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Ecospace Audit - An input Analysis for Products

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milieu defensie

Preface

Since the beginning of the '90s the concept of environmental space (ES) has been presented in 30 European countries by the Sustainable Europe Campaign of Friends of the Earth Europe and affiliated environmental organisations. Various people have expressed interest in the concept of ES and the need to measure progress towards sustainability at the company level. Besides general notions of more environmentally sound production processes no clear answers exist to the question how ES translates into specific, concrete, measurable and transparent demands at the company level. There is no practical method available to apply the ES concept at the company level.

To this end Friends of the Earth Netherlands has developed the project "Environmental space audit for companies: developing a practical method". The project has received funding from the Danish government, which has adopted the ES concept as a benchmarking principle for their environmental policies. The project started at the end of 1997 and ended in March 1999. In the development process a lot has been learnt, involving forerunner-persons from companies (but not representing an organisation) and (NGO) experts from the beginning in that process.

The following people took part in the project as members of the advisory committee of this project:

- John Elkington, SustainAbility, United Kingdom
- Nick Robins, IIED, United Kingdom
- Christa Liedtke, Wuppertal Institute, Germany
- Irina Maslennikova, Xerox Europe, United Kingdom
- Giacomo Elias, Agricultural Faculty of the University of Milan
- Chris Dutilh, Unilever, the Netherlands

This paper is the end result of an interesting project that has sought to define the strengths and limitations of:

- monitoring resource use at the company level;
- setting resource use (reduction) targets at the company level on the basis of environmental space reflections;
- redefining product/service concepts over the whole life cycle at the company level in a sustainable society with 10 billion consumers globally;
- developing concrete guidelines for practical use of the concept of environmental space at the company level.

The test presented in this document should be considered as a work in progress. It has, however, been thoroughly tested with the help of two leading companies. Xerox Europe in the United Kingdom is the European arm of Xerox Corporation, producer of copiers, printers, scanners, faxes and other solutions for document transfer.
David Foley, Environmental Researcher at Xerox Europe applied the Ecospace Audit to a Xerox DC 220/230 combined printer/scanner/fax/copier. Valuable comments and support were also given by Irina Maslennikova, Environmental Manager and Hugh A. Smith, Manager, Joint Venture Operations & Environment, Health & Safety Manufacturing & Supply Chain.
Ecover Belgium NV is a Belgian producer of ecologically produced detergents based on natural ingredients. Peter Malaise, Concept Manager at Ecover, applied the test to Ecover and gave many useful comments.

Valuable comments were also received from Fenny Eshuis of the Max Havelaar Foundation, the Netherlands and Teo Wams, Director of Friends of the Earth Netherlands.

We are very grateful to all these people for their contributions to this report. Nevertheless, any shortcomings are the responsibility of the authors.

Summary

What does the concept of sustainability mean for companies that produce the products and services today and that develop, design and produce the products and services of tomorrow? In the project “Environmental Space audit for companies: developing a practical method”, funded by the Danish Environment Agency, this was the central question. To guide companies in the direction of sustainable production a questionnaire was developed which is presented in this document. Rather than focussing on outputs (pollution, waste) the Ecospace Audit focusses on the amount of resources that enter the product or service in its entire life cycle (all phases: resource extraction, production, consumption, reuse, recycle, waste). This is based on the concept of ‘fair shares in environmental space’ which aims at assessing the sustainable resource use per person, taking increasing welfare all over the world into account. Depending on the current penetration level of a product or service and expected future penetration a company can assess the sustainability challenge for its products in the field of energy, non renewable materials, water and land use.

The Ecospace Audit focusses the attention of producers at the environmental and social quality of the resources they use. Labour conditions, respect for rights and participation of local people, local environmental and health performance and the democratic level in countries are important elements that a company should take into account as well when reshaping its production in a more sustainable direction.

The Ecospace Audit has been thoroughly tested with the help of two companies: Xerox Europe and Ecover. The Ecospace Audit was judged as a valuable tool to assess wider sustainability questions next of the implementation of current demands of environmental management. It needs to be stressed however that the Ecospace Audit is still a tool in development. Data on where resources come from, how they are produced, the amount of energy, materials and water consumed, are still difficult to obtain. The development of software should help overcome this problem.

The Ecospace Audit shows that the road for companies to produce sustainable products or services is challenging. Companies truly committed to sustainble development and preparing for the future will find it a valuable tool to critically assess current production, current thinking and current designing of products in the light of consumer demand in the 21st Century.

Introduction

The OECD report on Eco-Efficiency of 1998 clearly shows that in many cases the pressure on the environment from production has decreased in a relative sense. Emissions have decreased per dollar GDP or per dollar of product output. In absolute terms, however, the pressures have often increased. Development in industrialised countries will need to go in the opposite direction: increased quality combined with an absolute decrease in resource use.

Proposals for indicators at the company level from the business community are pointing in another direction. Their indicators mainly deal with relative efficiency improvements. The World Business Council for Sustainable Development, for example, in collaboration with the World Environment Council and the Canadian National Roundtable on the Environment and the Economy propose two eco-efficiency indicators: an index measuring resource productivity for materials and energy, or possibly two indices, one for materials and one for energy; and an index tracking pounds of toxic releases per product, with the releases weighted by toxicity. (White, 1997)

At the Continuous Improvement site of the EPE (European Partners for the Environment) a warning was issued that many environmental managers just wish to polish their management systems and forget about how to get environmental pressure from their company down to a sustainable level. “Green paper tigers evolving from traditional quality management thinking will not deliver the results needed for sustainable development”.

There exists a general apprehension among environmental NGOs that the current practice of eco-efficiency indicators will only be helpful for companies to claim a greener image by showing their relative increases in efficiency of for example 1-2% per year. Relative increases of 1-2% per year in efficiency do lead to a lower impact on the environment than without any progress in that area, but do not lead towards sustainable production and consumption patterns. Efficiency increases of 1-2% per year are a basic prerequisite for many businesses to stay competitive. Real eco-efficiency also includes reducing ‘to a level in line with the earth’s estimated carrying capacity’ (the less well known part of the WBCSD definition of eco-efficiency). In that case, an average efficiency increase of 4-5% per year is a more likely challenge.

The input audit seeks to broaden the scope of current environmental monitoring and management perspectives by helping companies in assessing, as far as it is possible, sustainable limits of resource use at the production level. The Ecospace Audit proposed in Chapter 3 builds on existing efforts of resource monitoring and ISO-14001 but goes beyond those mechanisms. Before doing so we will ask ourselves the question whether we are at all able to determine a sustainability level for companies.

> “Systems thinking tells us that sustainability cannot be defined for a single corporation: instead, it must be defined for a complete economic-social-ecological system, not for its component parts. (...) Paul Hawken in ‘The Ecology of Commerce’,

Accepting this, however, does not at all mean that companies cannot set out a course towards sustainable production. If we accept that sustainable consumption is a possibility, then it should be possible to develop guidelines for the input level of goods and services at the company level as well.
This paper tries to explore the boundaries of these problems. Can we set relevant targets at the company level that help companies to develop their production and marketing in a more sustainable direction? The outcome of this paper suggests we can.

In Chapter 3 an initial proposal for guidance towards sustainable levels of resource use at the company level is presented. This Ecospace Audit is presented as a guide to help companies to gain knowledge on the inputs into their products and processes, to help analyse their sustainability challenge in a meaningful way and to stimulate processes to improve products and production (redesign) and if necessary to shift to completely new solutions (rethink). The quantitative analysis is meant as a tool for this process and is not meant as a goal in itself. The input reduction targets are providing helpful guidance but should not be seen as a precise and final answer to what constitutes a sustainable product. It can certainly not be applied to prove that one existing product is better than the other. Detailed comparisons between similar products becomes less interesting when we realise that most products and services need to be dematerialised substantially in the coming decades in order to contribute to sustainable development as is discussed in depth in Chapters 1 and 2.

In Chapter 4 the main strengths and weaknesses, conclusions and proposals for continued work are presented.

1. Sustainability

1.1 Introduction

In June 1992 the major UNCED conference on sustainable development took place in Brazil. The following is probably the most widely known and accepted of more than sixty definitions of sustainable development. It is from "Our Common Future", the 1987 publication of the WCED Commission (better known as the Brundtland Commission).
"Basically, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and the institutional change are in harmony and increase the present as well as the future possibility to accommodate human needs (WCED, 1987)".
Ever since "Our Common Future", it has become impossible to do without the concept of sustainable development. The concept is, however, subject to many different interpretations. Some people get carried away and translate sustainable development as sustainable growth. Various approaches were therefore developed by both the NGO and business community to make the general definition of 'sustainable development' more concrete. A non-exhaustive list is presented below of examples of approaches to define or implement sustainable development more concretely.

- The Ecological Footprint developed by Wackernagel and Rees, for example, recalculates resource use in terms of hectares and aggregates CO_2 emissions, wood and land use to a single indicator (www.edg.net.mx/~mathiswa/).

- The Global Commons Institute (GCI) developed a 'Contraction and Convergence scenario' which combines environmental and equity concerns in the area of climate change (www.gn.apc.org/gci).

- The Wuppertal Institute rightfully points to what they call the 'rucksacks' that are behind each kilogram of product consumed in consumer countries. As a guiding tool they developed the MIPS concept (Material Intensity Per Service unit) (www.wupperinst.org). At the company level, studies were done on the completion of Eco-Audits with a flow analysis of the energy and material input and output of the company (Liedtke c.s., Wuppertal papers 69 and 72).

- The Natural Step developed a process approach to improve the quality of production and products in a more environmentally sound direction and applies a set of four rules for sustainable development. "The Natural Step concepts allow top management to view environmental considerations in a systematic way and to integrate them into corporate strategy for long term prosperity" Kevin Bond, Yorkshire Water (leaflet Natural Step). (www.naturalstep.org)

- The World Business Council for Sustainable Development adopted the concept of eco-efficiency as a main contribution by the business community to sustainable development. So far, efficiency improvements usually stay well below the growth rates of production and consumption. In absolute terms, energy and material use therefore goes on increasing in western consumer societies. Various approaches developed by members of the WBCSD can however be helpful in generating ideas on how to improve existing products or even how to switch from products to services. (www.wbcsd.ch)

- Some interesting ideas and examples from the business sector have been presented by Claude Fussler in 'Driving Eco-Innovation' (Fussler, 1996). Also, European partners for the Environment (EPE) as a public-private alliance for sustainable development can be a source of interesting information (www.epe.be). In general, the business community seems to be more sensitive than in the past to the appeal by the general public and environmental and social NGOs to produce in a socially and environmentally responsible way. It nevertheless needs to be said that still only a fraction of businesses have really started to address these issues in practical and commercial terms.

- At the product level, LCA (Life Cycle Assessment) and various related methods have been or are being developed which are usually emission oriented but also include accounts of (part of) the resources used (ISO-14040, 14041 etc.) (www.iso14000.com). Social aspects are not included, except in a Danish LCA variant which classifies the environmental and social aspects of the production of a product (UMIP; English: MECO)). The UMIP or MECO method classifies the resource consumption and environmental pollution of Material Use, Energy Use, Chemicals Use and Other (esp. labour conditions) (Wenzel et al, 1997).

- Friends of the Earth developed the concept of fair shares of environmental space. This approach is presented in more depth below as it forms the basis of the Ecospace Audit which was developed in the course of this project. More information can be found at www.xs4all.nl/~foeint. Several useful reference publications are Sharing the World, Towards Sustainable Europe, and the Action Plan Sustainable Netherlands.

1.2 Fair shares in environmental space

Global and regional ecological limits are already being exceeded. Developed countries are the main culprits. Their one billion inhabitants - about 20% of the world population - use 80% of the fossil fuels, metals, wood, minerals, and other resources that are extracted every year.

Despite increasing the efficiency with which we use these resources, our total consumption of them is still growing. In a few cases, pollution has been cut in some developed countries. But pollution and landscape destruction are growing in the countries where our resources are extracted or produced.

