NOKIA

/insight:

Environmental Report of
Nokia Corporation 2000

The aims and scope of this report

Based on information collected mainly during the year 2000, this environmental report is addressed to our employees, customers and other stakeholders. The report explains Nokia's understanding of the environmental aspects of its activities and their impact, outlines a program for reducing adverse impact, and reports actions aimed at implementing the stated policies and goals.

Nokia previously reported on its environmental activities in the publication Nokia and the environment in 1999. Nokia's business review 1999 also included statements on environmental issues. There has been remarkable progress in environmental management and environmental performance at Nokia since we last reported on these matters.

Nokia and the environment reported the start of the systematic collecting of environmental data from production sites. Work continues on the development of data collection and the creation of performance indicators aimed at measuring the success of Nokia's environmental work to date.

This group-level report includes no systematic site-specific information. The case studies offer close-ups of the practical environmental work that is being carried out in the different parts of the organization.

Nokia supports efforts to develop uniform and globally applicable guidelines for economic, environmental, and social reporting. This report, which is limited to environmental issues, applies the general framework proposed by the Global Reporting Initiative in its Sustainability Reporting Guidelines.

This report, as well as in-dept financial and social information, is also available at Nokia's online corporate reporting site; www.nokia.com/insight.

For Nokia views on the safety of mobile telephones and Nokia activities in electromagnetic research, please consult www.nokia.com/insight.

For more information on environmental matters at Nokia, please contact:

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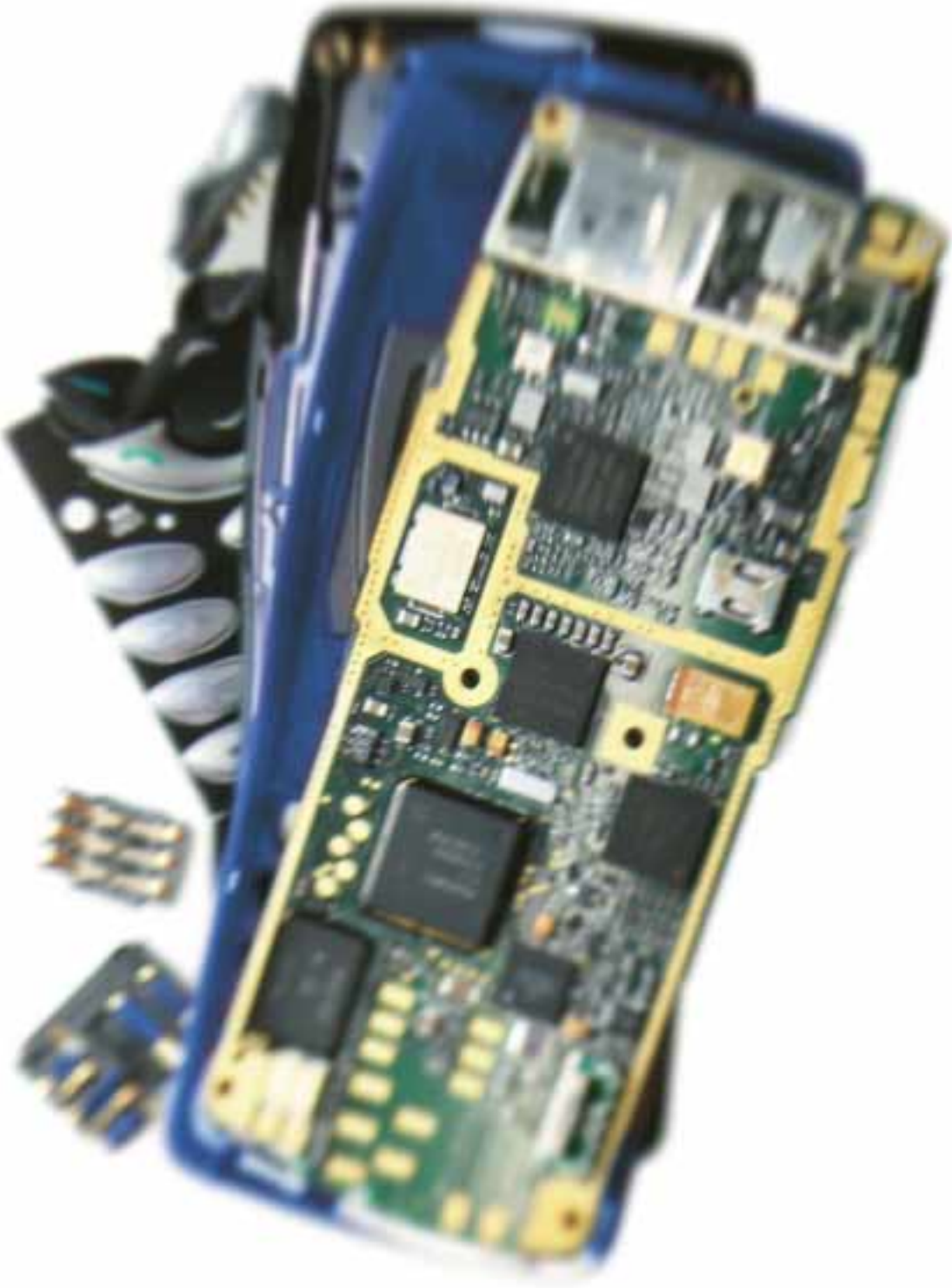


New freedom, new responsibilities

The new information and communication technologies that drive global economic development have the potential to open up new roads of sustainable development. Thanks to the dematerialization process that these technologies have started, a growing part of what we consume can be produced in the digital space.

The potential is there, but technology as such will not decide the course of development. Much will depend on individual lifestyle choices in the new context of freedom. Will we waste the saving made by transacting traditional business in the digital space by consuming materials and energy through other pursuits? Or will we accept that there can be no freedom without responsibility?

We at Nokia firmly believe that the global information age is fostering a new sense of social responsibility and we want to shoulder our share of that responsibility. Our commitment to the ideal of sustainable development means that we take responsibility for the consequences of our actions, striving to meet current needs without jeopardizing the rights or resources of future generations.

Globally operating industries increasingly want to establish uniform social and ethical operating principles, including principles of environmentally sustainable practices. Nokia supports this development and actively participates in global initiatives promoting uniformity. If companies were able to agree on the basic ground rules of sustainable development, we would no longer be locked in a zero-sum game and would instead be able to move towards a win-win situation.

Our environmental work is based on life cycle thinking. That means that we consider the life cycle adverse environmental impact of our operations and are committed to seeking to reduce this impact.

At Nokia, environmental work is not a separate field handled by specialists. Environment is everybody's business.

Cooperation and open communication are at the heart of our efforts to meet our economic, environmental and social responsibilities. Accordingly, Nokia supports initiatives to create a common framework for reporting on these elements of sustainability. This report is based on such triple bottom line thinking.

Nokia wants to participate in the joint enterprise of building new foundations for sustainable development.

Jorma Ollila
Chairman and CEO
Nokia
January, 2001

Executive summary

Nokia's environmental work is based on life cycle thinking. The goal is to reduce adverse effects throughout the product life cycle through environmental management of own operations, systematic supplier management, integration of Design for Environment into product development, and sound End-of-Life practices.

By the end of the year 2000, all Nokia production sites had ISO 14001 certified environmental management systems (EMS). Certification was piloted also at one R&D site. Nokia requires ISO 14001 certified EMS of its contract manufacturers.

The contents of the EMS in place vary somewhat,depending on such local circumstances as legislation, regulations and waste treatment capabilities. However, Nokia has decided to apply Nokia standards even in places where they are higher than the prevailing local standards.

Updated supplier requirements with revised environmental requirements were approved in 2000. Implementation started with the training of sourcing personnel and supplier audits based on the new requirements.

At Nokia, environmental activities are integrated into normal day-to-day business processes and ways of thinking. Design for Environment plays an important role in these activities and enters product development very early on.

Work has started on building a Nokia-wide database listing the material content – substances and quantities – of components used in Nokia products. The database is an essential Design for Environment tool and will help Nokia respond to restrictions on the use of substances. It will also help all parts of the organization give answers to inquiries on material content from customers and other stakeholders.

Efforts continued to develop environmentally preferable alternatives to substances that are to be restricted by forthcoming European Union legislation and other regulations. Alternatives are being developed for instance for lead, halogenated flame retardants, hexavalent chrome (chrome VI), cadmium and mercury.

In Nokia's view, recovery of products is a critical stage of economically and environmentally sustainable End-of-Life practices. Nokia offers its network equipment customers a takeback and recycling service. Different recovery and recycling options for mobile phones are evaluated and used.

Criteria have been determined for Nokia approved waste treatment and recycling companies. Instructions for auditing compliance with the environmental requirement have been drawn up.

In 2000, Nokia was selected as a component in the Dow Jones Group Sustainability Index and Nokia Mobile Phones, Europe & Africa won the European Quality Award in the Large Business category.

Veli Sundbäck
Executive Vice President
Corporate Relations and
Trade Policy of Nokia Corporation

Tapio Takalo
Head of Environmental Affairs

Profile of Nokia

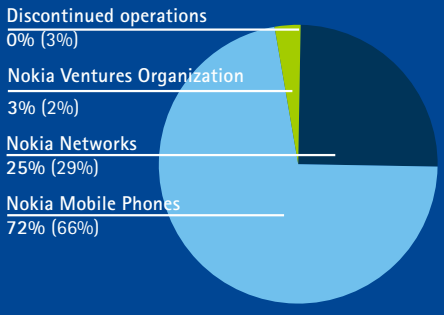
Business profile

Nokia is a world leader in mobile communications. The company's experience and innovation, combined with its user-friendly and reliable products and solutions, have made it the leading supplier of mobile phones and a leading supplier of mobile, fixed and Internet Protocol ("IP") networks. By adding mobility to the Internet, Nokia creates new opportunities for companies and further enriches the daily lives of people. Nokia is one of the most broadly held companies in the world, with listings on six major securities exchanges.

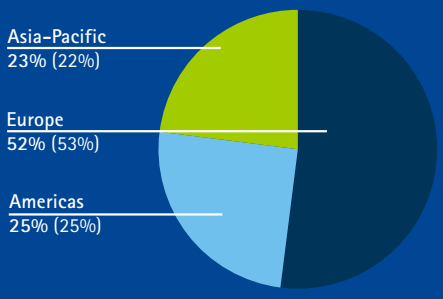
Nokia is comprised of two principal business groups – Nokia Networks and Nokia Mobile Phones – as well as Nokia Ventures Organization and a corporate research unit, Nokia Research Center.

At the end of 2000, Nokia had sales to over 130 countries. There were 23 production facilities, including joint ventures, in10 countries. Nokia had 55 research and development centers in 15 countries and a global network of distribution, sales, customer services and other operational units. Nokia employs 60 289 people.

