Towards a sustainable use of natural resources

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Contents

1 Aim of the report

The aim of this report is to demonstrate the need to reduce the consumption of natural resources (environmental impacts) in the economy and provide the initial impetus for a new policy to keep the use of natural resources within sustainable limits. (By ‘natural resources’ we mean the global reserves of natural resources and raw materials by used human beings.) Reduction of the use of natural resources in production and consumption is often referred to as ‘dematerialization’.

2 Depletion of natural resources

Three kinds of reserves of natural resources can be identified (Reijnders 1999, Chapman 1983): continuous resources such as sunlight and wind, the use of which does not lead to a reduction in their size; renewable resources, such as wood and crops that can be harvested – but not faster than their rate of replenishment; and non-renewable resources such as fossil fuels and minerals. The last are created by very slow geological processes, so slow in human terms that their use diminishes the available stocks. Resources such as clean water, fertile soils and biodiversity, given the time required for their recovery, can also be considered to be non-renewable.

The Club of Rome first drew attention to the depletion of resources at the beginning of the 1970s. At that time the emphasis was on the depletion of fossil and mineral resources. It was assumed that various important natural resources such as oil and various metal ores would be exhausted within a few decades. In fact, this turned out not to be true. Discoveries of new deposits, technological advances and falling energy prices have made possible the recovery of lower grade ores, and the estimated remaining lifetimes of some resources have been considerably extended.

But this is no reason for complacency. Sooner or later, at the current rate of consumption, the reserves of certain resources will be exhausted. This may be a long way off for a number of fossil fuels and mineral ores, but other resources such as biodiversity and fertile soils are being used up so quickly there is a danger that critical thresholds will be crossed.

The drain on biotic resources is particularly alarming; biodiversity and fertile soils are being rapidly used up. Research by WWF indicates that the ‘health’ of the world ecosystem, based on measurements of the loss of forest area and freshwater and marine animal species, has declined by 30% in 25 years (WWF 1998). Half the natural forest cover worldwide has already disappeared, 13% in the last 30 years. Europe only has 1% of its original forest cover left. And there is no sign of this attack on biodiversity diminishing.

	Decline	Expected trend
Health of the world ecosystem ▪ Area of natural forest ▪ Freshwater ecosystem index ▪ Marine ecosystem index	-30% in the last 25 years ▪ -13% in the last 30 years ▪ -50% in the last 25 years ▪ -40% in the last 25 years	Continuing decline More rapid reduction
Fertile soils ▪ Africa ▪ Asia ▪ Latin America	-25% in the last 50 years ▪ -30% ▪ -27% ▪ -18%	Same or greater reduction

Table 1: Some trends in the depletion of natural resources WWR, 1999, Anonymous 1999)

Poverty is an important underlying cause of further deforestation, of which about two-thirds is carried out by small farmers clearing land for cultivation and to obtain wood for fuel. Commercial logging for timber is responsible for most of the rest. The pressure on the remaining forests is increasing as the numbers of people with a low income and worldwide demand for commercial timber products grow. The demand for food, and therefore for agricultural land, will also rise sharply as the world's population rises and people's diets contain more protein (Matthews 1999). Almost all the best agricultural land is already cultivated and so less suitable land is being brought into cultivation, leading to more soil erosion and loss of biodiversity.

Fertile soil is the basis for agricultural production. In the last 50 years 25% of all fertile soils have been lost and/or degraded, and intensive efforts will be needed to prevent this process speeding up. The poorer countries are worst affected, and major problems are forecast in a number of important food producing areas in third world countries (Pinstrup-Andersen 1999). Soils recover naturally at an extremely slow rate and the costs of restoration are so high they are, in effect, unaffordable for these countries.

The growth in biofuels is also increasing the pressure on the reserves of suitable agricultural land. The National Institute for Public Health and the Environment (RIVM) in the Netherlands has calculated that if a large-scale conversion to biofuels – stimulated by greenhouse gas policies and the reduced availability of fossil fuels – implies that 20–25% of all suitable agricultural land will be needed for biofuel crops by 2050 (RIVM 2000a). It is hardly conceivable that this could happen given the considerable rise in the demand for land for the production of food.