Many developing countries are on course to realise a level of affluence similar to that of the USA and Europe. China, with its 1 billion inhabitants, is a case in point. Economic growth in China has been around 10% per year since 1980. It is expected that car ownership in China will reach today's UK level by 2020. This will mean 400 million more cars. With conventional technology, this would almost double global iron ore consumption, as well as massively increasing landscape destruction, pollution and greenhouse gas emissions.

If the developing countries come to consume in the same wasteful manner as the developed countries, global resource use will increase eight-fold while the population only doubles. If the developing countries remain poor - an undesirable prospect - the same doubling of world population would just add a quarter to global resource consumption. As a result, the level of resource use per capita is crucial in determining whether a consumption pattern is sustainable.

The concept of fair shares in environmental space therefore embodies both the environmental and social dimension of sustainable development. The economic dimension of sustainable development is discussed in the last paragraph of this chapter.

In practical terms 'environmental space' is the total amount of energy, non-renewable resources, agricultural land and forests that we can use without causing irreversible environmental damage or depriving future generations of the resources they will need. The amount of environmental space is limited. We have only one Earth. For example, there is a limit to the area of land we can sustainably put into agricultural production, while the threat of climate change limits our fossil energy use, and there is only so much timber we can fell each year without depleting our forests.

Sustainability requires social as well as environmental balance. The principle of equity and social justice is reflected in the calculation of 'fair shares in environmental space'. These are worked out by dividing the sustainable global availability of energy and resources by the expected world population for a given target year. In these terms, achieving sustainability means that each country consumes more or less the same amount of natural resources relative to its population size.

> Win-win options that reduce the input and are economically sane do already exist. Copper pipes used in installations for drinking water transport could, according to a Dutch manufacturer, be 0.7 mm thick instead of 1mm, just like in the United Kingdom. Due to historic reasons, pipes in Germany are 1.5 mm thick. This would give a 50% savings in material consumption for this purpose in the Netherlands. It would also give savings in transport energy and the costs of transport. It would mean less pollution and less use of energy during the melting of materials. What's more, this would result in capital savings for manufacturers (purchasing less materials). So, a material-efficient norm would lead to advantages in several areas (win-win). However, it needs to be said that this option would not contribute to a reduction of leakage from copper into (drinking) water.

Working towards fair shares in environmental space means that Europe and the other developed countries will have to make big cuts in their use of environmental space to create room for development for the developing countries. Some examples of the difference between a fair share of environmental space for Europe and present use of resources, as calculated by the German Wuppertal Institute, are presented below.

Resource	Present use per capita and year for the EU	Environmental space per capita and year
ENERGY		
CO_2–emissions	7.3 tons	1.7 tons
NON RENEWABLE RAW MATERIALS		
Cement	536 kg	80 kg
Pig iron	273 kg	36 kg
Aluminium	12 kg	1.2 kg
Chlorine	23 kg	0 kg
WOOD	0.66 m^3	0.56 m^3

Table 1 Environmental space, actual use and proposed targets for 2010 for the European Union (Spangenberg, 1995)

The fair share in environmental space for fossil energy is calculated on the basis of the existing consensus in the official commission on climate change of the United Nations. The fair share for energy is 1.1 tons of carbon dioxide per person per year (in the case of high population growth to 10 billion people in 2050). Or 1.7 tons in the case of low population growth to 7 billion people. Average emissions in Europe are over 7 tons. Germany, for example, is emitting 12 tons of carbon dioxide per capita per year. Nuclear power is not a sustainable alternative, because of the risks and cost of nuclear waste management.

The shares for other non-renewable resources are based on the assumption that to avoid unsustainable waste, pollution and landscape destruction, extraction of metals and minerals has to be reduced by around 50% on a global scale, while those for renewable resources reflect sustainable harvesting.

Although these reduction targets are approximations, they do give a clear and realistic indication of the direction, speed and order of magnitude of change needed in the use of resources by industrialised countries.

The concept of fair shares in environmental space has been welcomed as innovative and important for future environmental policies. The Danish Parliament decided that the concept of fair shares in environmental space should be used for the development of sustainability policies. The recently published Danish energy scenario suggests a target of 1.2 tons of carbon dioxide per capita in the year 2100. The Austrian government agreed to a factor 10 dematerialisation in its National Environmental Policy Plan.

1.3 The economic dimension of sustainable development

A significant reduction of resource input is possible, even without decreasing material wealth. Reducing resource extraction is not the same as reducing end use. We can aim to fulfil human needs directly while minimising the use of natural resources. Patterns of production and consumption can be changed in combination with existing and feasible technological improvements. Then it is possible to cut resource use by a factor of 10 or more and increase the quality of life too.

To achieve a fair sharing of the limited environmental space we need a radical change in the design of products and processes. Only then we can realise a closed-loop economy which can provide meaningful goods to 10 billion consumers in the next century without overburdening ecosystems. Manufacturers must remain responsible for their products, for example by leasing them rather than selling, and taking responsibility for repair or reuse.

As Claude Fussler (Vice President of Ventures and Environment Health & Safety at DOW Europe) says: "Businesses that take this course of innovation, and reduce environmental impact while bringing more quality to life, will create value for their shareholders. They will become more competitive with a motivating, creative environment for their workers. They will gain new markets."

Xerox Europe

The closed loop process for the recovery and reuse of end-of-life copiers is a key component of the Xerox waste free manufacturing site policy. This process involves the recovery of machines from the field (reverse logistics) once the customer has no further need for the machine, followed by the reprocessing of all reusable components and parts. These parts are reprocessed to an 'as new' condition meeting original specifications through stringent checks on functionality and reliability.

This activity produces several benefits. By diverting material from the waste stream, the recovery and reuse of material lowers the volume sent to landfill. It also lowers the requirement for raw materials in manufacturing. The activity provides an incentive for further development of Design for the Environment (DfE) principles. There are social advantages that are derived from this recovery of assets as well. An increase in employment resulted from the greater need for labour in the Asset Management Centre. It also allows Xerox to provide the customer with a solution to their waste problem.

Since 1995 this allowed Xerox Europe to make annual savings of US$85 million through avoiding raw material purchases, demonstrating vividly the economic benefits that can be drawn from eco-efficiency measures. The percentage of waste sent to landfills has been reduced from 42% in 1993 to 9% in 1998 from all production locations of Xerox Europe.

The Ecospace Audit developed in this project aims to lend companies a helping hand in developing their own answers and contribution to the challenge of sustainable production and consumption.

2. Analysing resource use at the company level

2.1 A sustainable company?

Following the same line of reasoning of Chapter 1 for sustainable resource use level at the national level, one could try to set sustainability targets at the company level as well. For example; if a company emits 100 tons of CO_2 per year in 1990 then a sustainable level would be 50 tons of CO_2 per year in 2010. This approach, however, is far too simple. It is not possible to do this as straightforwardly as we might want.

1. First of all we need to focus our attention not at the production level alone but at the whole life cycle of products. Energy use and material use during the consumption phase are often as important - sometimes more important - than resource use during the extraction and production phase. One can take account of this fact by analysing energy and material consumption during each phase in the assessment. This approach is taken in the Ecospace Audit in Chapter 3.

2. A reduction in absolute terms of resource use at the company level does not say anything about the development of the levels of absolute net primary resource use in a society, let alone globally. On the other hand, if at the same production volume of products and services, all the companies in the entire world were to use 75% fewer resources over the whole life cycle of each product, then production levels would be headed in a sustainable direction. The argumentation is the same at the level of the individual. If others are not demonstrating sustainable behaviour, we do not then say that an environmental friendly person living within his or her fair share is not living sustainably. Rather, we would say that he or she is living a sustainable lifestyle whereas others should change their lifestyle in a more sustainable direction.

3. Reductions in resource use at the company level are often described in RELATIVE terms. As production levels increase in absolute terms the performance of the company is perhaps becoming environmentally friendlier than before but is not becoming sustainable overall. This criticism of eco-efficiency efforts is absolutely correct. Efficiency improvements per product do not necessarily make production and consumption patterns more sustainable if continually more products/services are consumed. Here the question of current and future market penetration becomes essential. If global market penetration is 100% (the product being present in all households) and no increase in this market penetration can be expected on reasonable grounds, then a factor four decrease in materials, energy, etc. use will finally bring the consumption of this good by 10 billion consumers within the fair share of the environmental space for the consumer. However, most people in the world will still be hoping ‘to become a consumer’ in the coming decades.

4. For some products or services, an increase in absolute terms is to be expected when society develops in the direction of sustainability. For example, a factory producing trains is to be expected to increase its levels of resource use in absolute terms (producing more trains). For a company such as this, monitoring an increase in resource use would be a good development for a society developing in a sustainable direction rather than a bad result. However, a precondition for this to be sustainable is that at the level of a company producing a product/service that fulfils the same need a reduction in resource use is monitored - at a car manufacturing company, for example. In this sense it would be helpful for companies when addressing the challenge of absolute resource use reduction to ask the question: what need does our product fulfil and can this need be addressed in a different way. For example by leasing a product or by delivering a service.

5. Finally, even if a company is realising in both relative terms (per product/service delivered) and absolute terms a factor four or even ten improvement it does not show the social structure and position of a company. The socio-political position of a company is not revealed by these indicators. A company supporting an oppressive regime or a company suppressing its labourers or indigenous peoples may (in theory) achieve factor four or factor ten and still cannot be named sustainable. Companies have to make sure that their own locations, but also their suppliers in developing countries are still behaving in a environmentally and socially responsible way. Social and environmental sustainability needs to be considered over the whole life cycle!

2.2 Important elements to be considered when assessing the sustainability challenge of a product/service

1. Consider the whole chain

It is always desirable to increase the efficiency of production, but the aim should be to increase the efficiency over the whole chain. For example it is not useful to make a large effort in the production process in the situation expressed in table 2. In this example efforts clearly need to be focused at the consumer phase.

Indicative resource use (e.g. energy/materials)	Primary Resource	Production at Company level Production	Consumer Phase	Total
1990	100	10	1000	1110
Factor 10 at company level	100	1	1000	1101
Factor 5 over the whole life cycle	100	20	100	220

Table 2 Indicative resource use at different levels of a product/service stage for different situations.

2. Consider expected future penetration in the market

The issue of market penetration seems to be key in assessing the sustainability challenge of a product/service. This element forms the linchpin to constructing the Ecospace Audit that incorporates the notion of sustainable consumption or end use levels.

It is important to distinguish between products that have full market penetration and products/services that are still increasing their market share. A factor 10 improvement of a product that is fully penetrated into the market at a global level (so for 6 billion consumers) indeed leads to a factor 10 reduction in final consumption of resources in an absolute sense. If a product has a low market penetration this is not the case. For example, think of computers with a penetration level of somewhere around 20-30% in industrialised countries. At the global market level this is probably only 5%. Here it is clear that a factor 10 improvement in this technology will not be sufficient if we accept the fact that in the long term we will be living in a world with 10 billion consumers with (on average!) relatively high levels of free disposable income.

Table 3 presents the development in market penetration in Dutch households since 1990.

Product	1990	1992	1994
Freezer	53	56	60
Dish washer	10	12	16
Washing machine	88	90	93
Sewing machine	64	64	64
Colour TV	94	96	97
Solarium	3	6	9

Table 3 Possession of durable consumption goods in the Dutch household

From table 3 it becomes clear that the dematerialisation demand for solariums in the Netherlands will be different than for washing machines. Washing machines have an almost 100% market penetration and factor four in that case means producing washing machines that use 75% less energy and materials over the whole life cycle. Extending the product's average lifetime from 15 to 30 years would already contribute to a 50% reduction in material use. In combination with complete material reuse, a 75% target is clearly feasible. For solariums, full market penetration in combination with sustainability demands will mean a factor 40 improvement in energy and material requirements. It is highly doubtful whether that is achievable but that is not the point of the discussion here. Each producer will have to find its own ways how to contribute to sustainability and the Ecospace Audit worked out below is only instrumental in pointing out and monitoring progress or failure of achieving this challenge.