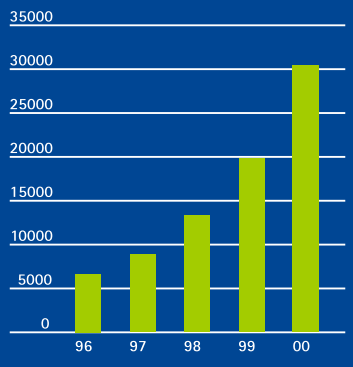
Net sales by business group
2000 (1999)



Net sales by market area
2000 (1999)



Nokia Group net sales
EURm



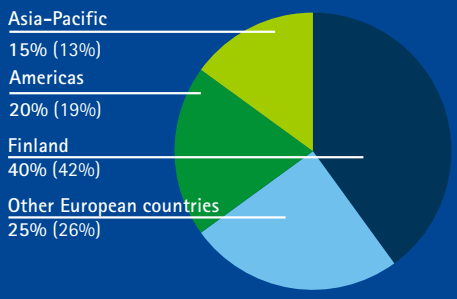
Nokia Networks is a leading supplier of mobile,broadband, IP network infrastructure and related services. Nokia Networks also develops mobile Internet applications and solutions for operators and Internet Service Providers. Nokia Networks's strategic intent is to be a pioneering partner in the era of mobile Internet and mobile multimedia.

Nokia Mobile Phones is the world's largest mobile phone manufacturer. With a product portfolio covering all consumer segments and cellular protocols, Nokia believes that it is in a strong position to lead the development towards a Mobile World. Nokia's mission is to enable people to connect with each other and access information regardless of time and place. Nokia's technology and applications are designed to meet human needs and are based on solutions that function together seamlessly and effectively.

Nokia Ventures Organization explores new business areas in order to facilitate future growth and boost Nokia's product and long-term business development. The organization develops innovative new business ideas to create a balanced portfolio of new, substantial and sustainable businesses outside the natural growth paths of Nokia's current businesses.

Nokia Research Center interacts closely with all Nokia business units to enhance the company's technological competitiveness. The center covers a full range of activities from the exploration of new technologies and concepts to their use in actual product development undertaken in the business units.

Personnel by market area



Nokia	2000, EURm	1999, EURm	Change, %
Net sales	30 376	19 772	54
Operating profit	5 776	3 908	48
Profit before taxes	5 862	3 845	52
R & D investment	2 584	1 755	47
Capital expenditure	1 580	1 358	16
Market capitalization	222 876	209 371	6

	2000, EUR	1999, EUR	Change, %
Earnings per share, basic, split adjusted	0.84	0.56	50

Personnel at year-end	2000	1999	Change, %
	60 289	55 260	9

Environmental profile

Nokia aims at reducing the environmental impact of its products over their entire life cycle. This requires a thorough understanding of the environmental aspects and impacts of the different stages of the long and complex process chain and extensive supplier network characteristic of the communications industry.

The whole Nokia network is instrumental in gaining this understanding and implementing the goals based on it. The network comprises in addition to Nokia business and research and development units, Nokia's supplier, logistics and end- of-life partners. Nokia's research and development organization keeps close contact with independent research institutions. The aim is to stay abreast of advances in basic research and to identify new environmental issues with a possible bearing on Nokia's business operations.

The information and communications industry has shared environmental goals. Nokia participates in industry-wide efforts to find economically and environmentally sustainable solutions to life cycle issues facing the whole industry, such as the collection and recycling of products at the end of their life cycle.

Life cycle thinking

The environmental aspects of Nokia products are linked with the use of materials and energy at the different stages of their life cycle. The environmental impact is associated with resulting waste and airborne and waterborne emissions.

Nokia uses life cycle assessment (LCA) of products to understand and evaluate the environmental burdens associated with a product over its whole life cycle. LCA is based on identifying and quantifying the energy and materials used, and the emissions and waste released to the environment.

Various LCA models have been developed, but more experience is needed before it becomes possible to carry out comprehensive quantified LCAs, bringing together the entire environmental burden of a product. However, even partial assessments are useful for guidance as to where to focus efforts at improvement.

The findings of life cycle studies help to identify focus areas for environmental work, including Design for Environment, at the most critical stages of the product life cycle. Studies have established for example that action targeted at supplier management can be more effective in reducing adverse impact from the total product life cycle than action targeting the assembly process.

Nokia products in LC perspective

Life cycle studies reveal similarities and differences among Nokia's main products, mobile phones and network equipment. For both types of products, the relative environmental impact of assembly at Nokia's production sites accounts for a very small part of the impact overall. The principal impacts of assembly at Nokia facilities are packaging waste, emissions caused by production of the energy consumed and emissions of volatile organic compounds (VOC), due to the use of solvents.

The life cycle profiles of different Nokia products are varied. For mobile phones, the upstream stages of raw material extraction and component manufacture account for the biggest part of the overall environmental impact. For network equipment, energy consumption during use accounts for the biggest part.

All Nokia products contain integrated circuit (IC) components. Component manufacture processes involve extensive side streams of material, resulting in significant volumes of non-recyclable waste. In addition, there are hidden material streams that do not issue in the product.

Component manufacture is energy intensive. A relevant difference between Nokia products is that network products contain a large proportion of metals whose processing consumes more energy than that of plastics, the dominant material, in mobile phones. On the other hand, metals can be more readily recycled than plastics.

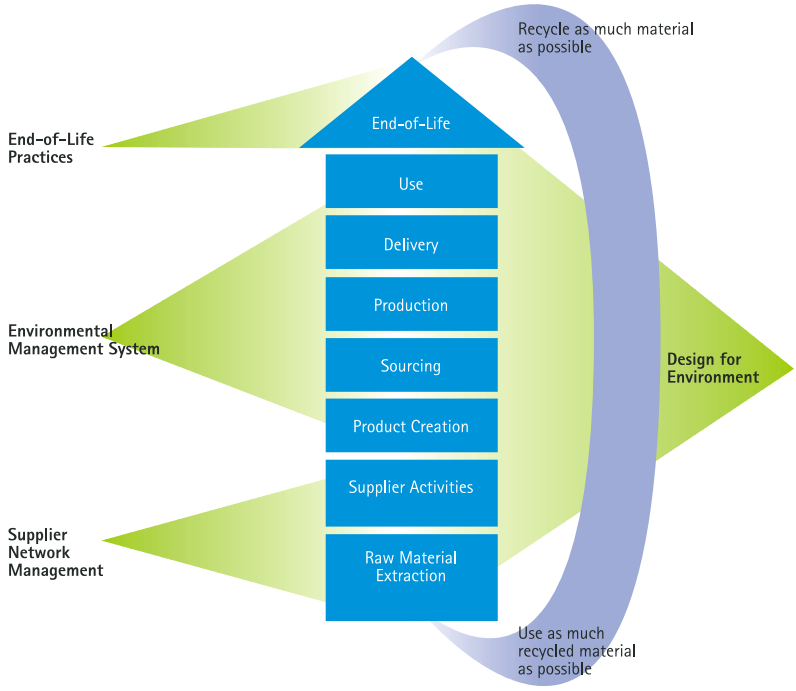
During the use of Nokia products, energy consumption has the greatest impact on the environment. At the disposal stage, the recycling of metals and plastics and proper handling of restricted substances are the central issues. Nokia is refining its methodologies to be able to measure the recyclability and disassemblability of its products.

Life cycle thinking in practice

In practice, life cycle thinking is aimed at reducing the adverse environmental impact of a product over its life cycle. Based on analyses of the environmental aspects of the life cycle of their products, the business units have identified focus areas for their environmental work.

The current focus areas are Design for Environment (for instance material issues, including packaging), environmental performance in the supplier network, integration of environmental issues into decision-making at every management level, and end-of-life practices.

Life cycle thinking in Nokia



Nokia's life cycle thinking is based on an assessment of the environmental impact of the product life cycle's different stages. Adverse impact is reduced by focused environmental work.

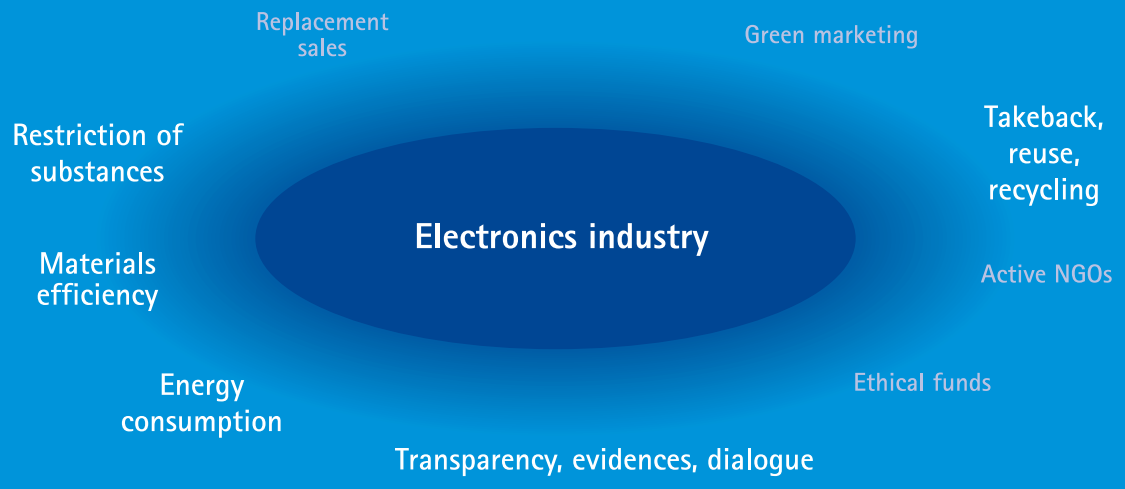
Vision and strategy

Nokia's business objective is to strengthen its position as a leading systems and product supplier in the rapidly evolving global communications industry. Nokia's strategic intent is to take a leading brand-recognized role in creating the Mobile Information Society by combining mobility and the Internet and by stimulating the creation of new services.

A key element of Nokia's vision of adding mobility in the Information Society is that the communications and information industry has the potential to transform man's impact on the environment. Many activities requiring large amounts of energy and raw materials could be transferred into digital space where their adverse environmental impact could be reduced. This potential opens up great opportunities, but also brings responsibilities.

A commitment to environmental issues is an integral part of Nokia's corporate culture. Our goal is to develop advanced human technology, products and services that have no undue environmental impact, are efficient in their consumption of energy and can be reused, recycled or disposed safely.

Besides life cycle thinking, Nokia's environmental strategy is based on an analysis of the changing operating environment that forms the context of the company's environmental activities.