The worldwide demand for fossil and mineral resources also continues to grow. Global policies to reduce greenhouse gases may inhibit growth in the use of fossil fuels, but there is little sign of this (RIVM 2000a). Demand for a number of mineral ores may even be rising faster than for fossil fuels, and the demand for metals is forecast to double over the next 50 years. The use of agricultural fertilizers (N, P, K) is rising even faster. Primary resource use may be checked by closing cycles, but increases in the percentages of materials recycled are nowhere near high enough to compensate for the growth in demand.

The end result is that the availability of many reserves is declining as the world population grows and demand for raw materials rises.

3 Sustainability of natural resource use

The exhaustion of reserves is in large part due to the use of raw materials. Of course, there are other causes; land, for example, is also needed for housing and infrastructure. But the use of raw materials largely determines the rate of consumption of natural resources. The extraction and use of natural resources are responsible for environmental problems all over the world, and the social and economic impacts of their use cannot always be justified. We now take a closer look at these three aspects of natural resource use.

3.1 Environmental impacts of natural resource use

The use of natural resources can lead to a variety of environmental impacts:

- Direct impacts of extraction, for example the impacts on nature and the landscape of opencast mining.
- Disruption of materials cycles by the introduction of previously unavailable matter into the biosphere (such as carbon, phosphate and heavy metals), or major movements of materials through the biosphere (e.g. the nutrients N and P), or the loss of natural areas (loss of fixed C, N and P as a result of deforestation and erosion).

Various other environmental impacts are also associated with the use of natural resources, such as pesticides used in the production of food and acidification caused by the combustion of fossil fuels.

The following table gives an indication of the type of environmental impacts resulting from the use of a number of important groups of natural resources, throughout the whole chain from extraction to disposal.

	Direct impacts of extraction and distribution	Disturbance to material cycles	Other relevant environmental impacts
Use of fossil fuels	Large local/regional impacts on the landscape and ecotoxicological pollution	Carbon cycle is greatly enlarged (greenhouse effect) Metal fluxes are increased (metals are present as contaminants) Sulphur cycle is enlarged	Greatest cause of acidification, important source of acidifying compounds in Western countries Calamities during extraction and distribution with large impacts on nature
Use of mineral reserves	Large local/regional impacts on the landscape and ecotoxicological pollution	The use on non-ferrous metal in particular (e.g. copper, zinc, lead and cadmium) is responsible for a steep rise in metal fluxes	Disasters during extraction and distribution with large impacts on nature.
Use of wood fibres as fuel and material (forestry)	Clearance, loss of forest area and loss of biodiversity in plantations and secondary forest, soil erosion	Carbon storage function reduced	
Use of agricultural products: food, material and fuel	Clearance and loss of forest area, loss of soil, consumption of groundwater reserves	Disruption of nutrient cycles, reduced carbon storage function Other greenhouse gas cycles affected Eutrophication and acidification due to use of nutrients or exhaustion due to use of nutrients	Ecotoxicological impacts of pesticide use
Fisheries	Overexploitation and shrinkage of fish stocks, loss of biodiversity	Disruption of nutrient cycles	
Use of water	Falling water tables, salination, exhaustion of groundwater reserves, damage to ecosystems		

Table 2: Overview of environmental impacts from the use of natural resources

The extraction of fossil fuels and minerals not only causes large local environmental impacts, but is also associated with regular disasters that have far-reaching impacts. Examples are the recent disasters in Spain (1998) and Romania/Hungary (1999) and the oil spills from Russian oilfields (2000). Accidents continue to occur during the transport and distribution of oil and these can have severe impacts on the marine environment.

The use of natural resources is the most important human activity in terms of global environmental effects. Table 3 indicates the relative significance of the use of different types of natural resources in terms of environmental impacts.

	Land use	Adverse effects on biodiversity from land use	Greenhouse effect (incl. fuel consumption)	Ecotoxicological impacts
Use of fossil resources	< 1%	*	ca. 70%	***
Use of minerals	< 1%	*	0 (ca. 10%)	***
Use of wood fibre as fuel and material (forestry)	approx. 32%	***	approx. 5% (8%)	*
Use of agricultural products: food, materials and fuel	approx. 38%	****	approx. 25% (42%)	***
Fisheries	NA	***	(< 1%)	
Use of water	?	**	(< 1%)	*

Ecotoxicological impacts relate here to toxic and hazardous substances, acidification and eutrophication.

