels. Man thus reinforces the greenhouse effect.

Gross weight
Maximum permitted weight for vehicle and load.

H

Heat coefficient
The amount of heat obtained from complete incineration of a specific quantity of a specified substance.

Heavy metals
Metals with a density (see above) in excess of 4.5 g/cm3, e.g. mercury, copper, cadmium, iron, lead, nickel and chrome. Most heavy metals are toxic but some of them are essential in extremely small concentrations for certain biological functions.

Hybrid power
A vehicle powered by more than one energy system, for example electricity as well as petrol.

Hydrocarbons (HC)
Organic compounds in exhaust emissions composed mainly of unburned fuel. They have an unpleasant smell and are suspected of representing a health hazard. The content of unburned hydrocarbons in exhaust gases can be reduced principally by improved combustion of the fuel.

Hydrogen gas
Hydrogen in gaseous form. A very lightweight gas, without colour or odour.

I

Injection pressure
The pressure at which the fuel is pressed into the diesel engine's combustion chamber.

Injection system
A diesel engine must be equipped with a high-pressure system consisting of an injection pump and injectors, designed to inject the fuel into the compressed air in the cylinder.

Injector
The part of the fuel injection system which

injects the fuel into the cylinder. It may have a differing number of holes to obtain the appropriate fuel distribution pattern. More holes results in more even fuel distribution and smaller droplet size, resulting in more complete combustion of the fuel.

ISO 14001
A standard for environmental management within the ISO 14000 series. (ISO = International Standardisation Organisation). ISO 14001 is a standardised way of working with classifications and programmes for continuous improvements in the environmental field. It is primarily considered an internal corporate management tool to ensure that a company's environmental work is of a certain quality. In general, a company that is certified in accordance with ISO 14001 has conducted a preliminary environmental audit and publishes an approved environmental report also meets standards for EMAS registration. An ISO 14001 certificate can be issued for an entire company.

L

Long CO_2 cycle
The carbon life-cycle which covers fossil fuels. Carbon dioxide is being released today from the burning of fossil fuels, but this carbon dioxide was bound in plant life through photosynthesis millions of years ago. The dead plants gradually formed into coal and oil. The opposite of the long CO_2 cycle is the short CO_2 cycle. Carbon dioxide is released when biofuels are burned and when dead organisms decompose, but this CO_2 is bound in living plants. By burning of fossil fuels, carbon dioxide is added to the atmosphere in excess of what is included in the short cycle. This is carbon dioxide which cannot be used up but which constitutes a net surplus and thus contributes to the accelerating greenhouse effect.

M

Methane
A colourless and odourless gas which is formed in various ways, for instance through the decomposition of plants in anaerobic environments and from waste in refuse dumps. Methane is also the principle component of natural gas. In addition, methane is classified as one of the so-called greenhouse gases.

Methanol
An alcohol (methyl alcohol) which is made through dry distillation of wood and other means, and which can be used as an alternative fuel.

N

Natural gas
Gas found in the earth's crust and consisting primarily of methane. Natural gas is a fossil fuel and is often extracted together with petroleum (see CNG).

Nitrogen (N)
Nitrogen is found in the air (78 percent by volume) primarily in the form of diatomic molecules (N_2) and in the earth's crust in the form of nitrates and ammonium compounds. In lakes and seas, nitrogen is found as a solute (N_2) and in the form of nitrate, nitrite and ammonium salts. Nitrogen is essential to all life and is also found in proteins. It is part of a complicated natural cycle involving the air, soil, water, plants and animals. Various human activities, among other things increasingly intensive agriculture and forestry and the burning of fossil fuels, have interfered with this natural cycle and lead to an increased concentration of nitrogen in lakes and seas (see Over-fertilisation).

Nitrogen oxides (NOx)
Chemical compounds of oxygen and nitrogen. From the environmental viewpoint, the most important are dinitrogen oxide (N_2O), nitrogen monoxide (NO) and nitrogen dioxide (NO_2). These contribute to acidification and over-fertilisation of soil and water.