Nokia strives to act proactively in an operating environment whose dynamics are determined by the interaction of a number of players and issues.

Materials efficiency

A key criterion in assessing the life cycle environmental impact of products.

Energy consumption

Energy consumption is one of the most important environmental aspects in all Nokia products and its reduction is an important design criterion.

Transparency, evidence, dialogue

Nokia strives for transparency through more efficient environmental communication, has initiated systematic collection of environmental data, and seeks dialogue with stakeholder groups in various forums.

Takeback, reuse, recycling

For instance the proposed EU Directive on Waste Electrical and Electronic Equipment (WEEE) is aimed at reducing the volume of electrical and electronic waste disposed without pre-treatment. Similar regulations based either on legislation or voluntary action are being developed in other regions, for example Japan.

Restriction of substances

The proposed EU Directive on the Restriction of the Use of Certain Hazardous Substances in electrical and electronic equipment aims at phasing out certain heavy metals and halogenated flame retardants from electronic products. The directive is due to take effect at the beginning of 2008. Similar regulations based either on legislation or voluntary action are being developed in other regions.

Policies and environmental organization

Nokia values and principles are the solid foundation for our business success, sound environmental stewardship and good corporate citizenship. The interrelated values and principles define the Nokia Way of approaching issues of business, employment, environment and society at large. The Nokia Way is the heart of Nokia's distinctive culture that unites the company across its locations.

Nokia Values

All Nokia employees are expected to adhere to the four core values of Customer Satisfaction, Respect for the Individual, Achievement and Continuous Learning.

Customer satisfaction is the basis of all Nokia operations. Nokia strives to discover customer needs, bring value to the customer and respect and care for the customer.

Respect for the individual means that Nokia believes in the individual, whether he or she is an employee, a business partner or a customer. It also means open and candid communication, fairness, mutual trust and acceptance of diversity.

Achievement presupposes that all Nokia employees know the goals of the company as well as those set for them. Working according to a strategy and well-defined goals achieves results. Leadership in the information and communications industry grows from innovation, courage and a constant willingness to learn.

Continuous learning means that in Nokia everyone is entitled to and expected to seek ways to improve performance.

Nokia wants to create an environment where employees, customers and suppliers and other partners feel they have the empowerment to develop and improve relations through common exchange and development of ideas.

Towards sustainable development

Nokia is committed to the pursuit of sustainable development. Underlining this commitment, Nokia signed the ICC Business Charter in 1991. Over the years, the aims and principles of the Charter have permeated daily operations at Nokia. This development and the simultaneous evolvement of the Nokia Way of doing business, with its commitment to the corporate values and good corporate citizenship, have supported implementation of a broader concept of sustainable development in Nokia operations. The broader concept of corporate social responsibility embraces social as well as environmental and economic issues.

The seven principles of eco-efficiency defined by the World Business Council for Sustainable Development combined with life-cycle thinking are of primary concern in developing, producing and delivering Nokia's products and solutions (see page 23).

Nokia's approach to the environment

Based on its resources, including technological know-how, market position and the continuous building of competencies, Nokia believes that it is well positioned to achieve its sustainable development goals, economic, environmental and social.

At Nokia, environmental management is integrated into business activities. Based on the principle of sustainable development, Nokia works continuously towards good corporate citizenship.

In environmental matters, implementation of the principles of sustainable development involves:

- Integration of environmental activities into business activities
- Active and open external and internal communication
- Cooperation within Nokia and between Nokia and external stakeholders, such as suppliers, industry and society at large in environmental matters.

Environmental policy

Nokia's commitment to continuous improvement in environmental issues is stated in the environmental policy, published in 1994. Implementation of the policy integrates environmental and business management, with line organizations charged with the implementation.

The basic principles of the environmental policy are:

- A successful business requires a solid product life cycle-based environmental performance.
- The Nokia Way means an active, open and ethically sound approach to environmental protection.
- The objective of Nokia's environmental policy is sustainable development in accordance with the ICC (International Chamber of Commerce) business charter (www.iccwbo.org).

Principles of implementation

The following principles guide and control the implementation of the environmental policy in the units:

- The environmental policy is part of the general management process.
- Line organizations plan and implement the action programs by using environmental specialists and the best available technology.
- The action programs are based on a thorough understanding of the environmental impact of a product throughout its life cycle.
- Minimizing the environmental impact requires continuous effort and follow-up on results; it is thereby a part of the total quality improvement process.

Goal areas

In the period under review, the goals for environmental management have been:

- ISO 14001 certification of the environmental management systems of all Nokia production sites as well as those of Nokia's main contract manufacturers.
- Integration of Design for Environment into the product development process.
- Integration of environmental aspects into supplier network management.
- Support for End-of-Life practices.

Good progress towards these goals has been achieved.

Environmental organization

Tapio Takalo, Head of Environmental Affairs, is in charge of all Nokia-wide environmental affairs. He reports to Veli Sundbäck, Executive Vice President, Corporate Relations and Trade Policy, who is responsible for environmental issues at the Nokia Executive Board.

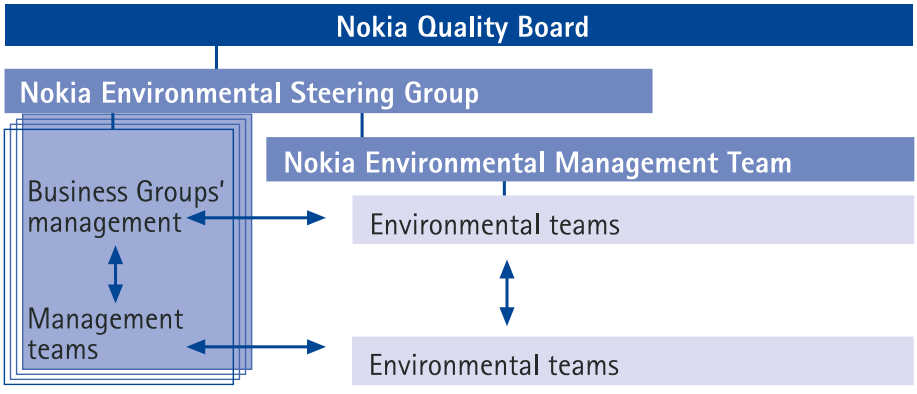
The environmental organization includes two Nokia-wide bodies: the Nokia Environmental Steering Group and the Nokia Environmental Management Team, which comprises representatives from the business groups.

The Nokia Environmental Management Team prepares proposals on environmental issues to be implemented on a Nokia-wide basis to the Nokia Environmental Steering Group. The Steering Group, chaired by Veli Sundbäck, prepares action programs and gives guidelines for business groups and line organizations. The highest decision-making body in environmental issues is the Nokia Quality Board, whose members include the Chairman and CEO of Nokia, the President of Nokia and the Presidents of the Business Groups.

These Nokia-wide bodies strive to ensure that the business group and unit level implementation of environmental activities is consistent with the environmental policy and that cooperation among business groups is efficient. All business groups have an environmental manager and environmental sourcing, production, product and end-of-life specialists.

At the business group and unit level, environmental work is integrated into normal business activities. The quality and process organizations act as facilitators in environmental issues and the daily environmental work is carried out in the line organizations. Each production site has a designated person responsible for the implementation and development of the site's environmental management system.

Communications Manager Outi Mikkonen is responsible for the internal and external communication of Nokia's environmental issues.



Nokia's environmental management is based on the principle that environmental work is carried out in the business units as part of normal business processes.

Stakeholder relations

Management of external and internal stakeholder relations runs through all Nokia operations. In this report, we discuss only those issues of stakeholder relations that are relevant to Nokia's environmental management and performance.

Cooperation in all stakeholder relations is at the heart of Nokia's drive for a credible environmental performance. The external stakeholders comprise the customers, shareholders, suppliers and other partners, non-governmental organizations (NGOs), governments, authorities and citizens of communities and societies in which Nokia operates.

Internal stakeholders

Nokia employees are the company's internal stakeholders. Nokia conducts global employee opinion surveys on an annual basis. The Nokia – Listening to you survey gives employees the opportunity to state their opinions about the company and their working environment. The results are used in developing the working environment Nokiawide.

The survey includes a statement probing the employees' opinion of Nokia's environmental performance. In 1996, 70 per cent of the employees regarded Nokia as an environmentally responsible company. The figure rose to 79 per cent in 1999 and remained at that level in the year 2000.

1996	70% of total favorable
1998	74% of total favorable
1999	79% of total favorable
2000	79% of total favorable

Internal environmental communication

The environmental performance of Nokia rests on the competence and motivation of the Nokia employees. At Nokia, it is intended that environmental issues form an integral part of everybody's business. Communication and training play a key role in translating goals and guidelines into practice throughout the organization. Nokia believes that a company that is seen to be environmentally responsible is in a better position to attract and retain employees.

The global environmental training program aimed at Nokia employees is regularly updated. The program comprises a slide set and a video, which presents a comprehensive view of Nokia's environmental policy and life cycle thinking as well as communicating management's commitment.

Nokia employees also have access to regularly updated environmental Intranet sites and a database for environmental information. Nokia Environmental Forums are aimed at all Nokia employees interested in environmental issues and developments in the electronics industry. Forums provide an open floor for discussions, presentations on the latest developments by both internal and external environmental experts, and updates on environmental activities in the business groups and business units. The Nokia Environmental Forum is organized twice a year.

Environmental issues are regularly discussed in Nokia's global in-house magazine, Nokia People. In 2000, a total of eight articles dealt with environmental issues.

External stakeholders

Environmental communication includes dealing with inquiries and questions from various stakeholder groups. Nokia participates in environmental forums globally and locally. As a member of "CARE Vision 2000", Nokia was one of the sponsors of the Electronics Goes Green 2000 conference, held in Berlin, Germany. The company conducts dialogues with stakeholder groups in many environmental forums, such as Managing the Industrial Business Environment (MIBE), an environmental research project coordinated by the International Institute of Management Development (IMD).

Sustainable shareholder value

In November 2000, Nokia was selected as a component of the Dow Jones Sustainability Group Indexes (DJSGI), the world's first index family tracking the performance of the leading sustainability-driven companies worldwide. The DJSGI consist of 236 companies from 61 industries in 27 countries, representing the top 10% sustainability companies worldwide.

David E. Moran, president of Dow Jones Indexes, states that "Being a component in DJSGI means public recognition of being industry leader in social, environmental and economic strategic areas. Investors and other important stakeholders such as legislators, customers and employees are attracted to corporate sustainability because it seeks to create long-term shareholder value by embracing opportunities and managing risks associated with economic, environmental and social developments."