Leolux, the largest manufacturer of furniture in the Netherlands, has decreased the input of a leather sofa together with its suppliers. Better practices by the cattle farms reduced damages to the leather reducing in turn cutting losses of the material. This illustrates the importance for producers to look at the input of resources carefully. Changes in the production process itself are obviously needed as well. Changing the design of the couches reduced cutting losses by over 25%. And finally the research by Leolux emphasises the need for producers to take account of the consumption phase and reuse possibilities. The biggest environmental profit is possible when the product is leased rather than sold. Then the product is returned to the factory after 12 years rather than being dumped in a landfill or incinerated. Leasing the furniture could double the lifetime of the product. This possibility is being investigated.

3. Consider rebound effects and income effects

Adapted products/services need to be assessed on their rebound effects as well. To illustrate, the combination of a computer with a copying machine, video cassette recorder, scanner, fax and telephone might lead to a huge reduction in materials used. But it might also stimulate households to buy a product which they might not have bought otherwise. The result is a stimulation in additional energy and material use rather than a reduction. On the other hand, if the TV and PC were to be combined than this would reduce material use as instead of two monitors only one monitor would be needed.
Some efficient products will lower the cost of purchasing or using them, providing the consumer with extra savings that can be used - or will stimulate using more of the product or service: such as efficient light bulbs which can help poor people to pay their energy bills but which can stimulate wealthy households to light their gardens at night.

4. Be realistic about the boundaries of input/resource use analysis at the company level

An important complicating factor of assessing the resource use at the company level is the emergence of a new product or a new company. Bringing a new, extra product on the market automatically leads to increased levels of resource use. Let's take the hypothetical case that the world has become sustainable. 10 billion people are consuming sustainable products produced by sustainable companies. The environmental space for fossil fuels, renewable energy, wood, non-renewables, land, water, etc. is being used completely. So any extra activity will have an impact on nature, climate, etc. This can only work when another product or activity is replaced by this product (Steady Flow Economy). Monitoring at the factory level, however, does not bring this option in sight.

Sustainable levels of (resource) consumption can in the end only be monitored at the national, continental (EU) and global level. Even a dematerialisation by a factor 10 of a mattress can contribute to increased resource use in other areas. If the dematerialised product leads to reductions in household expenditure, the savings could be used to buy energy and material intensive goods/services. Having said that, it would still be very useful if companies took their responsibility to dematerialise as well as to promote policies which encourage dematerialised production and consumption patterns.

3. Testing the company - the product

3.1 Introduction

Assessing whether a company is contributing to more sustainable production and consumption is difficult but is essential to the challenges of sustainable production and consumption in the coming decades. Obviously international and national legal and financial frameworks need to be put in place to enable producers and consumers to produce and consume sustainably. But companies that want to 'surf the upcoming curve of real eco-innovation' and that want to be ahead of governmental regulations need more clarity about what the sustainability challenge means for their company. Although currently eco-innovation at companies is largely driven by (inter)national regulations, companies can drive (inter)national regulations in an eco-innovative direction as well. By publicly promoting factor 4, 10 or 20 improvements, companies can put pressure on governments to change regulatory and financial incentives in the direction of a dematerialisation course.

The Ecospace Audit presented here can build upon existing practices in industry. In most companies with complex operations, environmental improvements now evolve from a thorough examination of unit or company processes. This is accomplished by first identifying all inputs and outputs to/from a process and then quantifying them (UNEP, IISI, 1997 Technical Report No. 38).

This audit will provide you with drastic reduction targets. Setting drastic resource reduction targets at the business level and demanding this improvement over the whole life cycle of a product obviously needs to be accompanied by meeting basic environmental and social criteria. The main thought is that drastic reductions of the input of resources into products/services will bring about environmental improvements anyway.
As drastic as these decreases are, some substances will nevertheless have to be fully eliminated. For example, a factor 20 decrease in CFC use in refrigerators is an improvement, but from an ecological point of view still unacceptable: in the end the ozone layer will still be damaged. For this reason a separate screening of the use or emissions of dangerous substances is still needed. In the Ecospace Audit, we use the category 'toxins' as a reminder of these aspects, and if relevant, traditional instruments to assess potential dangers of pollution and toxicity should be applied.

3.2 Ecospace Audit at the company or product level

To assess your sustainable input requirement, several steps need to be taken. It is assumed that the Ecospace Audit is being carried out by existing companies testing existing products over the whole life cycle. In the case of a new company or a new product, one needs to draw a comparison with existing companies and existing products/services to determine several crucial elements - for example, the penetration level of a product.

The Ecospace Audit can in theory be used both at the company level (over the whole life cycle of the aggregated products) and on a product-by-product basis. In the case of a product-by-product approach, the product assessments can be aggregated at the company level if desired. At the company level it can be decided to improve certain products more than others. As long as the overall achievement in resource use is complied with, this is not problematic. The Ecospace Audit can be carried out at the company level if resource use at the entire company is sufficiently transparent and homogenous, and if consumer markets of the products are comparable (e.g. a furniture company producing wooden chairs and tables for retail). The total company can then be taken as a unit in a supply chain of which the inputs over the life cycle of the whole range of products or services are analysed. However, this audit has not yet been applied to a whole company. Accordingly, the following steps are described at the product level for reasons of clarity.

It is important to note that this audit is primarily occupied with assessing and/or enabling clear discussions on sustainable resource use. It has not been designed to replace existing environmental monitoring and management systems. This audit is a tool to analyse, qualify and quantify your sustainability challenge and encourage you to rethink your products and services to become more sustainable. It will not assign your products or company a final score in absolute numbers and therefore no 'sustainability' claims can be based on the outcomes of this audit. Still, we believe that if all current products were to be assessed and improved according to the Ecospace Audit a much more sustainable world would become reality within the coming decades.

3.3 General outline

The general outline of the Ecospace Audit can be shown in a scheme as follows:

Step 1 Define the product and its life cycle

↓

Step 2 & 3 Assess relevant resource inputs over the life cycle

↓

Step 4 Quantify the relevant resource inputs

↓

Step 5 Qualify the sources of relevant resource inputs

↓

Step 6 Design a growth scenario:
- maximum use of product worldwide in combination with
- population growth

↓

Step 7 Assess your product sustainability challenge

↓

Step 8 Quick scan of general sustainability aspects of your company policy

↓

Step 9 Evaluation of desirable and possible changes in the product life cycle
- quantitative inputs
- qualitative inputs
- appropriateness for a sustainable consumption pattern

↓ ↑

Evaluation of sensitivity for lacking or unreliable data
List range of options and discuss with stakeholders
Check if different options give better audit outcomes

↓

Which policy and product changes do you want to make?

3.4 Data

The Ecospace Audit requires that you calculate, analyse and estimate the quantities and qualities of the main resources used during the life cycle. For your own factory or location this should not pose a problem, but further along the chain, the ability or willingness of suppliers or customers to deliver the required data will form one of the obstacles.
If precise data are not available, we need to continue with estimates based on the available general data. Some general data will be available through easy accessible LCA data bases.
At present, you can for example use: www.pre.nl, www.ec.gc.ca/ecocycle, www.eea.eu.int/frproj.htm, www.leidenuniv.nl/interface/c, www.tiac.net/users/tgloria/lca/lca.htm, www.unite.ch/doka/eca.htm.
LCA data base literature: See SAEFL, Boustead, Frischknecht.
Still, even if few quantitative data are available, the Ecospace Audit will be useful as it seeks to guide you to rethink your product and your company policy with respect to a broad, environmental and social sustainability concept. In any event it is important to check the sensitivity of the outcomes for variations in the input data. The sustainability challenge is likely to outnumber the possible variations in input data.

3.5 Explanations of terms used in the Ecospace Audit

It is advised to read this before starting the Ecospace Audit, as it will make you more familiar with the basic approach applied in the audit.

Caution: although we sometimes use broad categories such as minerals in the text, we would like you to specify each relevant material separately (copper, iron, glass, etc.) in the tables.

(Natural) resources:
Energy, water, land and raw materials. For this audit, these are considered crucial resources for the human economies. Land (surface area) as such is considered to be a resource, be it natural, agricultural, or built-up area.

Primary materials:
Materials that are directly produced from new raw materials (virgin materials). The other category is secondary materials: made from reused or recycled materials.

(Non-)renewable materials:
Raw materials originate from the earth, with a mineral, vegetable or animal source. They can (partly) consist of recycled material.

Renewable: new raw materials or energy can be produced by a stable source infinitely (considering a human time scale), as long as the source is well protected and managed (such as forests, agricultural land). Renewable raw materials are vegetable or animal.

Non-renewable: on a human time scale the source of the raw materials is finite. Non-renewable materials include *minerals.*

Minerals: substances found naturally in the earth, neither vegetable nor animal. All petrochemical substances from a fossil source (such as coal, oil and gas) are also put in the category minerals. Some minerals are scarce (in both economic terms as well as in the concentrations that they can be found in the earth's crust). Their exploration produces large amounts of overburden and involves the use of a growing amount of other resources such as chemicals, energy, water and land surface. Other minerals are more widely available but their extraction still involves relatively large amounts of other resources. Social aspects such as labour conditions, conflicts with local people, regional environmental and health aspects are often serious problems facing mining sites.

Energy:
All sources of energy (excluding animal or human powered), renewable and non-renewable are analysed. In the qualitative section energy is subdivided into origins and the social aspects of the various energy sources are analysed. It is often useful to divide between energy used for transport and other energy applications.

Land:
Land is a limited and crucial resource for humankind. First of all, the production of vegetable or animal materials requires a certain amount of land. This can be agricultural land (arable land, pasture land), forestry or natural area. Built-up area is a land category where human influence is maximum.
Natural area is land where natural processes are dominant and human interference minimal. Some but not all forests belong to this category.
If land is managed well and its character stays intact, it delivers renewable materials, of which food is the most crucial. About 80% of global cropland is needed to provide the world's population with minimum dietary requirements. A given area can supply a certain harvest annually. But if the character of the land is destroyed, then renewability is not the case. Even if the products can be considered 'natural', they are not 'renewable'. The exploration of mineral resources, which consumes a certain amount of land in the process, clear-cutting natural forests and digging peat are examples. Be it factories, roads, parking space, land-fills or a recycling workshop: in various phases of a product's life cycle, human activities use land surface. In this audit an estimate of this amount of 'land input' is made. Also the qualitative aspects of land use are analysed, which provides insight into the sustainability of the way the land is used. This applies to 'environmental' aspects such as farming and forestry methods as well as to 'social' aspects such as labour rights and the needs of local people.

Water:
We only consider water that is extracted from the natural system and used in the human system. How much water is used in each phase of the life cycle? If the same water is used in a closed loop, only the replenishments count.

Qualitative aspects are important: for example, is the source fed by new rainfall, or is the (perhaps fossil) source (gradually) depleted, irreversibly changing the original natural system?

Toxins:
This audit focuses on resource inputs. The category toxins is added simply as a reminder. Substances that are used (input) or produced (output) in a relevant quantity which are listed as toxic for humans, terrestrial and/or aquatic ecosystems should be taken note of and wherever possible eliminated from the life cycle. Literature which can be helpful is Council Directive 93/67/EEC, Annex III and associated Guidance.

Relevant:
Caution: there is no absolute guideline here. The aim is to think about the main inputs in your product's life cycle and to trace at least 95% of the (mass and volume of) inputs within each of the four resource categories (mass, J, hectares, litres), avoiding unnecessary burdens of data gathering in the next part of the Ecospace Audit. Consider it also from the cost point of view and see if that makes a difference.
Beware of seemingly small quantities with big impacts: toxins and scarce (expensive!) resources. If in doubt about what you should fill in, choose for the score 'relevant'.

Consider whether there are substances that make up a small percentage of the mass of a product (process) but for the individual end-user of a product or service still form a relevant percentage in their total usage of such a substance, because of the unique character of the substance or product (for example platinum in a catalytic converter in a car). Also, compare the amount to the available resources per capita (see table 3.9, for an example).

Phases:
For the sake of simplicity, no more than five phases are distinguished: extraction, semi-final production, production, consumption/use and waste/recovery. Make your own subdivisions as necessary to clarify the various stages in the life cycle of your product.