In the diesel engine, it is possible to reduce the content of nitrogen oxides in exhaust gases by modifying the combustion of fuel in the engine. This effect cannot be achieved by the traditional method of using catalytic converters.

Noise
Undesirable sound. Vehicle traffic is one of the biggest sources of background noise in society today.

NOx
(see Nitrogen oxides.)

O

Oleiferous plants
Common designation for plants whose seeds and fruits yield oil, for example rapeseed (canola).

Operational range
The distance a vehicle can travel depends on its fuel supply.

Organic solvents
Solvents containing carbon. They dissolve oil, grease and other substances which are not soluble in water.

Otto cycle engine
Usually known as the petrol engine. It features an electric ignition system and spark plugs which ignite the mixture of fuel and air. The Otto cycle engine is most commonly used in automobiles.

Over-fertilisation – Eutrophication
The condition whereby the soil, the inland waters or the sea are supplemented with a greater quantity of nutrients (phosphorus or nitrogen) than the ecological system is capable of handling, causing a net imbalance. In lakes and seas, this can result in an excessive build-up of algae and vegetation which in turn can cause other types of water-based flora and fauna to die out. The subsequent decomposition of this increased amount of organic material may lead to a vast shortfall in oxygen on the bottom of the lake or sea, causing the mass extermination of bottom-dwelling organisms.

Ozone
A form of oxygen which consists of three oxygen atoms (O_3). At an altitude of 15-20 km, ozone is an essential shield which prevents incoming ultraviolet solar radiation from penetrating to the earth's surface.

At ground level, however, ozone is a toxic substance which poses a health hazard in high concentrations and which can damage agricultural harvests and forests. Vehicles emit both hydrocarbons and nitrogen oxides, and are therefore a major source of the increased ozone levels seen today.

Ozone can be regarded as a secondary pollutant since other pollutants are required for its accelerated formation. Ozone levels are not very high in urban areas partly because other chemical compounds present in urban areas tend to break it down, and partly because it takes a certain amount of time to form. High levels may therefore be noticed at great distances from the source.

P

Particulate trap
There are two types:
A ceramic exhaust gas filter in which the exhaust gases are forced from one duct to another through a porous wall which traps the particles.
A metal filter in which a metal mesh traps all passing particles. All types of filter must be burned clean at high temperatures. By coating the filter with a special catalytic agent, the combustion temperature can be lowered.

Particulate traps are specifically intended for retrofitting to vehicles powered by engines which have not been designed to meet future exhaust emission requirements.

Particulates (PM = Particulate matter)
Diesel exhaust gases contain soot particles which are coated with hydrocarbons and sulphuric acid. The soot core can be reduced by fine atomisation of the fuel, thus providing better combustion. If the aromatics content of the fuel is reduced, soot is also reduced. A low sulphur content in the fuel also reduces the proportion of sulphur in the particulates. Hydrocarbons can be reduced by more efficient combustion and by filtering the exhaust gases through a catalytic converter, which also removes the unpleasant diesel odour.

Petrol
A blend of hydrocarbons. The most common fuel used for Otto cycle engines.

Petroleum
(see Crude oil.)

Photochemical oxidants
Reactive compounds which participate in chemical reactions in response to sunlight, whereby they oxidise (give off oxygen) to other substances. Ozone is the most important of these from the environmental viewpoint.

Photosynthesis
The process by which green plants use solar energy to convert carbon dioxide and water into oxygen and carbohydrates (starch and sugar compounds).

Polycyclic aromatic hydrocarbons (PAH)
Polycyclic aromatic hydrocarbons, known as PAH compounds, are bound to the soot particles in the exhaust gases from diesel engines. Tests on animals have shown them to be mutagens (i.e. they cause genetic changes) and carcinogens (i.e. they give rise to cancer).