Further distinctions achieved by Nokia in 2000:

- The European Quality Award was awarded to Nokia Mobile Phones Europe & Africa; criteria for the award included environmental factors
- The World Business Council for Sustainable Development (WBCSD) invited Nokia to become a member
- Nokia and the Environment publication received the Newcomer of the Year award in Finland in its category of environmental reporting. The competition was organized by the Helsinki School of Economics and Business Administration, the Finnish Institute of Authorized Public Accountants, the environmental organization Elinkaari and the business daily Taloussanomat.

Nokia in Society

Nokia strives to reduce the adverse environmental impact of its technology, products and services. Nokia also respects and promotes human rights and acts as a responsible member of society. In Nokia's view, ethical conduct and corporate citizenship issues are an integral part of environmental thinking.

As a corporate citizen, Nokia supports charitable, educational, human rights and community activities through donations and other resources. Nokia endeavours to be a good corporate citizen wherever it operates, and is dedicated to the improvement of life skills and the creation of an environment that fosters open and creative thinking.

Nokia's belief is that every individual should be treated with genuine respect and encouraged to achieve full potential. The promotion of skills, knowledge and the social affairs of youths fit in naturally with Nokia's values and creates a foundation for the future. Through programs such as Class Link and our work with the International Youth Foundation on the 'Make a Connection' program, Nokia aims to nourish meaningful connections between youths and their families, peers and communities, promoting the best practices across all borders.

Participation in industry cooperation

Nokia participates actively in the work of industry associations at national and international levels, with the aim of fostering closer cooperation among businesses, governments and other organizations concerned with the envi-

ronment and sustainable development. As a member of the World Business Council for Sustainable Development, Nokia shares the coalition's commitment to sustainable development, i.e. environmental protection, social equity and economic growth. The WBCSD's seven principles of eco-efficiency are an important guideline in Nokia's environmental work.

Membership in industry associations enables Nokia to contribute to the development of legislative requirements and voluntary agreements. Nokia is for example a member of the European Information and Communications Technology Industry Association (EICTA) and the European Association of Consumer Electronic Manufacturers (EACEM) and takes an active part in their environmental work. Among the topical issues on the EICTA and EACEM agendas is the emerging European Union legislation concerning recycling of electrical and electronic waste and restriction of the use of hazardous substances and Code of Conduct on Efficiency of External Power Supplies.

In the US, Nokia is a member of the Cellular Telecommunications Industry Association (CTIA), the Electronic Industries Alliance (EIA) and the American Engineering Association (AEA).

Training works at Haukipudas

Eija Heikkinen is responsible for environmental training at Nokia Networks' Haukipudas production site in Finland. She says that the objective for the year 2000 was to train 75% of the personnel. Part of that goal is achieved through basic site training that is given to every employee. Those responsible for environmental issues at the production lines receive special training, including for example visits to recycling companies. The sourcing department is responsible for the environmental training of the purchasing personnel.

"It only takes a couple of days to train the first 500 employees. It is a harder job to motivate office staff to join the effort," Eija says.

The training includes some theory and a practical overview of waste and recycling issues. Nokia's environmental video, slides and other material have proved to be good training material, and so have the actual waste containers and labels.

"The best way to teach is to go through the contents of a waste container and think what items in it could have been passed on to recycling. Once people have an idea of the volume of waste, it is easy for them to understand that small improvements can bring big savings," Eija remarks.

To increase environmental awareness, a recycling competition was arranged with a view to identifying new ways to utilize waste.

According to Eija Heikkinen, the response to the training has been positive. The messages of environmental benefits, cost savings and enhancement of the company's image have hit home. The task for the future is to maintain the enthusiasm necessary to keep up with the ISO 14001 certificate's requirement of continuous improvement.

Training has brought results at Haukipudas. In 1999, 69% of solid waste ended up in the landfill. The target for 2000 was to reduce the landfill proportion to 52%. By November 2000, the landfill proportion had sunk to 43%.

Plant a tree today

Nokia celebrated its 15th anniversary in China by launching a nationwide volunteer tree planting campaign during the spring season. Highlighting the corporation's determination to root deeply in China, the event also served to plant hopes for China's volunteer environmental protection drive.

March 12th is the Tree Planting Day in China. Nokia and its joint ventures started a nationwide volunteer tree planting campaign. Among the cities involved are Beijing, Shanghai, Guangzhou, Chongqing, Zhengzhou, Taiyuan, Huangzhou, Fuzhou, Kunming, Dongguan, Shijiazhuang, Guilin, Suzhou and Haikou. "The campaign was established under the auspices of Nokia Forestry or Friendship Forestry together with our partners, government officials, customers and suppliers," says Liu Chijin, Vice President for Business Development in China.

Vice Minister Lou Qingjian and Zhang Chunjiang of the Ministry of Information and Industry joined the event in Beijing and unveiled the Friendship Forestry together with Nokia. There were some 5000 people participating in the events in total across China, including Nokia staff, Nokia partners, customers, suppliers, and family members. It is estimated that the number of trees planted reached 8000 and covered 150 000 m^2.

According to Liu Chijin, Nokia plans to make the tree planting initiative a long-term project.

Help for Hungary's heart and soul

In February 2000, the dam of the Aurul gold mine at Baia Mare, Romania broke. More than 100 000 m^3 of cyanide polluted water was washed into little creeks and from there to the Somes, Lepos, Tisza and Danube rivers. The poisonous water killed fish, birds and aquatic vegetation in the upper stream of the river. At the same time the two main sources of livelihood in these regions, fishery and tourism, were destroyed.

The Tisza River is the second longest river in Hungary and is considered to be its most beautiful. It is often called Hungary's heart and soul.

The most polluted area is located in Hungary's poorest region, where most of the people have earned their living from the river. The recovery of the river's ecosystem will take years and meanwhile these people are forced to look elsewhere to earn their living.

The communications manager of Nokia Hungary, Anna Simai, tells how the news touched Nokia's employees there. On the employees' initiative, Nokia decided to participate in support of acquiring new water monitoring equipment for the river. The results of the monitoring will be published on a regular basis to inform the people when it is again safe to eat fish from the river and return to the area for holidays.

"There has been a lot of positive feedback from our employees. Also the Hungarian government has recognized Nokia's contribution," says Anna. "Many other companies have followed Nokia's example and have participated in efforts to help the river recover."

Management performance

Nokia applies global operating standards for business practices, transfer of technology and management systems throughout its business units. These standards are applied when establishing a new site in any country. Nokia has a large number of contract manufacturers who share the company's technology and expertise. The company encourages its partners to adopt Nokia guidelines insofar as they are applicable, taking into account local requirements.

Nokia's basic principle is that environmental matters are not isolated from overall management. They are to be integrated into the unified management system. Putting this principle even more firmly into practice has been one of the focus areas in the period under review. The role of the business units' environmental specialists is to help management to include and execute environmental considerations in product development and manufacturing, supply chain management, real estate management, legal compliance and risk management.

Research & Development

Nokia Research Center supports environmental work in the business units. This involves, among other things, the monitoring of emerging environmental issues, impulses to development work, such as development of lead-free solders, and development of such concepts as Design for Environment.

The main focus in R&D work in the business is currently replacement of selected hazardous materials – certain heavy metals, lead in particular, and halogenated flame retardants. This work is closely connected with and supported by research into the material content of products.

Testing and development of various End-of-Life alternatives is another important R&D focus in the business units.

Environmental management systems

It was decided in the late 90's that all Nokia production sites should build an ISO 14001 certified environmental management system (EMS). This was followed by a decision to certify the systems and to require the same of Nokia's main contract manufacturers.

By the end of 2000, all the production sites of Nokia had an ISO 14001 certified environmental management system. With the exception of the very latest acquisitions, Nokia's main contract manufacturers also had such systems. With new facilities, the policy is first to build a certified quality management system as a basis for the EMS. Based on accumulated experience and expertise, an EMS can be built and certified at a new site within one year.

Environmental management of Nokia's office and R&D facilities is emerging as an important issue. Measured by floor space, those facilities account for a larger share of Nokia's real estate than the production facilities. In October 2000, the Tampere R&D site was awarded an ISO 14001 certificate as the first non-production facility. The Tampere EMS was a pilot project whose results will be utilized if and when similar systems are built for other R&D facilities.

The contents of an Environmental Management System vary somewhat depending on local circumstances such as legislation, regulations and waste treatment capabilities. However, Nokia has decided to apply Nokia standards even in places where they are higher than the prevailing local standards.

The control of environmental impact afforded by the EMS is being extended from Nokia's own operations to those of its suppliers. Nokia will offer EMS support to manufacturing partners and other suppliers. EMS plays an important role in Nokia's new supplier requirements.

Supplier management

New requirements

Nokia buys an increasing amount of components and assemblies from suppliers around the world. The suppliers' activities account for a substantial part of the life-cycle environmental impact of Nokia products. It is an integral part of Nokia's supply chain management to ensure that

The new global Nokia Supplier Requirements, approved in 2000, state a number of requirements on environmental management:

Environmental Management System
The Supplier shall have a documented Environmental Management System in accordance with requirements of the ISO 14001 or other internationally recognized standard.

Environmental Policy
The Supplier shall have an up-to-date, documented Environmental Policy including commitment to environmental protection, prevention of pollution, compliance with environmental legislation and continuous improvement. The policy shall be effectively communicated to and understood by the whole organization. The supplier shall also be able to provide evidence of implementing the policy.

Legal Compliance
The Supplier shall know the environmental legislation and applicable regulations, and comply with them.

Programs for Improving Environmental Performance
The Supplier shall have identified the significant environmental impacts of its operations, and have improvement programs for them. These programs cover e.g. efficient recycling/disposal of waste materials and improving treatment and control of emissions to air, water and soil. The Supplier shall be able to provide supporting data.

Suppliers' Environmental Performance
The Supplier shall evaluate its Suppliers' performance, and set environmental improvement targets as necessary. If a Subcontractor is used for waste disposal the Supplier shall determine if that Subcontractor is correctly authorized and licensed through on-site inspection or third party certification.

Design for Environment
The Supplier shall take environmental issues into consideration in all phases of product development and manufacturing process design, e.g. with specific Design for Environment tools or defined checklists. Choices made during this work should reduce or eliminate negative impacts in the environment.

The Supplier shall record the raw material contents of its products supplied to Nokia, and provide end-of-life treatment recommendations for them. This requirement is currently not assessed. The record must be available to Nokia upon request.

the suppliers comply with Nokia's supply chain requirements. The approval of a supplier as a Nokia supplier involves quality and environmental auditing.

The requirements in effect encourage the suppliers to build a certified EMS, as the possession of it entails compliance with the requirements, barring the last two. They also extend the control of the life cycle environmental impacts of Nokia products one step further upstream towards the suppliers' suppliers.