Social aspects:
We see a growing demand for transparency and social acceptability of all the phases of production. The more crucial your resource input, the more details you need to know about the qualitative character and the four social (PLED) aspects. In this audit we ask you to give a three-tiered rating for the combination of these four aspects: high, medium or low risk of exploitation of people and the local environment.

PLED:
P = respect rights and participation of local people: it is often easier to give examples where this aspect is not observed. Oil exploration in Ogoni land in Nigeria is a well known example where the local population only feels the negative consequences of the activity and has not been able to participate in the decision-making with respect to the development of the area. Local people should be informed and be able to participate in democratic decision making on production locations, processes etc. Their rights in the broadest sense - traditional ways of (earning a) living, access or ownership to land and water, the right to know, human rights, legal rights, cultural heritage, etc. - should be respected. The UN has a long tradition of defining such rights and also 'Agenda 21' gives guidelines especially with respect to local sustainability (www.un.org).
In general, opportunities for local rights and participation are better in democracies, but this is not always the case.

L = labour conditions: the SA 8000 gives a clear overview of basic labour conditions that should be respected worldwide. Either implementation of this standard or the application of strict regulation in a country contributes to a 'low risk' score. Partial or no application gives a 'high risk' score. References: www.sa8000.com, www.ilo.org

E = local environmental and health performance: in the quantitative part of this audit you have probably used data which already gave you an indication of these aspects, perhaps related to an 'average' resource input. But in this case you need to discover the impact on the local environment of your relevant sources of resources. For example what is the score for your main supplier of iron?
This covers all sorts of aspects that can affect local quality of life: amenities, noise, pollution, heavy traffic, wildlife. Beware that just having an ISO certification does not guarantee that your supplier is a good performer in this respect, as ISO does not prescribe a certain environmental quality.

D = democratic level of country or region: what is the character of the country or region in general: can people influence political decisions in their country?
A certain level of literacy and equitable access to knowledge and resources is required for a good score. Unlike the first three aspects, this social aspect is difficult to influence for an individual supplier. This score can be a useful

general indicator, especially if the other scores (PLE) are unknown for certain suppliers, usually upstream in the product chain. Resources coming from clearly undemocratic countries pose a high risk for the quality of all social aspects.

In the explanation of the various steps in this audit, you will find examples from the two companies that helped us in trying out the Ecospace Audit: Ecover and Xerox Europe.

Ecover is based in Malle, in northern Belgium. Around 40 people work in this company that produces a range of 40 cleaning and washing products for household, professional and personal care. Active ingredients are for 98% based on plant derived compounds which have a high degradability and a low impact on water life. The factory is largely built from wood and has a grass covered roof. Products are exported to some 17 countries on 4 continents. Ecover is privately owned and associated to Group 4 Securitas.

Xerox Europe is the European arm of Xerox Corporation. The Company operates in Europe dealing with all the Western European countries. It has 21,000 employees and a turnover of USD 5.5 billion (1997). Xerox Europe is based in the UK. The production site for the DC 220/230 is located at Mitcheldean and the general office is in Marlow.
Xerox offers a wide array of document-related business solutions, product and services. Xerox sees the document as a tool for productivity which is at the heart of most business processes, whether the tool be electronic or paper. The company has recently moved into the digital market from Light-Lens technology. Xerox produce copiers, printers, scanners, faxes and provide solutions for document transfer. The company has been working for many years to minimise its impact on the environment and its resource utilisation.

3.6 Ecospace Audit

Step 1: Define product and life cycle

Definitions

Define here which product and service is being analysed in this audit. Each product should also be defined in terms of the service it provides. This should include a description of which needs are being fulfilled with this service. Also include the needs fulfilled for the end-user, even if you do not produce for or deliver to consumers. This is relevant for the potential range of alternatives that exist or can be designed as alternatives to the analysed product.

Ecover:

Definition of Product:	1 litre of household cleaner in plastic bottle
Definition of Service Unit:	cleaning most surfaces in the house for 1 person in 1 year (W. Europe)
Description of Needs Fulfilled:	increase or maintain level of hygiene in the home

As precise statistics lack, an estimate of average consumer use had to be made on the basis of experience and related to general data on consumer expenditure for cleaning agents. This is 1 litre per person per year. The bottle can be used at least ten times for refill at some retailers shops, but this option has not been taken into account in this audit.

Xerox:

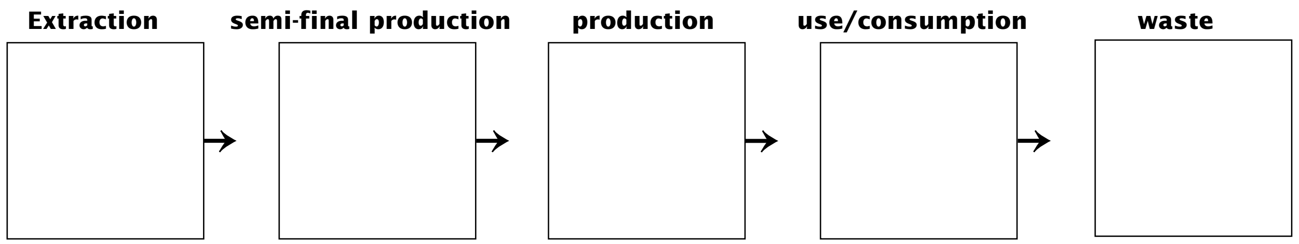
Definition Product:	Xerox Document Centre 220/230
Definition Service Unit:	One year life of printer/copier used and produced in the UK (1yr life = 84,000 copies, single sided)
Description Needs Fulfilled:	Communication of documents through fax, copy, print and scan capabilities.

The printers/copiers are produced by Xerox. There are two models; Document Centre 220 and Document Centre 230. These are digital machines that allow the user to print, scan fax and copy documents easily. DC220 copies at 20 pages per minute (ppm) and the DC230 at 30 ppm.

The service unit was chosen to allow consideration of typical use. The number of copies made in a year was taken as the projected average number of copies that the machines would make. The machine is delivered to the consumer on a reusable steel tote. The tote is returned to Xerox and reused. At the end of its life the tote is recycled. Xerox machines normally contain a large part of reused and recycled components. However the recent change from analogue to digital technology has made it harder to reuse components until a critical mass of reusable parts is established for this machine. For ease of completion of this audit only virgin materials were considered.

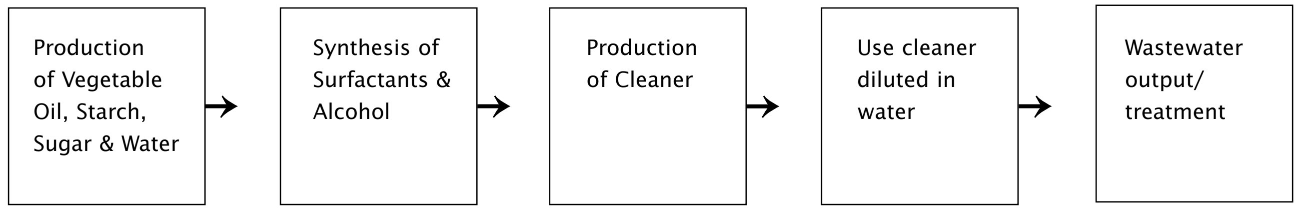
Life cycle

Make an initial description of the life cycle which is analysed in this audit. This general scheme should be adapted to your situation. Consider all major elements of your product.

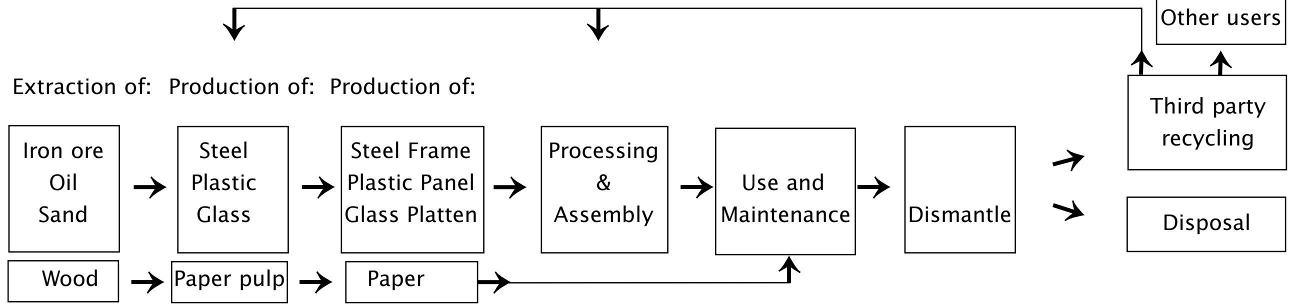


In the examples below, only the main elements of the product are shown in a simple diagram. The additional resources which are needed in each phase are not shown: energy, water and various materials are used in each phase and will be analysed in the next steps of the Ecospace Audit.

Ecover:



Xerox:



Step 2: Assess relevant resource inputs for each phase

Assess which inputs are important for each phase in the life cycle as described in step 1. This requires more detailed understanding of the processes involved in each phase, using knowledge available in your own company, from suppliers or from other sources such as technical handbooks.
Fill in Table 3.1 in draft form. This step is needed to help you select the relevant inputs for further analysis. An input that forms part of the product should only be applied once: the first time it enters into the life cycle. In the Ecover example, the vegetable materials already enter at the extraction phase so this is the only column where they are listed.
Consider if there are possibly toxins involved.
Fill in 0 for inputs which are not relevant or too small to be considered.
Fill in + for relevant inputs that need to be considered.

Resources – input	Production of vegetable oils, starch, sugar	Synthesis of surfactants & alcohol	Production of cleaner	Use of cleaner diluted with water	Waste water output and treatment
MINERALS					
Non-metal minerals	+	0	0	0	0
Metals	0	0	0	0	0
Fossil carbon/ petrochemicals	0	0	+	0	0
ENERGY					
Transport energy	+	+	+	0	0
Other energy	+	+	+	+	0
LAND USE based resources*)					
Agricultural area directly/ animal or vegetable materials	+	0	0	0	0
Forest area directly/ animal or vegetable materials	**)	0	0	0	0
Natural area directly/ animal or vegetable materials	**)	0	0	0	0
Other surface area directly (buildings, infrastructure, etc.)	0	0	+	0	0
WATER	+	+?	+	+	0
TOXINS involved?	+	+	0	0	0

Tabel 3.1.a Ecover resource inputs

*) Animal and vegetable materials are associated with either cultivated or uncultivated area. In this step you only need to determine whether the quantities involved are relevant. If you do not know, list as relevant: in this category small quantities are already relevant. In step 3 you need to calculate the actual area involved. Products originating in fresh and salt water can also be listed here.
**) The transformation of forests into oil palm plantations is a reported problem. Here we calculate oil palm plantations as cropland.

Xerox:

In this preliminary step, the following inputs were identified as relevant for further investigation. In future steps it was possible to identify the importance of these inputs.

the production phase:	the consumption phase:	the waste/recovery phase:
Steel frame	Steel tote	
Plastic panel	Paper	
Glass platten		
Copper cable		
Printed circuit board		
Transport energy	Transport energy	Transport Energy
Other energy	Other energy	
Factory area	Space for machine	Factory area
Water		Water for cleaning

Table 3.1.b Xerox resource inputs

For the extraction phase, there was not enough insight into all related production processes to assess all the relevant inputs. This was done in the subsequent steps after more detailed information had been obtained.
The components which make up more than 98% of the product's weight were put to further analysis: steel, plastic, glass, copper and the printed circuit board.
Also the use of paper during the consumption phase is important to analyse further as these represent large inputs as well. As the further analysis of copper and printed circuit board could not be completed within the available time, you will not find details for these elements in the next steps.

Step 3: Assess relevant resource inputs needed for resource production

In step 1 and 2 we have obtained a general overview of the resource inputs that are relevant over the life cycle of our product. We only considered the major inputs.

Now we take one step further back and see what we need to know more about these inputs. Did these inputs in their turn require large resources to deliver them? These are in fact 'hidden resources', about which we easily forget, but they need to be taken into consideration as well.