Powder painting
Painting process using paint in powder form. The colour pigment, hardener and other components are included but unlike other paints this type contains no solvent. There are several methods of applying this paint. In dip coating, the material to be painted is preheated and dipped in a mixture of powder and air, whereupon the paint melts onto the surface. In the frictional charge system, the powder particles are electrostatically charged and the paint is applied to the surface using a spray pistol. An electric field is created between the pistol and the earthed material, and the paint sticks to the surface. The material is then heated and the paint melts to form a smooth, uniform surface.

R

Rapeseed oil – canola oil
Vegetable oil which can be used as a fuel for engines.

Recycling
Utilising waste and other residual products. In terms of the conversion of a residual product, recycling can be divided into reuse, material recycling and energy extraction. Recycling may occur in several stages of the waste management process.

Refining
Improving crude oil through the "cracking" process.

Reformulated diesel fuel
Diesel fuel which has been subjected to a chemical process to improve its composition, e.g. by desulphuration and de-aromatisation. This process results in a fuel with lower harmful emissions.

Refrigerants
The operating agent in cooling systems such as refrigerators and air conditioning units.

It can absorb, transport and release heat by alternating between liquid and gaseous form.

CFCs (freons, see above) and ammonia are some of the agents used as refrigerants.

Older types of CFC contribute considerably to the greenhouse effect and thinning the ozone layer in the higher reaches of our atmosphere. Modern air conditioners use so-called "soft" CFCs which are less reactive and therefore less destructive to the ozone layer.

Return packaging
Packaging materials which, when emptied, can be returned to be reused, for example the Euro-pallet.

Reuse
Recycling a product in its existing condition by utilising its qualities, for example return packaging and the reuse of returnable bottles as containers for other products.

Rolling resistance
Energy is used up when a wheel rolls across a surface, in the form of tyre deformation and surface resilience. This, together with friction in the wheel bearings, adds up to rolling resistance.

Rolling resistance has been considerably reduced in recent years owing to immense progress in tyre design and other areas.

S

Solvents
Substances which are used to dissolve other materials. Can be water-based in certain cases. However, from the health and environment viewpoints, the organic solvents are worthy of more attention. They can dissolve oil, grease and other substances which cannot be removed with water and they contain volatile organic compounds (see below).

Soot
Finely ground coal which is formed owing to the incomplete combustion of organic substances.

Sulphur (S)
A chemical element which is found in fossil fuels and other sources. The content in crude oil, for example, varies depending partly on the conditions under which it was originally formed and partly on the degree of desulphurisation in the refining process. The discharge of sulphur from burning of fossil fuels is the main cause of soil and water acidification. If the sulphur content of a fuel is reduced, so too is the emission rate during combustion.

Sulphuric acid
The end product in the combustion of sulphur.

T

Transmission
The components which transfer the power produced by the engine to the driving wheels.

Transport work
Measurement for a quantity of goods transported a certain distance. This is expressed in units of tonne-kilometre.

U

UF concentrate
Ultrafiltration concentrate. Waste oil from the treatment of washing fluids and cutting emulsions.

V

Vegetable esters
In their original form, vegetable oils have limited use as engine fuels owing to their density, viscosity, cetane rating etc. However, if they undergo esterification, they take on characteristics similar to those of diesel fuel. Rapeseed oil methylester is just such a product which is becoming increasingly significant as an alternative fuel.

Volatile Organic Compounds
Abbreviated as VOC, these appear in such products as solvents, paints and petrol. VOC evaporates into the air as a gas at room temperature. They are sometimes known as hydrocarbons but in addition to carbon and hydrogen, they also contain other substances such as chlorine and oxygen. Emissions of VOC contribute to the formation of ozone and other photochemical oxidants at ground level. Certain VOCs are carcinogens.

W

Waste oil
Oil debris that collects as a result of machinery maintenance, oil separators etc.

Water-based paint
Paints and varnishes which use water as a solvent and diluting agent.

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