The implementation of the new requirements is backed up by a program directed at the top suppliers to the manufacturing system. These suppliers provide the overwhelming majority of the components and subassemblies used in the assembly of Nokia products.

The program involves auditing of suppliers in accordance with the new requirements. The audits were started in 2000. The program further includes training and information. The training of Nokia's global sourcing organization was initiated. By the end of 2000, about half of the sourcing personnel had undergone the one-day training. The entire body of relevant personnel will receive the training. The aim of the training effort is to make sure that environmental issues form part of the normal supplier management process rather than remaining a matter only to be handled by environmental specialists.

A central issue in the audits has been that the improvement programs contain significant environmental aspects of the supplier's activities.

Nokia can support a supplier to meet the requirements by for example directing it to the right source of information, but it is Nokia's principle that the suppliers shall accomplish by themselves what is required for compliance with the environmental guidelines. In 2000, support action involved some training.

To help the sourcing personnel and the suppliers to understand the requirements, their background and contents and implementation practices more deeply, a brochure, Nokia Suppliers and the Environment, was produced and distributed. The brochure explains the new environmental guidelines in detail (www.nokia.com/insight).

Life cycle perspective

The two last points of the new supplier requirements – declaring the raw material content of products delivered to Nokia upon request and providing end-of-life treatment recommendations for those products upon request – mark a significant step in implementing life cycle thinking at Nokia. Design for Environment (DfE) decisions rely on and impose requirements on the raw material content of components. Accurate information on the raw material content is equally important for recycling arrangements.

In 2000, a template was created to serve as the tool for the collection of raw material content. Collection of the data starts at the beginning of 2001. The collected data will be stored in the Nokia-wide material database, accessible to all the business units.

End-of-Life recommendations from the suppliers will help disassembly, recovery and recycling.

Legal compliance and risk management

Nokia is committed to compliance with all applicable laws and regulations. Nokia's legal offices assist personnel dealing with environmental issues in interpretation of legislation. Nokia has personnel at regional levels responsible for following the development of new legislation and disseminating information to those concerned. At a local level, the personnel responsible for environmental issues follow the development of environmental laws and regulations, working in active cooperation with local authorities.

The ultimate goals of Nokia's risk management are to ensure customer satisfaction, to protect shareholder value, protect company brand and image and instill risk management principles into the daily operating procedures of all Nokia personnel so that all employees proactively implement risk management practices in their daily work.

Nokia Risk Management supports business units in mitigating risks that threaten the health and safety of people, company assets, the environment, and continuity of production.

In order to manage risk, systematic risk analyses and surveys are conducted together with a corporate risk manager, line management and an insurance company. The Risk Management department works continuously to increase risk awareness within Nokia, conducts risk surveys and risk assessments, brings up loss prevention aspects in the design and building of real estate, and sees to insurance matters. The risk surveys and assessments form a base for further design of buildings and establishing alternative operating strategies to restore critical functions quickly after accidental damage occurs.

In mergers and acquisitions due diligence is conducted among other things to control the validity and conditions of permits and related responsibilities.

Liabilities

No occurrences causing any spills or toxic releases were reported in Nokia operations globally in 1999.

In 1999, Nokia was fined once on an environmental issue. The fine of $38 000 was issued by the US Federal Aviation Agency for failure to ship material labeled hazardous by proper means. A testing device containing hazardous components was shipped by air, rather than by ground. Air shipment would have been proper if the appropriate exemption certificate would have accompanied the shipment. No harm to the environment or any person was caused.

In 2000, there were no events giving rise to liabilities for Nokia.

Side by side with our suppliers

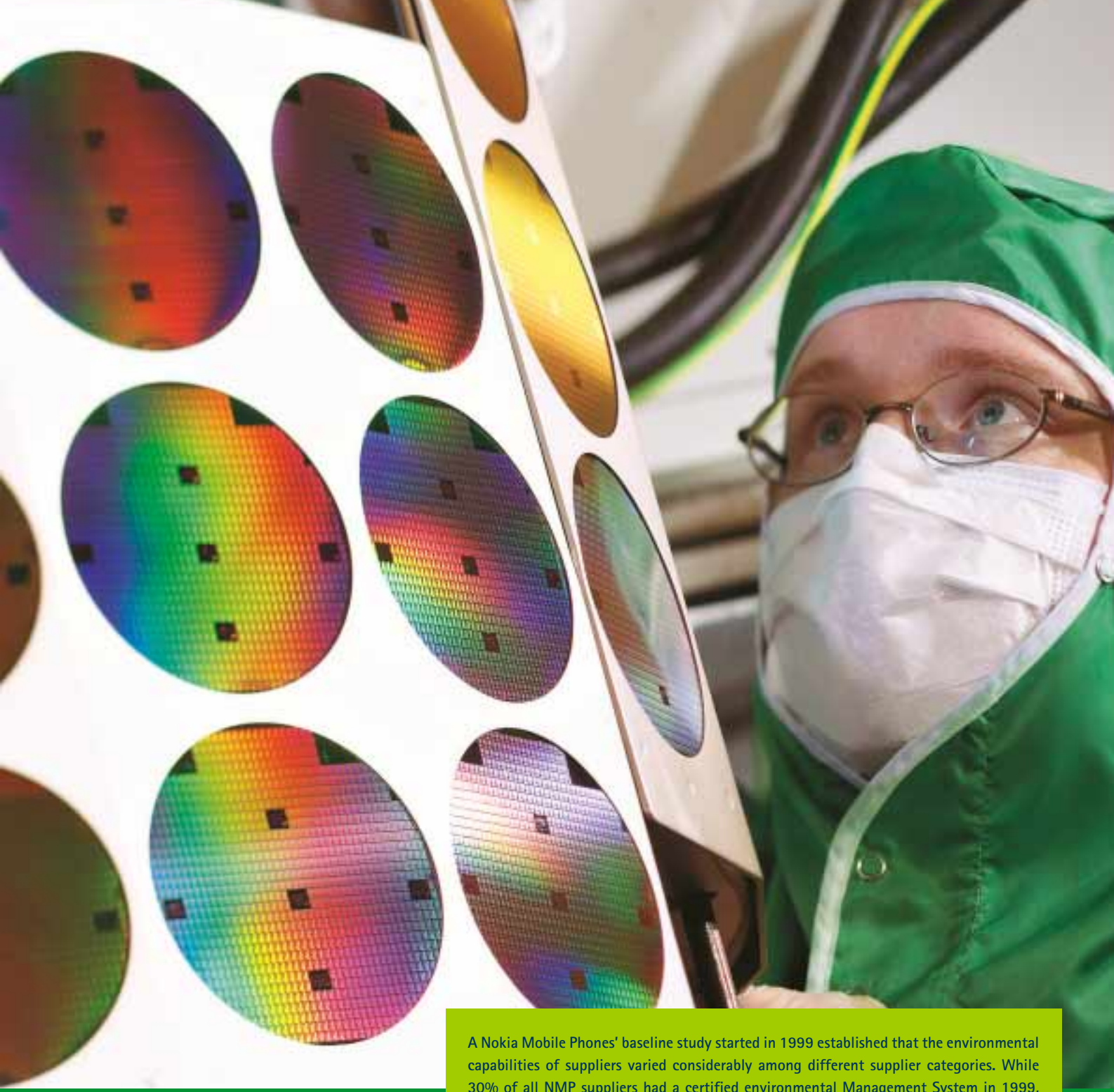
Managing the environmental impact of base stations is a challenge with the average cellular base station containing a wide range of subassemblies and components. Working together with the suppliers, Nokia tries to ensure that the subassemblies are manufactured in an environmentally responsible way.

"We treat our suppliers like true partners," says David White, Environmental and Safety Manager, Americas. "My team and I try to be involved with a prospective supplier right from the very beginning." Typically, once the necessary components for a product are identified, the sourcing department searches for an approved vendor.

That is when David and his team step in. "We have a questionnaire that we send out to suppliers which asks how they manage their processes from an environmental perspective," he explains. The questionnaire acts as a small-scale environmental audit, which focuses specifically on the components that Nokia is using.

David describes the process after the initial assessment as a sharing session. "We sit down with the supplier and review the process and how they fit in with our own environmental objectives," he notes. In many cases, the supplier has a strong environmental awareness and has put into place ISO 14000 certified Environmental Management Systems.

In other cases, the supplier has some work to do and this is when David and his team become true partners. "I tell them to consider me their newest team member. I'm willing to do anything I can to help them in reaching the necessary environmental objectives," he reveals. "It's a fundamental part of my job."



In the end, David prefers to work with suppliers to help them develop their own environmental management systems if necessary. This avoids the need for costly, specialized processes later on in the supply chain. "By working with suppliers to minimize the amounts of hazardous constituents in a component through design, we save money for everyone," he says. "The environment benefits, we benefit and suppliers benefit."

For Nokia, having suppliers that conform to accepted environmental standards is a necessity. David feels that "if our suppliers are environmentally negligent, it reflects badly on us. This is a great chance for us to work with our suppliers and improve the environmental impact of the whole supply chain."

A Nokia Mobile Phones' baseline study started in 1999 established that the environmental capabilities of suppliers varied considerably among different supplier categories. While 30% of all NMP suppliers had a certified environmental Management System in 1999, over 70% indicated that they'll achieve the certification in two years' time. Substantial differences in environmental management level could be found between different commodity groups; also, that large multinational companies were well ahead of smaller size companies in their environmental work.

The questionnaire that formed the basis of the study included several questions on the suppliers' readiness to help Nokia with implementation of life cycle thinking. Of all the suppliers 47% were setting environmental criteria for their suppliers and a little over half of those also audited compliance with the criteria. The total of those using a Design for Environment system was again 47%. A high proportion of the suppliers questioned, 87% in all, were prepared to declare the material content for products delivered to Nokia, while less than half of those asked said they were able to provide an end-of-life treatment for the delivered materials.

The study will be repeated in early 2001 to establish progress.

Operational performance

Environmental management implementation

The building and certification of environmental management systems at all Nokia production facilities has involved careful analysis of the environmental aspects of the operations and the environmental impact of those aspects.

The EMS building has brought concrete results. Focus on energy consumption and reduction and sorting of waste has increased efficiency and produced significant savings. Environmental training and review of health and safety matters form part of the basis for the continuous improvement required by the EMS.

The EMS work has confirmed that **energy consumption** is one of the most important environmental aspects of Nokia's production. The main environmental impact of energy consumption is airborne emissions from energy production at power plants that supply Nokia with the electricity and heating energy it uses. In addition to energy bought from utility companies, some Nokia sites use natural gas and small amounts of oil.