Ecover example:

Palm oil is one of the important inputs for the production of surfactants that are least damaging to water life. Basic data from suppliers were not available, but from Unilever we obtained the following data on palm oil production:
Fertilisers are used for the production of palm oil. Over the life cycle of palm oil production, the fertilisers account for about 0,5 GJ of energy needed to produce, for transport and refine the oil. The agricultural activities account for 0,6 GJ, the refining 0,9 GJ and the transport for 1.4 GJ of energy use.
Overall production and transport of one ton of palm oil requires 3.5 GJ, excluding the process energy derived from burning crop waste. Transport energy volume is high because of the distance from Asia to Europe.
Another important resource is land. To produce 1 ton of oil, 0.25 hectares of agricultural land was needed.
Similar data were available for coconut oil, another frequently used input. For example for 1 ton of this oil, 2.5 hectares of cropland is needed.
Please keep in mind that these data do not necessary apply to the analysed product, but they give the best approximation that is available.

Xerox example:

The Xerox DC 220/230 steel frame is made in Japan and contains 87.5 kg of steel.
Details on the production processes and the origin of raw materials could not be obtained from the supplier within the research period. Therefore, general European data on steel production have been used from SAEFL (SAEFL, 1998). The most important material inputs for the production of 1 kg of steel are: crude iron ore (2.4 kg), scrap (0.122 kg), limestone (0.28g) and coke (1.3 kg) Total energy use for steel production (transport not included) is 0.03 GJ per kg. We had to make a very rough estimate of the land area connected to the exploration of these inputs, partly based on data from Frischknecht. Our estimate resulted in 0.00008 m^2 per kg steel. This amount we considered insufficiently relevant to take into further account.

As you see, some of these data might be difficult to obtain. Ask your suppliers or use general LCA sources. In future, we hope a software version of this audit will be developed that will provide future users with this basic information for a large number of resources.

Step 4: Quantify the relevant resource inputs

At this point you shall have gained some more understanding of which inputs are relevant for further analysis. These need to be quantified and specified for each resource separately. For the toxins we simply copy the scores 0 or +.

Ecover example:

The ingredients which make up 98.5% of the weight of the product were chosen for further analysis: water, surfactants and alcohol. The other ingredients all occur in small percentages and have no special properties which suggest that they have large 'hidden inputs'. Also the additional water use in the use phase will have to be looked at, although we fear that the lack of data will pose a problem there.

Allocation to service unit

The table needs to be filled in with the defined service unit as a basis (as defined in step 1).

Xerox example:

For Xerox the service unit is one years' life of printer/copier DC 220/230 used and produced in the UK (1yr life = 84,000 copies).
Data have been calculated so that they refer to this unit. As the factory in the UK actually produces many other products as well, assumptions had to be made for the allocation of inputs to the production of this type of machine. This was estimated to be 15% of the total, which we know is a rather high estimate. The next step is to divide this by the number of machines produced. The lifetime of the machine was assumed to be five years.

Concerning other surface area and building materials required, it was not known whether they might be relevant, so an approximation was made. It was estimated that Xerox sites occupied 100 acres and contained 80,000 kg of aggregates. We used a figure of 60,000 for the annual Xerox DC production rate. There are 404,700 m^2 used by Xerox. Divided by 60,000 and multiplied by 0.15, the result is 1 m^2 of land. This is roughly split 80-20 between production and recycling/reuse. The same procedure was carried out for the quantity of aggregates, giving 0.16 kg and 0.04 kg of aggregate for production and recycling/reuse respectively.

Data

All inputs, including the 'hidden inputs' have been analysed with help of specific data from the factory, various suppliers, some earlier Xerox research, specific and general LCA data as well as general information. Many estimates had to be made, especially with regard to land use, as precise data were often not available.

In some areas where your (supplier's) knowledge is limited you will have to use standard data or even estimates. Please keep aware of the assumptions made and do not use the resulting figures as absolutes. The figures will nevertheless still help you to gain insight in the chain, to see where important resource inputs occur and where your knowledge needs to be improved.
Each relevant resource as well as similar resources from different origins are listed separately. For example: both secondary (recycled) paper and virgin paper are used in relevant quantities, making two types of materials to be listed.

Resources inputs specified and quantified Approximate numbers	Extraction & processing Phase	Production Phase	Consumption Phase	Waste phase	TOTAL
MINERALS (kg)					
Non-metal Minerals	N/A	-	-	-	-
Metals	-	-	-	-	-
Fossil Carbon for plastic bottle (MJ equivalents)	-	1.79	-	-	1.79
ENERGY excl. transport (MJ)	-	0.01	0 - 20 MJ ***	-	
Transport energy	-	1.23	-	-	
Total energy incl. transport (MJ)	1.18	1.24	0 - 20 MJ ***	-	2.42 - 22.42***
LAND USE (m^2)					
Agricultural area (oil, starch, sugar)	0.5 *)	-	-	-	0.5
Forest area/materials	- **)	-	-	-	**)
Natural area/materials	- **)	-	-	-	**)
Other surface area (for buildings, infrastructure, etc.)	-	0.0008	-	-	0.0008****
WATER (litres)	N/A	0.83	170 - 350 ****	-	> 71 - 351****
TOXINS involved as input/output (copy the indicative scores of step 1 and 2 here)	+	+	0	0	0

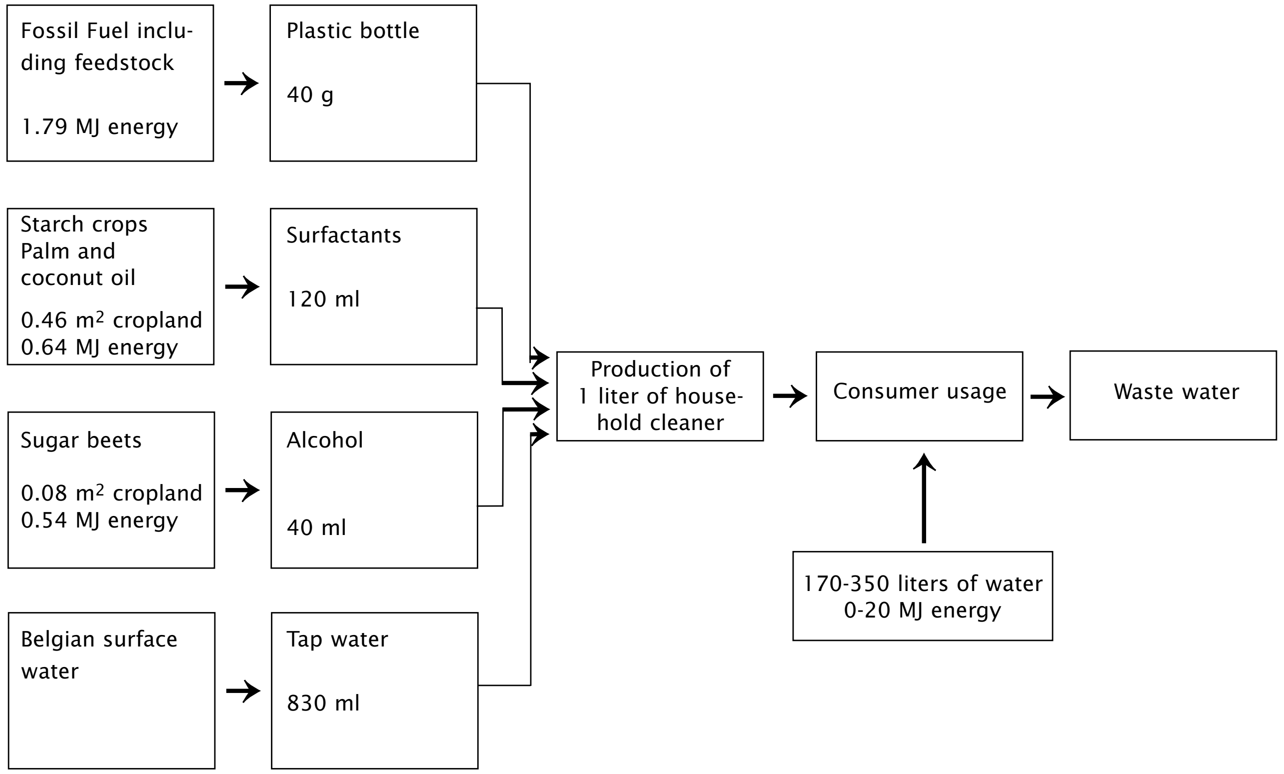
Table 3.2.a Ecover household cleaner - 1 year of cleaning household surfaces per person

*). Depending on type of crop and country of origin, the range is between 0.2 and 0.9 m^2.
**) The transformation of forest into oil palm plantations is a problem, but will not be quantified here.
***) Depending on the use of cold or lukewarm water, rough approximation
****) Data lacking, so a rough estimate was made: recommended amount of product in water and additional rinsing with an equal amount of clean water assumed.
N/A: not available

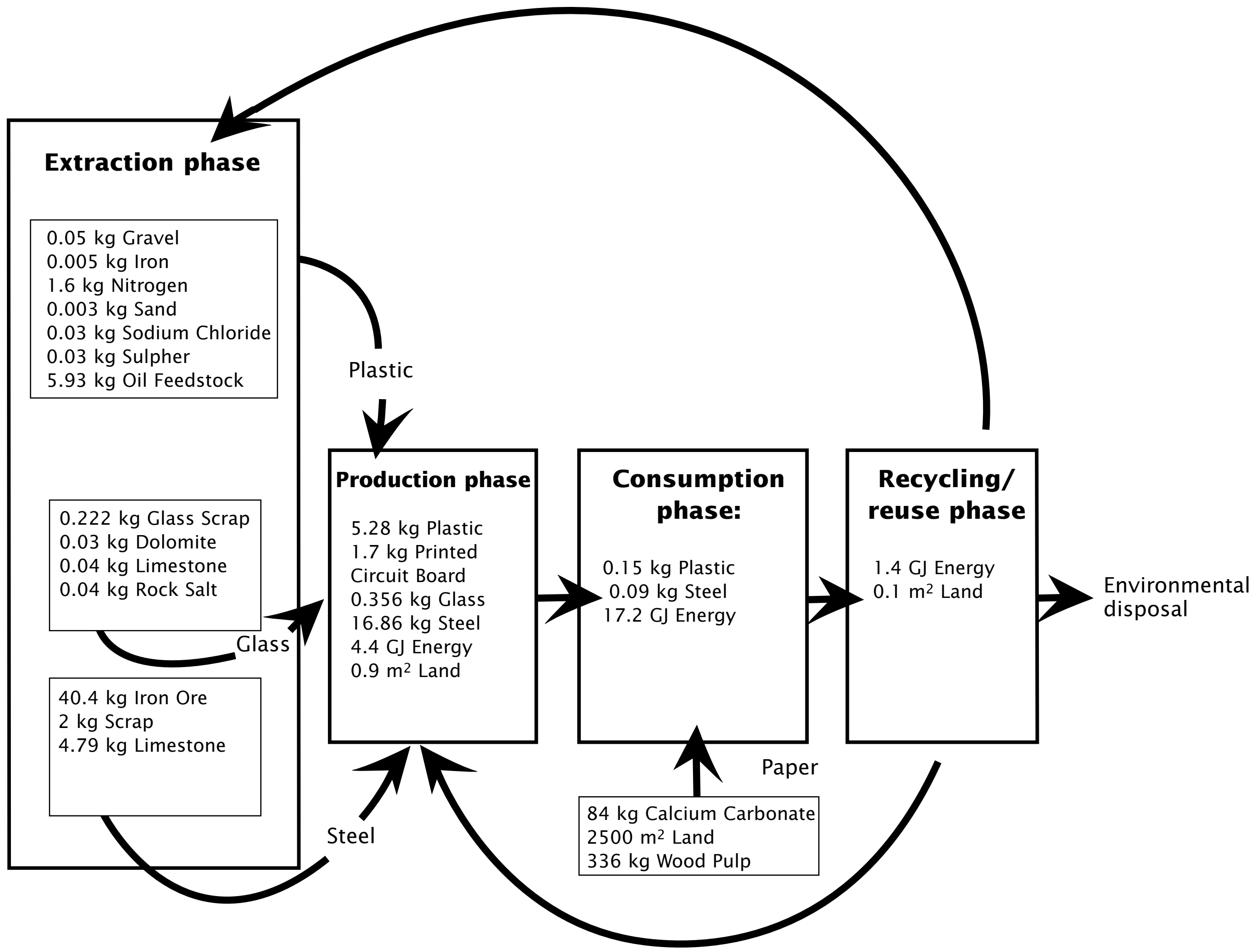
	Extraction phase	Production phase	Consumption phase	Recycling/ reuse phase	TOTAL
MACHINE COMPONENTS:					
Steel (Frame, tote)	0	16.86	0.09	0	16.95
Plastic (Panel)	0	5.28	0.15	0	5.43
Glass (Platten)	0	0.356	0	0	0.356
NON-RENEWABLE MATERIALS (kg)					
Aggregates (buildings, infrastructures)	N/A	0.16	0	0.04	0.2
Calcium Carbonate (Paper filler)	0	0	84	0	84
Talc	0.1	0	0	0	0.1
Limestone	4.9	0	0	0	4.9
Sulphur	0.03	0	0	0	0.03
Rock Salt	0.04	0	0	0	0.04
Sand	0.09	0	0	0	0.09
Glass Scrap	0.22	0	0	0	0.22
Nitrogen	1.68	0	0	0	1.68
Sodium Chloride	0.03	0	0	0	0.03
Iron Ore	40.6	0	0	0	40.6
Scrap	2.066	0	0	0	2.066
Dolomite	0.03	0	0	0	0.03
Gravel	0.05	0	0	0	0.05
Fossil Carbon Materials (kg oil equivalent)	5.93	0	0	0	5.93
ENERGY all energy excl. transport (GJ)	1.62	3.17	15.85	0.34	20.98
TRANSPORT ENERGY (GJ)	0.27	1.28	1.38	1.03	3.96
Total Energy (GJ)	1.89	4.45	17.23	1.37	24.94
LAND USE (approximate numbers!)					
Forest area (m^2) [wood (kg)]	0	0	2 500 [336]	0	2500 [336]
Natural area (m^2)	0.03	0.041	0.143	0.014	0.228 **
Other surface area (m^2) (For buildings, infrastructure, etc.)	N/A	0.8	1	0.2	>2
WATER (m^3)	7 - 20**	N/A	N/A	N/A	>7 - 20 **
Environmental/ health TOXICS	N/A	0	0	0	0