From a global perspective, emissions of carbon dioxide and other greenhouse gases are regarded as having the most important adverse environmental impact of energy consumption. Of the other airborne emissions, the emissions of nitrogen oxides are the most significant in view of the fact that no technology exists for their effective elimination.

The EMS building has confirmed that **solid waste**, in particular packaging waste, is one of the most significant environmental aspect of Nokia's production. Careful study of waste streams, sorting of waste into different recyclable fractions and new packaging solutions have achieved big reductions in the volume of waste at all the sites.

To achieve a positive environmental impact, sorting of waste requires the infrastructure for the collection and recycling of the different fractions. In certain countries this infrastructure is advanced and working, while in some others it is still in the early stages of development. Nokia's goal is to reduce to a minimum all waste fractions, especially those destined to end up untreated in landfill. For instance at Nokia Mobile Phones' Salo site the landfill proportion was only 25% in 1999.

At Nokia sites, materials currently suitable for recycling include cardboard, paper, metals, plastics, electronic waste, wood and toner cartridges. Some sites also collect biowaste/food for composting. Composted waste is classified as recycled.

Packaging materials constitute an important aspect of waste management. The main packaging materials of incoming components are cardboard, paper and different types of plastic. Nokia reduces, reuses and recycles incoming packaging materials as much as possible. Employees actively seek opportunities to reduce the volume of packaging materials and to exchange non-recyclable materials to recyclable ones. This requires close cooperation with suppliers.

Good results have been achieved through the reuse and recycling of packaging materials. Nokia has stopped using polyvinylchloride (PVC) plastic in packaging and has replaced polyurethan foam with materials based on natural fibers. A growing volume of packaging is returned to suppliers to be reused.

The **air emissions** of Nokia facilities are small. Volatile organic compounds (VOC) arise from the use of solvents in cleaning during the soldering process. Nokia is working to minimize the use of solvents causing VOC emissions. VOC is associated with odors and production of low-level ozone, which is harmful to animal and plant life as well as being a major constituent of photochemical smog.

Water at Nokia sites is mainly used for sanitary and catering purposes, with small volumes used in the production processes. As a result, total water consumption at a plant depends on the number of employees.

At a typical Nokia site, water consumption is less than half of the average household water consumption in Finland and about one third of that in the US. (In Finland, consumption is 50m^3/person/year; in the US, the figure is 69m^3). In order to further reduce the use of water, it is Nokia's policy to install new water-saving armature when buildings are renovated.

To be a good corporate citizen in China

Beijing Nokia Mobile Telecommunications (BNMT) was the first of Nokia's factories in China to get an ISO 14001 -certificate. The cross-functional team lead by Quality Manager Chen Min began its work in 1998 under the quality organization and in June 1999 the factory received the certificate.

"There was a need for the environmental management system," says Ren Shuifang, Quality System Engineer, who was building the system. "Laws and regulations, as well as competition put pressure on us. We saw also possibilities for savings and improved reputation which this system would bring."

In China, environmental awareness is growing all the time. "The government has put emphasis on environmental issues," says Chen Min. "For instance, the state organizes an Environmental Protection Day and Beijing's target is to be 'Green City 2008', when the Olympic Games might take place in China."

"The environment is getting better in Beijing. When I came here two years ago the air was very polluted. Now its is significantly better," explains Antti Wäre, Vice President, China, Customer Operations, Nokia Networks. Antti added that Nokia aims to be 'a Good Citizen of China' and EMS helps that, as do environmental campaigns like the tree planting carried out by Nokia's employees and customers (read more on this initiative on p. 13).

EMS has brought savings, especially in packaging costs. Sales of recycled materials, for example paper, have also increased income.

One of the future challenges is the auditing of recyclers and suppliers. As well, moving to a new factory provides work for the EMS team: The environmental aspects should be taken into account in the new factory, where the certification scope expands and energy savings should be gained when building new facilities and choosing tools.

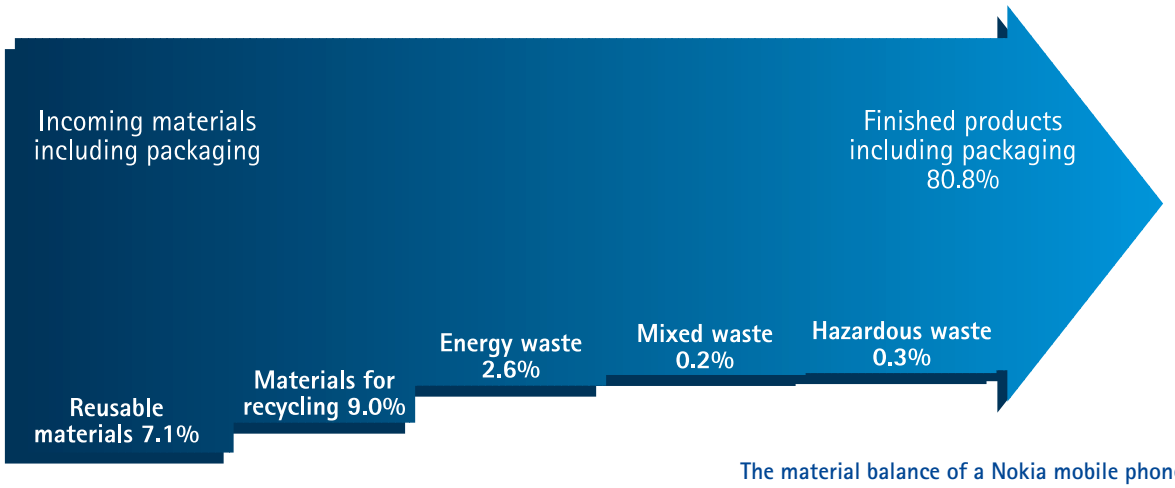
"The interest of our people in environmental issues is growing, but we still need deeper training to make people realize and accept their responsibilities, says Ren Shuifang."

Recycling pays off

A waste study conducted at the Nokia Networks Oulu facility as part of the building of an EMS in 1997–98 revealed that only 22% of all the waste produced was recycled. Esko Nurmi, who is responsible for waste management and recycling in Oulu, says the volume of landfill waste could be significantly reduced during 1999. In 2000 some 58% of all the waste was recycled. In 2001, the figure should rise to 60%.

According to Esko, the goal is that recycling should cover the greatest part of waste management costs. This goal was nearly attained in 1998, thanks to the wave-soldering machine that produced as by-products tin that also contained precious metals. Currently, metals used in printed wiring boards can be recycled while the glass fiber board can be utilized in energy production within the recovery process.

Recycling has been tested in various projects in Oulu. Esko says that one area where a lot remains to be done is plastic recycling. Impurities are one reason for the slow progress. Impurities, such as paper labels glued to plastic component boxes, easily block the jets of plastic molding equipment.



The material balance of a Nokia mobile phone
80% of the incoming materials to a factory are incorporated in the product. The share of reusable and recylable waste materials is 16%.

Environmental training has been given to all Nokia production personnel in connection with EMS building. Personnel whose tasks involve handling of substances that can cause a risk to the environment have received special training as part of the EMS process.

Transportation of products

Transportation is perhaps the most obvious environmental aspect of logistics, the coordination of the process chain. Transportation of components from suppliers to Nokia's production sites and of products to customers has an environmental impact through emissions of greenhouse gases from combustion of fossil fuels. Ways to reduce this impact include logistics planning and product and packaging design.

In an earlier study, the environmental impact of transportation was calculated for two alternative logistic solutions for production of two Nokia products, a mobile phone and a base station controller, on the basis of driven ton kilometers. In one alternative, components were transported to Finland for assembly and the products then transported to China. In the other, assembly took place in Germany and the products were transported to customers all over the world. The conclusion was that in both cases the transportation of the products to the customers consumed two to three times as much energy as the transportation of parts to the production site. In the light of this finding, the establishment of new production sites in the middle of growing markets decreases the overall environmental impact of transportation.

Market demand and competition have had an environmentally beneficial impact through the reduction of the weight and size of products. Smaller products with more software substituting hardware take less space in transportation. Similarly, packaging design can be used to reduce total weight and save space in transportation.

The Oulu way of saving energy

Nokia Networks' Rusko factory in Oulu, Finland, was the first of Nokia's units to be awarded the ISO 14001 certificate. The certificate requires continuous improvement in environmental issues. An energy analysis carried out in 1997 gave some guidance for that.

Increasing the efficiency of air-conditioning, pre-heating of employees' car engines in wintertime and the use of lighting have resulted in the biggest savings in energy consumption. At the moment, these services are controlled by an automation system, which for instance switches lights on and off at certain times off day. This is also true for the production facilities.

"The power outlets for pre-heating of employees' car engines are not on at all if the outside temperature is above 0° C," explains team leader Kari Manninen. "When the temperature is below -25° C power is on all the time and between these two temperature it is on periodically and not in every car pool at the same time."

In addition, the outdoor lights and heating, which keep gutters free of ice, are under control. Other savings have been realized by decreasing the use of water in washrooms and humidification.

" We do not use much water for production but merely in washrooms and catering," adds Kari.

All the suggested actions have not been taken in Rusko and Limingantulli yet. One of the ideas under consideration involves using snow for cooling, which is the biggest energy consumer in production.

Product performance

Design for Environment

Design for Environment (DfE) translates into practice in Nokia's life cycle thinking, which is aimed at reducing the adverse environmental impact of our products over their whole life cycle.

DfE means systematic integration of environmental objectives into product design. The purpose of DfE is to satisfy the requirements of customers and other stakeholders in a way that causes a minimal adverse environmental impact. In practice, DfE involves using design practices striving for minimized material and energy usage at all stages of the life cycle as well as maximized reuse and recycling of the products.

As far as mobile phones are concerned, Nokia's DfE activities take place in an environment of fast technological change, fast product development and short product life. Network products have a very much longer life span. Market developments and customer preferences have supported some DfE objectives, notably the reduction of size and energy consumption during use that mobile phones have undergone over the past few years.

Nokia's DfE approach is that it should not form a separate activity but be integrated into day-to-day decision-making and design processes. This ensures that environmental issues are considered throughout the product creation process right from future research and the initial idea of a product down to product delivery.

Given the fast product development processes, it is essential that DfE considerations bear on the process at an early stage. The business units have defined processes of implementation of DfE into their product development.

To support the integration of environmental requirements into product creation, a package of specific tools and guidelines has been developed to

Base station designed for the environment

The first customer deliveries of the Nokia Networks' new GSM base station, MetroSite, got underway in autumn 2000. With the Nokia MetroSite solution operators can build a dense microcellular network with capacity of up to ten times that of a conventional macrocellular network.

Marketing and manufacture was preceded by plenty of planning work including work on the environmental aspects of the product. Heli Lauronen, who is responsible for Design for Environment at Nokia Networks and Eero Riekki, specialist, explain that MetroSite features several details that decrease environmental impact.

"Everything begins with material selection," says Heli. "We test the materials for long periods since the products have long service lives. We examine their environmental suitability and availability, for instance with our suppliers who often give us very good ideas."

"The use of recycled plastics is rather difficult in the components which have strict quality and color requirements. But they can be used for shielding units that replace transmitter-receiver units (TRX) in the cabinets. The cabinets must be filled up in order to ensure optimal cooling," says Eero.

There is a maximum of four TRX in MetroSite and when TRX are lacking, shielding units are used. Cooling is a challenge in the sense of energy consumption, which should be decreased. This is also a customer demand.

In MetroSite the use of materials has been decreased by thinning the material accumulations with better design. At the same time the product weight has decreased which has influenced product price and transported tons. The transportation has also been made more efficient by loading the large plastic parts from a supplier inside the end packages that are fetched from another supplier at the beginning of the logistic chain. This has reduced the transportation as well as warehousing costs.

In MetroSite there is only one type of plastic used, and it is recyclable. Also, exclusion of flame retardants, paints and coatings has improved recyclability.

"Recycling and disassembly have been made easier by molding several parts as one component, decreasing the number of screws and marking the mechanical parts," Eero explains. "There is no internal cabling in MetroSite either, making for easier disassembly."

DfE has been a part of Networks' product design since 1996. "We want DfE to be part of all product design, which is a great challenge to training," says Heli. "There were more than 100 people designing MetroSite, which is only a small fraction of the people to be trained, and new employees are coming in all the time. Also, outsourcing of design work will increase. Our goal is to get DfE to go through the whole process smoothly and to move the emphasis to the beginning of the planning."

help the implementation of DfE in the design process. For example, it gives guidance for designers on material choices, recyclability and disassembly. Training support forms an important part of this activity. In practice, DfE always starts with training of those taking part in the design process.

In the design of a Nokia mobile phones the current DfE focus areas are material substitution, disassembly, recyclability and energy efficiency of power supplies. Nokia Networks has designated as its DfE goal areas material efficiency, environmentally relevant materials, recyclability, site solutions, remote management, extension of product life and energy efficiency.

Materials, recyclability and disassembly

Nokia is currently looking for a method for assessing impact of different materials at each stage of the life cycle. This includes both the upstream impact of the production of the materials and also their end-of-life behavior and recyclability. Materials are selected with a view to both the elimination of restricted materials and recyclability.

Such materials are selected to aid in facilitating part separation and sorting at the end of the product's life, increasingly the feasibility of recycling.

Using fewer materials to make new products reduces both the use of natural resources and the amount of material that needs to be recycled or disposed of at the end of the product's life.

Material database

The business groups have developed in cooperation a material database system. The database will support the Design for Environment work and will also help answer external questions from end-of-life recyclers, trade customers and other stakeholders. The effort centrally involves collection of raw material content data from Nokia suppliers (see page 15). The material database will enable Nokia to better manage and track material usage in its products. The effort is supported by studies of the material content of different Nokia products. One such study is highlighted on page 23.

Key projects on material usage have focused on elimination of lead and certain types of flame retardants from Nokia products. In these projects it

Nokia and the Fraunhofer Institute for Reliability and Micorintegration determined the material content of the Nokia 6110 mobile phone. Plastics, metals and ceramics were the largest material groups.

What is a mobile phone made of?

The environmental impact of a Nokia 6110 mobile phone was investigated in a study by Nokia and the German Fraunhofer Institute for Reliability and Microintegration (IZM). The aims of the project were to estimate the material content and potential toxicity of the phone, to identify the environmentally relevant parts and components, and to identify targets for environmental improvements. Battery and accessories were not included in the study.

Using the toolbox developed by IZM, 90% of the material content of the phone was determined. The weight percentages of the main material groups and the components containing them were as follows:

Plastics 56%
- covers
- key mat
- printed wiring board (PWB) and components

Metals 25%
- PWB
- components
- mechanics

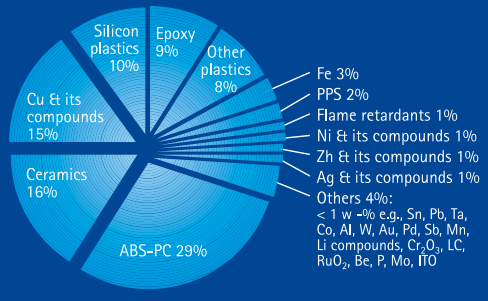
Ceramics and glass 16%
- glass in liquid crystal display (LCD)
- ceramics in components
- glass fibre in PWB

Others 3%
- liquid crystal in LCD
- flame retardants
- components

The phone contained several different types of plastics, with the largest type, ABS-PC, accounting for 29% of the total material content. Of metals, copper and its compounds accounted for 15% of the total. Other main metals were iron, nickel and its compounds, zinc and its compounds, and silver and its compounds. The lead content of the phone was under 1%.

Based on the material content of the compound, the toxic potential indicator (TPI) of the products was evaluated. The TPI is the result of a fast environment-related evaluation method developed by the IZM. Components with the highest TPI are indicative for replacement or improvement. The highest TPI scores were for metals and their compounds – copper, nickel, silver, tin and lead.

In evaluation of the recycling potential of the phone, the material content in combination with the product structure was used to estimate the optimal recycling strategy. The criteria required minimum quantities of valuable materials for standard recycling processes and tolerable maximum quantities of interfering or noxious substances. The conclusion was that precious metal refining and copper smelting are the optimal options for the assembled PWB and also for the complete mobile phone.



Nokia's DfE approach is in line with the seven dimensions of eco-efficiency formulated by the World Business Council for Sustainable Development:

- Minimizing of energy intensity
- Minimizing of material intensity of goods and services
- Minimizing of toxic dispersion
- Enhancement of recyclability
- Maximizing of the use of renewable resources
- Extension of product durability
- Increasing of total efficiency in process

is also important to investigate the environmental impact of alternative substances and materials.

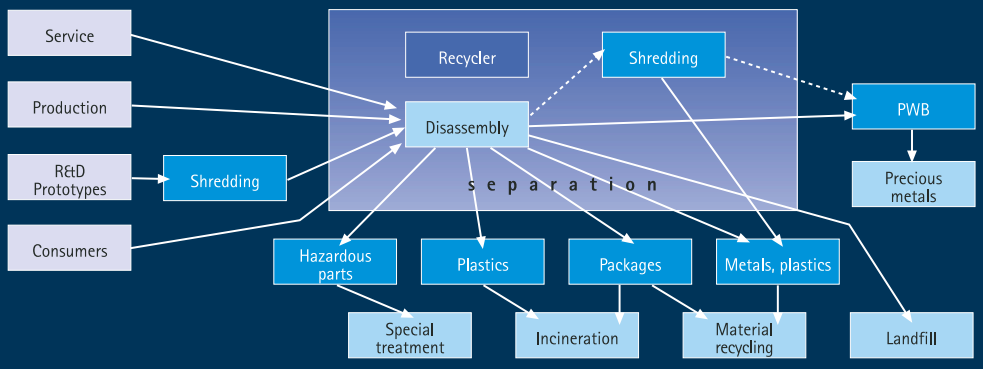
In Nokia current products, lead is used in solders and in some components. Flame retardants are used in printed wiring boards and some plastic parts. Nokia products pose no risk to human health or the environment during use, but may cause harm if they are disposed of improperly.

Focus areas for DfE in business groups

One of Nokia Mobile Phone's specific DfE targets is reduction of the stand-by energy consumption of the power supply. This small energy saving becomes significant when it is viewed in the life-cycle perspective. Energy consumption by a mobile phone during its use becomes as significant as energy consumption during parts manufacture if charger energy is included. The user can influence the power consumption by unplugging the charger when it is not in use.

Of the specific Nokia Networks DfE goal areas, remote management of base stations reduces travel, saving energy. As for energy efficiency, the current GSM base stations use energy very efficiently. The new third generation mobile networks will increase the use of energy, but with the larger range of services, their energy consumption per service provided may stand comparison with that of the GSM networks.

Operation of a recycling company



The material streams of the recycling of electronics products.
Precious metals are recovered, metals and part of plastics and packaging are recycled, some plastics and packaging are incinerated, part of the material is landfilled, and hazardous waste goes to special treatment.

Environmentally sound packaging

On packaging, Nokia policy is to avoid unnecessary packaging and to replace one-way packaging with reusable packaging whenever this is feasible. Nokia's packaging designers work in close cooperation with material suppliers to develop recyclable packages and seek to reduce the amount and weight of packaging materials without compromising the requirement for adequate protection.

A smaller amount of packaging requires less space and is lighter to transport. More products can be transported in the same space, reducing the driven kilometers and emission from use of transport fuels. Environmentally sound packaging will also reduce costs.

In a new packaging solution for certain infrastructure products light cardboard replaces plywood and recyclable plastic replaces non-recyclable aluminum coated plastic foil in protection against humidity.

End-of-Life practices

End-of-Life (EoL) practices are aimed at collection of equipment at the end of service life with a view to recovering their material and energy content and ensuring safe treatment of substances that can cause harm to people or the environment if disposed of untreated.

EoL treatment can reduce the environmental impact of the product life cycle. For example, if the metals in the product can be recycled for reuse, the environmental impact of extraction and refining can be avoided.

Supplier information on the raw material content of the products is important for sound EoL treatment. DfE choices give guidance for EoL methods and, conversely, information about EoL treatment forms an important input to the DfE process. Decisions on the material content and structural design of the product have a direct bearing on the ease of its disassembly and recyclability.

Reclamation of materials from electronic waste offers economic and environmental benefits. Precious metals in particular are commercially valuable. At the same time, proper treatment of substances that can cause harm during treatment or on disposal is essential. Nokia has formulated strict criteria for its approved EoL partners. New legislation and regulations will have a bearing on the role Nokia and the other producers can play in the treatment of waste products. Different models are emerging in different countries. Nokia has participated in pilot projects and run pilots of its own to learn about alternative models.

Recycling service of infrastructure products

Nokia Networks launched at the beginning of 1999 a recovery and recycling service for the customers of its infrastructure products. The service package includes site disassembly, transportation, selection of an authorized recycler and contracts with the recycler.

Collection of mobile phones

There is no reliable estimate on the return rate of mobile phones, but it appears that many consumers keep their old phones.

The European Union estimates that currently some 90% of all electrical and electronic waste ends up in landfill or is incinerated without proper EoL treatment. According to proposed EU legislation, the producers will have the responsibility for financing the end-of-life treatment of the products from private households.