Table 3.2.b Xerox DC 220/230 - main resources input * - 1 years service

*) some relevant inputs might lack (see step 1 and 2). Of the known inputs, only materials with an input higher than 0.02 kg have been listed here.
**) unreliable data. Figures give an indication of order of magnitude.
N/A not available



Schematic of Resource Flows for Ecover household cleaner during one year of use



Schematic of Resource Flows for Xerox DC 220/230 during one year of service

Step 5: Qualify the sources of the resource inputs

Qualitative aspects

In step 5, the qualitative aspects are analysed in two ways. First the character of the source is examined in more detail from an environmental/technical perspective: what type of source and what methods of production are used? For example, does an agricultural product come from ordinary methods or is it produced with certified 'organic' methods? The most common alternatives are listed in the tables.
Secondly, we ask you to come up with a score for four social aspects: PLED. This can only be done in a draft version. The aim is to analyse what the 'social quality' is of the main inputs in the product life cycle and ascertain where improvement is most urgent. We suggest that a complete lack of knowledge of these aspects for your main inputs is a bad score ("high risk" of exploitation) and an urgent issue for evaluation. The scores are rough and no exact calculations are expected. What is important is that you make your own analysis of the social and environmental quality of the sources of crucial resources, taking into account information and views from citizens' organisations near these sources.
If similar sources are from completely different origins and this is relevant, you can introduce extra categories. This would be the case, for example, when petroleum is an important input and 40% comes from Nigeria and 60% from Norway, with completely different production circumstances. In many other cases you can assume that you use the average mix that is delivered in your country or is available on the world market.
The main goal of this step is to go down the list of resources as drawn up in step 4, find out from which regions they come and determine which you should be concerned with in regards to the social and environmental circumstances. Try to define the category in which they should be ranked: low, medium or high risk of exploitation. Take account of the next four aspects:

P = respect rights and participation of local people
L = labour conditions
E = local environmental and health performance
D = democratic level of country or region

5.A Energy sources

Types of energy

Indicate how the energy used has been produced. Apply this only to relevant quantities.

For Ecover, no specification for energy sources has been made because of lack of data.

Energy sources (GJ)* Xerox DC 220/230 per service unit	Extraction phase	Production phase (UK mix)	Consumption phase (UK mix)	Recycling/reuse phase (UK mix)	TOTAL % (UK mix)
Coal	No data available For this phase	1.20	6.03	0.13	38
Oil		0.06	0.32	0.01	2
Gas		0.86	4.28	0.09	27
Other fossil		0	0	0	2
Nuclear		0.95	4.76	0.10	30
Hydro		}	}	}	1
Solar		0.10	0.48	0.01	
Wind					
Biomass					
Total Non-renewable (GJ)		3.07	15.38	0.33	18.79 97%
Total Renewable (GJ)		0.10	0.48	0.01	0.58 3%
Total energy					19.37 100%

Table 3.3 Energy sources Xerox DC 220/230 per service unit

*UK Energy Source mix details from the UK Government DTI

Social aspects of energy use

Only for relevant sources: indicate the quality of social aspects as follows:
- high risk of exploitation: bad conditions, no standards
- medium risk of exploitation
- low risk of exploitation: for example average West-European practices. Labour conditions: minimum is SA 8000

P = respect rights and participation of local people
L = labour conditions
E = local environmental and health performance
D = democratic level of country or region

Energy sources risk rate social aspects (PLED)	Extraction phase	Production phase	Consumption phase	Recycling/reuse phase
Coal Oil Gas Other fossil Nuclear Hydro Solar Wind Biomass				

Table 3.4 Energy sources risk rate social aspects (PLED)

No elaborated examples are available here. For Xerox DC 220/230, the extraction phase for the energy input is unknown - a reason for concern. For the other phases, a UK energy mix or European energy mixes apply: no assessment could be made in the time available as to the potential risks of exploitation.

5.B Land products sources

How is the area managed or cultivated? Which guarantees can be given? Are pesticides, fertilisers or genetically modified organisms used? Only for relevant quantities. In percentages of the total.

Xerox DC 220/230 Origin of land products qualitative	Extraction phase	Production phase	Consumption phase: paper use	Recycling/ reuse phase	TOTAL
AGRICULTURAL AREA: - Traditional (low input) - Modern (intensive) - Integrated (somehow certified) - Organic (certified)	0	0	0	0	0
FOREST AREA	0	0		0	
- Clear-cutting			0		0
- Plantation			1%		1%
- Managed (specified*)			99%		99%
- FSC certified			0%		0%
NATURAL AREA - 100% protection or even improvement - partial protection/deterioration - almost 100% change of character	**)	0	0	0	0

Table 3.5 Xerox DC 220/230 origin of land products

*) Guaranteed by the suppliers (see text)
**) A small amount of land surface is altered by the extraction of mineral resources. It is not certain whether this was natural area.

Social aspects of land use

With the help of a table similar to table 3.4, the social aspects of the various locations of origin for the most important resource inputs can be analysed.

According to the International Labour Organisation, in 1990, 47% of the world's economically active population worked in agriculture. "Labour in agriculture is vulnerable. Contracts of employment are generally precarious in daily and casual work. Labour is mostly unskilled. The application of basic labour laws is tenuous and labour inspection services are usually weak in most countries." "Child labour in commercial agriculture is reported to be widespread in Africa, Asia and Latin America, in plantation crops (tea, coffee, sugar, cotton, rubber) and on fruit, vegetable and flower farms." "Rates of fatal injuries in agriculture are above the all-industry level in many countries. Farm machinery, implements and agro-chemicals are among the main causes of injury."

Ecover example

For Ecover in Belgium, the basic agricultural resources are: sugar, vegetable oil and starch, used as inputs by large enterprises to convert to compounds that are bought by Ecover as ingredients for the household cleaner. They typically come from 100% intensive, modern agriculture. The sugar is used to produce alcohol and comes from sugar beets produced in this region of Europe. This means a low risk for social aspects. The origin of the starch is unclear. A world market for starch exists and it could come from a variety of crops and countries. That means there is need for further research. The vegetable oil is mainly derived from either palm or coconut. Indonesia, Malaysia and the Philippines are likely countries of origin. This gives reason for concern as to the social circumstances, which will of course differ per country. A few years ago in Germany, concern over the position of Philippine coconut farmers led to discussions with the chemical industry Henckle - a producer of surfactants - and consequently to the establishment of PalmPool, an organisation in which Ecover also participates. Another problem is the transformation of forest into palm oil plantations, for example in Sarawak, Malaysia. Ecover rates its vegetable oil sources as a 'high risk' both in environmental and social terms.

Xerox example

With regard to the social and environmental aspects of wood production, Xerox Europe sources its paper for resale from companies that are committed to the practice of sound environmental and sustainable forestry management. These practices are designed to protect forest integrity - including the ecosystem, bio-diversity, water resources and soil protection - and maintain sustainable yield. Companies must be in full compliance with governmental environmental regulatory requirements in the countries where they operate. Xerox requires its suppliers to match certain environmental criteria. These include conservation of natural resources, minimisation of environmental impact, compliance with all applicable government regulations, and a commitment to conform with the ISO 14001 standard for environmental management. Xerox therefore rates its wood sources as a 'low risk' for the local social and environmental aspects. (Nevertheless, the total amount used is a point for concern.)

5.C Water sources

What is the origin of the water used? Only for relevant quantities.

Type of water source	Extraction	Production	Consumption	Waste
Groundwater/ non-renewable				
Groundwater (renewable)				
Surface water		100%		
Rainwater				
Other:				

Table 3.6 Ecover type of water source

Xerox could not, within the given time, assess the water sources. In general in the UK surface water accounts for about 70% of the water supply.

Social aspects of water sources

Rate the risks involved in the local social and environmental aspects of the relevant water sources.
Ecover rates its own water use as a low risk. The other sources in the chain are difficult to assess.

5.D Minerals, social aspects

All over the world, mining companies are coming into conflict with local communities and environmental groups. Mining is usually a damaging and hazardous activity for the local environment as well as for the workers. The International Labour Organisation : "Although only accounting for 1% of the global workforce, mining is responsible for about 8% of all fatal accidents at work (around 15,000 per year). No reliable data exist as far as injuries are concerned, but they are significant, as is the number of workers affected by occupational diseases (…) whose premature disability and even death can be directly attributed to their work."

Only for relevant quantities as specified in step 3. Distinguish between similar materials if the origins are quite different.
Please note that here only the PLED risk scores are asked for.

Mineral sources Risk rate social aspects (PLED)	Extraction phase	Production phase	Consumption phase	Waste/recovery phase
Various raw materials:	(Unknown, so reason for concern: potentially a high risk)			All materials Recycling: Low risk: UK
Steel Frame		Low risk: Japan		
Plastic Panel		Low risk: UK		
Glass Platten		Low risk:: USA		
Paper filler			Unknown: Medium risk	

Table 3.7 Xerox DC 220/230 Mineral sources risk rate social aspects (PLED)

Step 6 Designing growth scenarios

To assess sustainability targets for resource input in the specified product or service, we first need to consider its market development and assess which influences that could have on the resource use. To this end, one or more growth scenarios are developed.
Take into account that in a more sustainable world, material welfare is much more widespread and thus market penetration of products can potentially increase dramatically.

The following elements are combined in a scenario:

1. Current resource use
2. Current penetration of a product in the global market
3. Expected penetration level in the future (2010, 2030, ect.)
4. Expected increase in the intensity a product/service is used
5. Growth of global population in the target year compared to 1990
6. Potential increase in resource use

Market penetration

Assess current market penetration of the product. Not just penetration of your product but of all similar products. Therefore a rough subdivision in comparable types of products or services needs to be made. What is the potential penetration grade in a growth scenario?

User intensity

Besides market penetration, increased user intensity is an important factor that needs to be taken into account when designing sustainable products/services. Take for example the car. Increased user intensity is not only a matter of more cars on the road, but also of individual drivers driving more. As is similar with many electronic appliances, we are using them for a longer time during the day.

Sometimes a realistic increase of user intensity can be estimated. For example, the time (e.g. TV) or distance (e.g. car) a product will be used in the future, based on present trends in high-consumer countries.

But do not restrict yourself to 'realistic' scenarios. For example, extrapolating present trends to a maximum, but also assuming (gradual or abrupt) economic or cultural changes can form the basis of interesting 'what if' scenarios.
Please do not attempt to make predictions of the future, because nobody can do that. Investigating likely and unlikely scenarios should provoke new thoughts and challenges, rather than speculation about the 'real' future.

Assess user intensity in relation to each relevant resource:
a. current user intensity (in minutes, kilometres, or other relevant quantity), and
b. expected/possible/desired user intensity in the target year (e.g. 2030) as a factor driving resource use. Beware: the exact year is not that important! The targets are. You can also omit an exact year or choose several different years.

Population growth

Population growth is also a driver of consumption. Assess which numbers will have to be applied. Nine or 10 billion is often mentioned for the final stabilisation of the world's population in 2030/2040.

Combining the various elements in a calculation:

Resource use x Market penetration change x User intensity change x Population growth = Increased resource use

Example: Xerox DC220/230

This machine is a typical office machine for departmental use. It is difficult to assess how many office workers make use of a single machine, but in many cases between five and 20 people will probably share the machine for printing, copying, faxing and scanning. Various scenarios for future usage were developed, but we present only the 'middle scenario' as an example here.

1. Current resource use has been estimated in table 3.3.
2. Current market penetration of all similar machines (all branches) is estimated at 800,000 machines for 5 billion people. This is equal to 0.16 machine per 1000 persons.
3. In a 'middle scenario' for 2010, it is estimated that 0.5 machine per 1000 persons will be on the market. This is a growth in market penetration of 0.5 divided by 0.16 = 3.125.
4. In the middle scenario a modest increase of 10% in paper use is assumed: a user intensity change of 1.1. The energy use of the machine is assumed to be unaltered as the same pattern of time in the sleeping mode/in the active mode was assumed, user patterns varying widely in practice anyway (user intensity change for machine = 1). User intensity for materials remains unaltered (1). (This could change substantially if the lifetime of the machine was increased.)
5. Population increase estimated from 5 to 7 billion people in 2010: a growth factor of 1.4.
6. Calculation for potential increase in resource use for machine components (present resource use = 1): 1 x 3.125 x 1 x 1.4 = 4.375.

Thus, these assumptions result in a more than fourfold increase in the production of machines, so in a further unaltered situation resource use would increase equally. A total of 3.5 million machines are expected to be 'in the field'.
The potential increase in paper use: 1 x 3.123 x 1.1 x 1.4 = 4.8125.
The potential increase in energy use associated with the machine is similar to material use, but total energy use increases more as the energy connected with paper production goes up by a factor 1.1.
As the energy for paper production is about 75% of total energy input, total energy potentially goes up by a factor of 4.7.

In step 7 we will take a more differentiated approach and consider which substitution or compensation factors will have to be applied that alter the potential resource growth. For Xerox this could be the projected high reuse and recycling grade of machine components.

Example: Ecover household cleaner

1. The situation for growth in Europe only (excluding the European part of the former USSR) was considered, as global penetration is thought to lead to different product characteristics.
2. Current market penetration of this type of product (household cleaner with vegetable oil based ingredients compared to all household cleaners) in Europe is estimated at 0.4% of a total population of about 500 million people (1990). Penetration of all household cleaners is about 100%: a household cleaner can be found in virtually every home.
3. For 2010, an increase to 15% market penetration in Europe was assumed: growth factor = 15/ 0.4 = 37.5.
4. A change in user intensity is not expected (= 1).
5. We assume that the total European population in 2010 has grown to about 600 million. Growth factor 600/500 = 1.2.
6. Calculation for the potential increase in resource use: 1 x 37.5 x 1 x 1.2 = 45.

Thus, this scenario leads to a potential resource use which is 45 times higher than the present resource use.

In step 7 we will take a more differentiated approach and consider which substitution or compensation factors will have to be applied which alter the potential resource growth. For Ecover this will be that the product will substitute similar products with fossil oil based ingredients.

Step 7: Assess the product sustainability challenge

Social sustainability goals

For the social aspects (PLED) of sustainability, we have not made an attempt to quantify targets. The challenge is here to reach the best score ("low risk") level for each aspect that has been defined as relevant in the process of working through step 5. Bad scores or 'unknowns' for crucial inputs pose an urgent challenge. Evaluate the outcomes in step 9 on evaluation and improvement.

Qualitative challenge of resource use

For the other qualitative aspects as defined in step 5, the most sustainable options will have to be targeted. However, it should be considered that reducing quantities of resources input is the first priority, and that choosing the best (sources of) resources is the second best option. Ideally, the input consists of the lowest possible volume of resources stemming from the most sustainably operated source. In the process of evaluation and improvement, more quantitative targets can be established as benchmarks for improvement, for example a specific increase in the percentage of renewable energy, or a certain percentage of certified forest products.

Quantitative resource use targets

Based on various publications by FoE (Buitenkamp, 1992; Spangenberg, 1995; Carley, 1998) the following GLOBAL targets compared to 1990 can be used for an assessment. (In some areas the policy debate on targets has not even started (e.g. on land use) and some targets are disputed by other parties (e.g. phase-out of persistent chemicals/chlorine)). Sensitivity for changing targets can also be analysed by using different scenarios. Many problems require urgent action, thus the years 2030/2040 are only an indication of the lengthy period needed before the world can achieve this.

Recource	2030/40 or sooner
Primary MATERIAL use (in kg)	–50%
Fossil ENERGY use (in CO_2 equivalents or GJ)	–50%
Nuclear ENERGY use (in kWh or GJ)	–100%
Renewable ENERGY use (in kWh or GJ)	+400%
WATER use (in m^3)	National/ regional estimate needed on the basis of source replenishment
Primary WOOD/PULP use (in m^3 round wood equivalent or in tons)	-50%
Forest products from FSC certified forests	100%
Land use area total, excl. natural area	Stabilise or reduce
Agricultural area	Stabilise
Built-up area	Stabilise
Area used for nature	Stabilise or increase
Toxins (specified)	–100%

Table 3.8 Global sustainability targets (ref. yr. 1990)

Looking at effects on other products or services

Before defining the sustainability target for the product, it is also necessary to analyse whether and how increased penetration or user intensity of your product will lead to a lower penetration and/or use of other products/services. These may be similar products, but can also be completely different products. If this effect is significant this might reduce or increase the sustainability target for your product.

If disposable income keeps increasing then new products/services will increase global resource use without any substitution effect. If your product is so cost-effective, it might create additional disposable income for resource intensive products or services such as air travel. We do not propose to solve this theoretical question here and now, but rather intend to make an estimate which can be considered in the evaluation.

Below examples are presented of the types of thought processes one could follow to consider effects on other products or services. They are of course not comprehensive for the analysed products.

Example: Ecover household cleaner

Probable substitution effect on other products and services outside this company:

Petroleum based products will be substituted. Assuming a similar use of these products, this means that (fossil) plastic bottle and content together deliver a net reduction of around 30% per unit of service. But population and thus units of services delivered have grown to 120%. A reduction of 30% thus results in a remaining 84 %: an overall reduction of 16%.
If we exclude the fossil energy included in the plastic bottle and only consider the contained product, a similar calculation shows a reduction of 45% per unit of service resulting in an overall reduction of 34% in a grown population.
(As the market share was 15%, this only refers to the 15% of the population that uses the product.)

Example: Xerox DC 220/230

Probable substitution effect on other products and services outside this company:

The volume of materials used in the Xerox DC 220/230 is hardly more than in a comparably sized copier, but this machine can also print, fax and scan. This can result in substitution for a separate printer, fax and scanner in many offices. However, in other offices perhaps either some of these machines were not (yet) available or a copier was not yet available. Also, with increasing living standards, paper use, printing and copying is expected to increase dramatically on a global level. We therefore have no good reason to assume an overall substitution effect. Production growth should be considered to cause a net growth in resource use of machine material inputs as well as of the energy and paper involved.

Compensation factors

Apart from a comparison with substituted products of a different character, a comparison with the reference group of similar products can be made. In practice this is a difficult task, as information about the life cycle of average similar products is usually not available. At the same time, it seems unfair and unsatisfactory if the product has some major advantages in resource input (or: major disadvantages) while this is not incorporated into the target setting for the product.

For Ecover and Xerox a compensation factor was not chosen due to the lack of reliable data. However, you can easily see the difference it would make in the outcome: for example if Xerox were to assume that it currently uses 20% less materials than the average for one unit of service, this could already be incorporated in the final target.

Product sustainability challenge

Finally, the product sustainability challenge can be defined by combining the outcome of the growth scenario with the suggested sustainability targets, taking possible substitution or compensation aspects into account.

Please note that the numbers presented below are all approximations. The main reason for using precise numbers with decimals here is that they enable you to understand the method of calculation.

Example: Ecover household cleaner

The Ecover growth scenario leads to a potential resource use which is 45 times higher than the present resource use. However, the product will fully substitute similar fossil oil based products and no change in user intensity is expected. Accordingly, we can assume that the only absolute change in resource use will be caused by the growth of the population and possible changes in the vegetable ingredients.

No substitution or compensation occurs for the vegetable materials and thus for the amount of cropland involved. Hence, the net increase of cropland use for an unaltered product is indeed the factor 45 from the scenario. For agricultural area, a stabilisation target was suggested: consequently the target is a 98% reduction of cropland per unit of service (from 45 back down to 1).

For the fossil energy involved it was already shown that substitution would lower the energy use per unit of service by about 30%. The net effect in a stabilised population would be a remaining energy use of 84%, whereas the suggested fossil energy target is a reduction to 50%. The remaining sustainability target for the product is thus another 40.5 % reduction of energy use per unit of service (from 84% to 50%).

Example: Xerox DC 220/230

The Xerox middle scenario showed a potential increase in paper use by a factor of 4.8. No substitution or compensation was assumed. For both the filler and the wood pulp the sustainability target is a reduction to 50%. From 480 % down to 50% is a reduction per unit of service of 89.6 %.

The potential increase in energy use was a factor of 4.7. Assuming this is mainly fossil energy, which has a reduction target of 50%, a reduction per unit of service of 89.4 % is the result.
(If there is any significant amount of renewable energy involved, it will be in the paper production, but there data lacked. As material inputs in the paper have to go down by a similar percentage anyway this energy target should not pose an additional problem in the case of paper.)

From the middle scenario, a potential increase in resource use for machine components of a factor 4.4 resulted. For the resource inputs related to components such as steel frame, plastic panels and glass platten the 50% reduction target for primary ('new') materials applies, as they currently contain virtually no recycled materials. This results in a target of 88.6 % reduction of material input per unit of service. It should be noted here that as soon as there are more machines at the end of their lifetime returning to the factory, internal reuse and external recycling of components will change that situation.

Step 8: A quick scan of general company policies

General questions on environmental, social and public company policies

In order not to forget basic aspects of company policy that are not covered by the Ecospace Audit, the following quick scan can be done. Make an estimate of your own performance, in a range from 1 (worst) to 10 (best) and draw your own conclusions. We cannot cover all aspects in depth: please find some important references below.

- Compliance with the environmental and social laws which are applicable to all locations of your company.
- Implementation of an environmental policy and program, including monitoring and control, with clear responsibilities at management level.
- Application of the same stringent environmental standards for products and production in each country of the world and provision of enforcement possibilities by independent authorities.
- Application of the social SA 8000 standards including third party verification to all its locations.
- Implementation of a policy and program that aim to eliminate the possibility of any catastrophic accident.
- Implementation of a quality policy and program which also set environmental and social standards for its suppliers.
- Implementation of a policy and program on openness, product information and product responsibility - including good communication with consumers and participation from stakeholders, as well as guidelines on socially responsible marketing.
- Abstention from the use of genetically modified organisms (GMOs).
- Abstention from the production of conventional, biological or chemical weapons.
- Abstention from co-operative relationships with oppressive regimes.