There shall be no charge for the consumer for the collection and recycling of the products. At the same time, different national models are emerging for the collection and subsequent treatment of electronic waste. In some countries the municipalities will organize the collection, while in others special bodies have been set up for collection of household packaging waste, batteries and other waste fractions.

Nokia has participated in a number of mobile phone takeback and recycling pilots to learn about the alternative models. Nokia does not have a single standardized takeback system in place. The company always deals with recycling issues at the national level because legislation and recycling efforts vary by country. For instance, in the Netherlands and Norway the municipalities handle recycling. In Australia, Nokia is a participant in a joint industry project. In Singapore, recycling has just recently begun, and in the US takeback systems are being created.

Arrangements for EoL treatment

According to the proposed EU legislation, the collected electronic waste will be treated at authorized treatment facilities. The producers finance for the treatment of the waste. Under current proposals, the financing may be provided by means of collective or individual systems. In practice, a collective fee might be levied simply by weight of electronic waste received. In Nokia's view such an arrangement for new products would work against the aims of Design for Environment. If the fee takes no account of the recyclability of the product – ease of disassembly and choice of materials – there is less motivation for continuous DfE improvements. Nokia is active in an industry group promoting a solution that rewards good DfE.

Economic benefits of recycling

The recycling experiments in which Nokia has participated show that it pays to recycle the products. The recovered value of the precious metals

Flax cradles phone

Environmental issues are an integral part of packaging planning at Nokia. Mobile phone packages have to meet many criteria, such as durability, adequate protection of the goods inside, and usability.

"When we started planning the interior of the box designed for the Nokia 6250, we looked for an alternative that would suit the ideology of this tough product," says Packaging Designer Lea Sarasjoki.

"Flax fiber as a part of paper pulp provided the robust character we wanted. It perfectly suits a phone made to resist shock, water and dust. We wanted to create a feeling of nature and the outdoors for the Nokia 6250 package, i.e. the usage environment of this phone model."

Mobile phone packages consist of a box and a separate interior part. In all packages, the box is made of completely recyclable corrugated cardboard, of which 2/3 is recycled fibre. In the Nokia 6250 package, the inner part contains 20–30 flax fibre, while the rest consists of recycled fibre.

Lea is pleased that the line fiber is ecologically sound. "Flax is environmentally friendly to cultivate, it requires significantly less energy than wood fiber when processed, and it is very easy to recycle both with paper and cardboard."

"Environmental thinking has spread rapidly to packaging at Nokia Mobile Phones, and we are definitely thinking about utilizing flax in the package concepts for future products as well. Flax is quite an appealing alternative because of its physical and ecological characteristics, but further research will reveal entirely new opportunities for utilizing flax."

in the PWBs is considerable. In countries where commercial companies handle recycling, competition has considerably reduced recycling fees. In the life cycle perspective, the recovery of metals is in any case valuable, as recovered metals save energy.

A typical recycling practice of mobile phones starts with the removal of the battery. The product is then shredded and metals and plastics are separated. Precious metal refining and copper smelting are used to recover the metals. As far as mobile phones are concerned, plastics and materials attached to metals can be utilized as fuel in the metal recovery processes.

The recycling rate of plastics used in electric and electronic products has remained low. One reason is that recovered plastics are often contaminated with materials that can cause problems in the recycling processes. It is a more general EoL input to DfE that product design should avoid the use of substances that can cause interference in the various recovery processes, whether of metals or plastics.

Battery takeback

In Germany, Nokia is running a takeback of mobile phone batteries. The takeback is based on the conviction that sorting of waste at source is the only feasible way of achieving a good rate of recycling. Some 5000 Nokia shops and service points take back Nokia phones, batteries and accessories. Separate collection containers are provided for phones, batteries and accessories. The collected material goes to a Nokia approved recycling company for recycling. Nokia provides the necessary materials for the collection and return of the equipment, including information on the aims of the project.

Care Centers take care of EoL devices in Asia

"In Care Centers we take care of our customers and the environment," says Ian Broughall who is responsible for Nokia Mobile Phones' environmental issues in the Asia-Pacific region. The recycling project was started in Singapore in February 2000 and the pilot was carried out in June-July. "We did not get too many devices or accessories back, mainly some batteries," explains Ian. "The main reason was simply the low awareness of people."

Now Ian has a recycling partner in the Singapore Zoo. Pedro, an otter sponsored by Nokia, is giving recycling shows every night and at the same time people are told about the environment and recycling. "You have to be creative when you try to increase awareness. In Singapore the zoo thing works, in other countries you can find different ways to make people think." Pedro is part of the recycling campaign 'Future in your hands' which encourages people to return their EoL devices and accessories to care centres from where the recycling partner takes them to be recycled or disposed of safely.

The recycling schemes will be rolled out in Asia-Pacific region by the end of the year 2001. Some of the countries where recycling will start this year include Malaysia, China and The Philippines. In Australia, Nokia participates in the recycling program of AMTA, an organization for manufacturers and operators.

Malaysia is one of the pilot countries along with Singapore for recycling mobile phones in Asia. "We are looking for ways to raise people's interest in returning phones to care centres," confirms administrative secretary Nellie Abdullah. "Phones are precious equipment and people prefer keeping them to bringing them in for recycling."

Ian notes that the overall experience from the pilot in Singapore has been positive. Recycling has brought a competitive advantage and good publicity and the response from people has been positive. On an encouraging notes he adds, "Recycling is a serious business but it should be also fun, at least when communicating on it."

People decide the direction of development

"The environmental impact of information and communication technology is in the end a question of life style turning on social behavior, preferences and culture. The possibility of remote work will not induce people to move into the peace of the countryside if they have come to associate the good life with a range of services that only cities can offer," says Erkki Ormala, Nokia director in charge of technology policy.

It is unrealistic to expect that the highly educated people of the industrialized world would reverse their preference for an urban lifestyle. The opportunity for change is in the developing world. Could there be an alternative to the present route to welfare that runs through the slums of the cities?

The slums are in many respects – just think of the environment or people's health – the worst alternative. Inexpensive mobile terminals and mobile networks cheaper than traditional fixed networks could extend service to remote regions. That could help people find new sources of livelihood in their traditional habitats, enabling them to retain their traditional way of life. It is another question whether the traditional way of life is preferable from the environmental point of view if it includes, say, the gradual destruction of forests.

Benefits of dematerialization

The technologies on which the information society are based are called dematerializing technologies. They help to reduce the amount of physical resources used in product manufacture through essentially better control of production processes and material streams, reuse of material and design of production systems that enable increasing utilization of process by-products. Process cycles can be progressively closed.

Also, information technology can help to construct more effective logistic systems. Great gains become possible if the production and distribution of services can be done in the Internet environment.

There is a tangible saving in resources if, instead of driving to the video shop to hire a new video, you can download it from the net. Or the computer can be used to produce visual effects that have previously required a lot of dynamite, building products, transportation and so on.

Thanks to the dematerialization process, a growing part of what people consume and use can be produced virtually in the Internet environment. However, this only applies to a part of the service field. There will always be services requiring the physical distribution channel. Food cannot be distributed over the Internet. The same goes for social and health services. However, it will be possible to free administrative resources to actual service production, resulting in productivity gains and better services.

Consumer is king

Much will depend on the business models companies apply to cope with the profound shift in the value chain, moving the focus of value from the material end of the chain to software and services. Many traditional companies suddenly find that they are facing the consumer market directly. This brings new imperatives of social responsibility, including environmental responsibility.

In this new situation, success in business requires deep understanding of and answers to questions arising from the ongoing public discussion. That is one key to winning the trust of the consumer, which in the end is the only way of succeeding in a consumer-driven market. Winning the trust of the consumer is a long process, but it can be lost in a second. One blunder is enough.

Industry and business cannot afford to ignore the central issues that to a great extent guide people's thinking and public discussion. These issues focus on the environment, human rights, social marginalization, and trust.

These are fundamental things. If people cannot feel that their money and privacy are protected to the extent that information gained on them is properly safeguarded, the whole undertaking will collapse. Technology cannot do it alone. People need to see that somebody is accepting liability.

"The old model of industry and business solving problems by themselves and then saying that everything's fine won't work any longer. If the trust of the consumer is not there, it won't work," Ormala sums up.

Definitions and abbreviations

BASE STATION
Fixed transceiver (transmitter and receiver) equipment used for communicating with mobile phones in a mobile network. A base station may cover one or more cells or a part of a cell of the network.

DfE
Design for Environment systematically integrates environmental considerations into the design of products, processes and services.

EACEM
European Association of Consumer Electronics Manufacturers

EICTA
The European Information and Communications Technology Industry Association combines the objectives of its predecessors, ECTEL and EUROBIT.

EMF
Electromagnetic fields

EMS
Environmental management system

EoL
End-of-Life

GRI
Established in 1997, the mission of the Global Reporting Initiative is to develop and disseminate globally applicable Sustainability Reporting Guidelines for voluntary use by organizations reporting on economic, environmental, and social dimensions of their activities, products and services. The GRI's Sustainability Reporting Guidelines, released in June 2000, have served as a guide in the drawing up of this report.

GSM
Global System for Mobile Telephony. Digital cellular network operating in the 900, 1800 or 1900 MHz frequency band.

HAZARDOUS WASTE
Waste, or a combination of wastes, which because of its quality, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in serious irreversible, or incapacitating reversible illness or pose a substantial present or potential hazard to human health, safety or to the environment when improperly treated, stored, transported, used or disposed of, or otherwise managed.

ICC
International Chamber of Commerce

ISO 14001
International Organization for Standardization's standard for environmental management systems including specification and guidance for use.

LCA
Life Cycle Assessment is an objective process for evaluation of the environmental burdens associated with a product, process or activity by identifying and quantifying energy and materials used and waste released to the environment. LCA is a tool for evaluation of opportunities for environmental improvements.

LIFE CYCLE
The life cycle of a product begins with the acquisition of raw materials and includes processing of bulk materials, production of engineered materials, manufacture, use, retirement, disassembly and disposal of residuals produced at each stage.

PWB
Printed wiring board

RELEVANT SUBSTANCES
Substances, preparations or materials that are considered relevant due to
1) their hazard to humans or to the environment in their applications or end-of-life treatment methods,
2) their availability as natural resources,
3) their known high impact during their life cycle.

VOC
Volatile organic compounds

Printed on Galerie Art Gloss 115 g/m²
Cover Galerie Art Gloss 200 g/m²

Design: Louise Boström Oy. Copywriters: Risto Pitkänen, Fountain Park and Nokia. Photos: Tapani Pelttari and Nokia's photo archive. Print: Sävypaino ISO9002, 2001.

441 017
Printed matter

CONNECTING PEOPLE