The maximum score is 100; your total score out of 10 items: ....

More extensive guidelines on environmental and workplace health aspects can be found in: CERES Report standard form.
On social aspects: SA 8000.
Very broad (social and environmental) sustainability aspects: Cannibals with Forks. (Elkington, 1998)

Step 9: Evaluation and improvement

Evaluation and improvement is a continuing recurrent process and is best done in an open, innovative company culture. The company policy as a whole is also very important. This report does not focus on these very important aspects, but in this final step some elements are brought to your attention.

9.1 List important uncertainties that remained in the Ecospace Audit: sensitivity for unreliable data and need for further research. Concern over toxins could compel a separate assessment.

9.2 List the main problems and challenges that came from the various steps of this audit:

- The largest resource inputs over the life cycle
- Unknown or low quality of the main resource origins (no guarantees or certifications)
- High social risks for the main resource origins
- For which resources did the product/service show the largest reduction target?
- How does the use of your service compare to the availability of resources in a more sustainable consumption pattern? See the following box:

Comparing to one person's fair share

Analysing the relative importance of a certain resource in a sustainable pattern will help you to focus on the main issues and relate resource use to a concrete human scale.
You can relate the resource inputs of your product over the life cycle to the 'sustainable' average per capita resource use: how would your product fit in a sustainable production and consumption pattern?
The figures in table 3.9 are indicative, but can be used as a good directional guide.

Global averages for a population of 7 billion people		Sustainable use of resources per person per year	Current resource use for analysed product or service	
Resource	unit		Xerox DC 1 yr use	Ecover 1 yr use
Iron ore	Kg	50	40.6	-
Fossil Energy	GJ	25	24	0.00024
Renewable Energy	GJ	35	0.6	-
Cropland	Ha	0.25	-	0.00005
Wood	Kg	200	336	-

Table 3.9 Indicative figures for sustainable resource use

9.3 Policy: Analyse the general questions score for your company: what are the main problems and challenges here?

9.4 Combining all Ecspace Audit results, which changes or improvements in 'sustainability policy' can be thought of? List all possibilities without omitting options that you consider not feasible.
If you analysed a combined set of products: are there products that have a relatively large resource input and/or scope for improvements?
The sustainability challenge of a whole company can be assessed by 'adding up' the results of the various products. It might be interesting to go beyond the sustainability challenge for some products thereby reducing the need for improvements of other products.

9.5 Discuss various qualitative and quantitative options for change and improvement, involving other departments at the company such as the production people, but also marketing people and consumers as the application (service) that the product delivers also has to be taken into account.
How useful is your product for the end-user?
Could completely other products or services fulfil similar needs?
Consider inviting your main suppliers for a brainstorming session.
Select the most promising options.

9.6 Do the audit again with the selected options.

9.7 Which policy and product changes do you wish to implement?

For Ecover and Xerox we do not fully elaborate this evaluation, but give some elements that could play a role in this process. The process described in this step 9 goes beyond the scope of this project.

The Ecover example: some elements for the evaluation

For Ecover household cleaner, the first quantitative analysis showed that the energy use in the consumer phase is a potentially high input. Then there is the plastic bottle. The use of vegetable ingredients is advantageous for the total energy input, and essential for the low toxicity of the product.
It should be noted that no research has been done on the typical usage of the product by the consumer and therefore the assumptions on quantities used might be on the low side.

Qualitative analysis showed that the vegetable origin of the ingredients is 100% modern agriculture which is currently an unsustainable method of producing renewable materials. Of special social concern, however, is the origin of the vegetable oils, presumably mainly from Asian plantations. This is rated as a 'high risk' of exploitation of local people and the local environment, until more transparency proves the opposite. It is rather difficult for a rather small company like Ecover to effect this kind of change, as large industries dominate in the vegetable oils market. Membership in the pressure group PalmPool is one way to try to influence the situation.

The quantified target for the growth scenario is quite dramatic: 98% reduction in land use related to the vegetable inputs. First of all we need to stress that the land use figures were a rough approximation and showed a large dispersal, depending on which type of crop and country of origin was assumed.
The ingredients of a household cleaner can be neglected as part of the total land use per person, but if vegetable ingredients are applied on a larger scale for several other cleaning and washing products the amount becomes relevant (one person using about 40 times the vegetable ingredients in a household cleaner). The scenario worked with 15% penetration in the European market, but in the long run a much larger share is quite likely.
The vegetable oils currently come from main crops with high commercial interests involved and pressure to transform forest area into cropland is high. The best option in the view of Ecover is to maintain and improve the advantages of low toxicity and low fossil energy use while at the same time to strive for more efficiency in land use, preferably by employing crop waste rather than main crops, which should ultimately come from organic farming in Europe. To this end, an EU financed experiment is being set up in France.

For the user phase, more precise data are needed. More attention could probably be given to improvement options for this phase, such as the instructions for use and avoiding wasteful use of the cleaner and (hot) water. As the main ingredient is water, creative solutions for packaging, transport and concentration will have to be devised.

The Xerox example: some elements for the evaluation

It can be seen from the quantitative analysis carried out on the Xerox DC 220/230 that the largest impact is certainly the consumption phase, most of which is connected to paper use. Paper use in the consumption phase is responsible for more than three-quarters of the energy consumption attributable to the provision of the service. This provides an interesting push for more investigation into the effect of increased availability and use of digital technology. If the advent of digital technology and solution software are drivers for the transfer of documents by electronic methods as opposed to the conventional transport of paper, they could have a considerable effect on the impact of office equipment. Another option for the future could be reusable paper, for re-use within the office.
The input of iron is also quite substantial as can also be seen when compared to one person's sustainable resource use. Options of changing the design, extending the lifetime and re-use of the steel frame should be explored further. The re-use or recycle option is, however, limited in a fast-growing market where the

total number of machines in the field is steadily increasing. The analysis of the material inputs was limited to a few main components: the steel frame, plastic panels and glass platten. Some other elements which were not analysed in this audit due to time limitations, such as copper and the printed circuit board require further research.

Transport burdens are more evenly spread through the life cycle phases. The extraction and processing phases are considerably smaller than the others.

In terms of land use, the paper production in the consumption phase is by far the most significant burden. Paper production is quite clearly the major burden associated with the life cycle of the Xerox DC 220/230. A much larger application of recycled paper will have to be considered, in combination with other paper-saving options such as more attention for double-sided copying, electronic transfer of information and reusable paper. As many of these issues involve an important aspect of consumer behaviour, more attention is needed to see how this can be influenced, for example by offering specific products, tariffs and services and communicating optimum usage.

With regard to social issues, Xerox Europe consistently meets or exceeds western standards on the known production and supplier locations. However, in the given time span, Xerox was not able to trace the origins of the majority of the resources that are used by its suppliers - with the exception of wood for paper. The extraction of minerals in particular is rated as a 'high risk' of exploitation. In the coming period, Xerox will devote additional research to the origins of the major resource inputs upstream in the product chain. Further actions to be derived from the Ecospace Audit are still to be decided.

4. Evaluation of the project

1. General

The companies that tested the Eco-space audit found it interesting because of the different perspective taken, compared to existing methods such as LCA which focus more on emissions. The focus on resource inputs, as well as the more unusual but important land use, combined with the broadening to the social aspects was much appreciated. These elements are seen as issues that come up anyway in society for which the business sector needs to prepare itself. Equally important is that the people involved judge that equity and social issues as well as resource use are important values to respect as a company.

Irina Maslennikova, Xerox Europe: " We found the process of going through the Ecospace Audit to be a useful exercise helping to better understand Xerox's "triple bottom line" accountability in a very focused, practical way. It certainly added important new dimensions to the scope of issues we would now consider".

David Foley, Xerox Europe: "Taking a different perspective on our business impacts proved a useful exercise. The targets the audit produces give real food for thought, and focus the aims of carrying out the audit. Bringing in social considerations are a welcome addition to a 'sustainability tool'."

The process of auditing has strongly influenced and improved this final version. Nevertheless, this report should be considered as work in progress rather than a 'final result'.

2. Transparency

It is still unusual for suppliers to provide details on their social and environmental performance related to specific products or services, let alone that they provide detailed data on their suppliers' resource origins. This audit is in fact a call for more transparency over the entire life cycle of the product. Anyone applying this audit is therefore likely to run into some problems when trying to find out social and environmental data upstream. According to the companies involved, this should not be a reason to abstain from such efforts. According to Peter Malaise of Ecover: "In the long run we can create a more transparent situation with respect to the origin of resources if we keep asking questions to our suppliers, maintaining that no answer indicates a bad score for that resource."

3. Comprehensiveness

According to the comments received, the audit appears to include all the relevant aspects. However, in the social aspects, employment has not been included. Various people suggested that this was an important element of production, considering companies that make large groups of workers redundant for higher profits are irresponsible, only answering to shareholders and not stakeholders. On the other hand, discussing ways to include this, we could not find a generally accepted standard for this point. The guarantee that trade unions are informed and remain critical seemed the best guarantee against unnecessary dismissals. Especially the allocation of production to low wage countries was a good example: it might be of great advantage to developing countries as long as labour conditions are fair.

4. Compensation for better or worse performance?

Some products, services of companies might have better or worse rates of efficiency than others: should that alter the target that a company sets for itself? We introduced an optional 'compensation factor' for products that perform better or worse than average. However, lack of data will often make this a difficult factor to quantify. After some debate on omitting this factor, we kept it in. If companies choose not to fill in a figure for that option, discussing it can still help to clarify the company's position and to consider whether it does change its challenge significantly.

5. User-friendliness

The large number of boxes in the presented tables, the linear structure of a paper document, as well as the difficulty in locating all the relevant data posed the biggest problem for the users. At present the Ecospace Audit

requires similar knowledge and skills as are needed for making LCAs. There is general agreement that the Ecospace Audit can increase enormously in value for a broad group if adequate software is developed, which guides the user through the audit and enables him/her to go through it in a linear, lateral or circular way.
Necessary but lacking data can then be provided based on average, standard data, obtained from LCA data bases and supplemented with social aspects. Contacts with a LCA software expert suggested that this is possible.
Through user-oriented interaction the user should experience a better overview of the main issues, leaving aside unnecessary questions and information on the one hand and giving additional information on request on the other hand in such a way that they contribute to overall insight.
By providing general data where the user lacks specific data the Ecospace Audit can be conducted much more easily and quickly. Ideally an initial quick scan should be done in a few hours. To maintain transparency, the program should provide the user with a list of information gaps.

6. Qualify or quantify?

Especially for the social aspects we chose not to make a quantitative score, as the judgement is rather subjective and data on the social conditions further back in the chain are often incomplete. Companies should make a reliable assessment for themselves, and look at it from an analytical point of view. On the other hand, one of the companies suggested providing the Ecospace Audit with the possibility of making a more or less objective score for the social aspects, preferably in software that should be developed.
Also, for the product sustainability, target quantification may seem to be out of proportion in relation to the present situation as usually quite large reduction challenges will result from the calculations. However it can still give a directional guidance and is one of the elements in helping to define priorities (using a distance-to-target approach). The question was raised whether it was not better to give companies general instructions for improvement rather than a number of targets to be calculated. Hugh Smith, Xerox Europe: "Seeing all the different challenges and then choosing should not be a problem. In fact it reflects our management process where the manager analyses, defines gaps and set priorities. Analysing a large number of items gives self-determination. As managers we want to assess our own outcome."

7. Defining growth scenarios

This was clearly a difficult point in the Ecospace Audit. People at companies - especially marketing people - like to think in realistic scenarios and the suggested years seemed too far away for any realistic 'predictions'. The text has been adapted to stress the theoretical, 'what if' type of approach, which seeks to challenge and to rethink generally accepted 'common sense', taking account of increased penetration levels of products, increased user intensity and a growing population. Some large companies could involve the strategic experts, but many smaller companies won't have these. We hope the scenario examples in the text will encourage others to dare to think in scenarios as well.

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