The greenhouse effect shown in brackets includes the combustion of fossil fuels. About half the total combustion of fossil fuels, which accounts for about 70% of the total greenhouse effect, is for the direct use of energy. The other half is used in the production of foods and other products.

* = relatively limited contribution on a global scale; ** moderate contribution globally; *** large contribution globally; **** very large contribution globally

Table 3: Overview of the significance of environmental impacts caused by the use of natural resources
Sources: IPPC 1996, WRI, 2000, FAO 2000.

The shaded boxes in Table 3 show the environmental impacts caused largely by use of the indicated resources.

The production of agricultural raw materials has the greatest environmental impact worldwide. A great deal of land is needed for agriculture but fertility is diminishing. Large areas of soils are being lost, mineral use is not in balance with the needs of the crops and the use of pesticides causes ecological impacts and health effects (in farmers).

3.2 Ecological limits

The environmental impacts of using reserves of natural resources are so great that various ecological limits are easily exceeded.

Greenhouse effect
According to the Intergovernmental Panel on Climate Change (IPPC) the heightened greenhouse effect must be reduced by 50–70% from 1990 levels to keep the effects of climate change within manageable proportions (Watson et al. 2000, RIVM, 2000A). Signing the 1997 Kyoto protocol was the first step for the industrial countries. But so far little attempt has been made to achieve a reduction of 50%.[1]

[1] This reduction target agrees well with the ecological footprint approach, which attempts to provide a picture of the use of global biological productive capacity. At the moment this is about 30 to 50% higher than that

Biodiversity
At the 1992 ‘Earth Summit’ held in Rio de Janeiro (UNCED) it was agreed that current levels of biodiversity worldwide must be preserved as far as possible. Each country is responsible for the conservation of its own biodiversity. Nevertheless, the loss of biodiversity is continuing undiminished, despite a small number of successes (WWF 1998, RIVM, 2000b).

Various attempts have been made to estimate how large an area of the world’s land area should be left undisturbed to enable biodiversity to be maintained at present levels (de Vries 1994). These estimates lie around the 20% mark. At present about 30% of the world can be considered to be in an undisturbed state. This is not a reassuring figure, though, because the quality of the areas concerned is of great importance for the conservation of biodiversity. The increasing demand for land for agriculture, forestry and buildings will lead to the loss of areas of great value for biodiversity. We cannot conclude, therefore, that there is room for further uncontrolled exploitation of natural areas.

3.3 Social and economic sustainability: fair shares

Industrialized countries make a much greater claim on raw materials than developing countries. About 20% of the world’s population lives in rich countries and uses on average about 50% of the world’s various reserves. Consumption of most resources is increasing both in rich and poor countries, but faster in poor countries. For example, during the last 10 years fossil fuel consumption in China, with a fifth of the world’s population, has more than doubled. Meat consumption in China has also doubled in the last 10 years; in 1996 it stood at 41 kg per person, a little more than half the figure for Europe and a third of the amount consumed in the US.

	Production in poor countries	Use in poor countries	Growth factor at OECD levels of use throughout the whole world	Growth according to forecasts for total world demand over the next 50 years
Fossil resources				1.7 to 2.9 with declining availability of oil and natural gas (RIVM 2000a)
▪ coal, oil and gas	PM	52%	3.8	
▪ limestone	70%	69%	2.5	
Minerals				1.5 to 4 with declining quality of ores and poor accessibility (Vuuren 1999, Matthews 1999)
▪ ferrous	65%	40%	4.8	
▪ aluminium	60%	30%	5.6	
▪ copper	65%	30%	5.6	
▪ N, P, K nutrients	?	55%	3.6	
▪ Cars	PM	15%	6.8	
Wood fibre as fuel and material				
	PM	67%	2.4	1.6 to 2.6 assuming growth of 1 to 2% per year with declining area of forest cover worldwide and halving of tropical forests (Matthews
▪ Firewood				
▪ raw materials for industry	90%	90%	NA	
	40%	33%	6.8	

produced naturally by the earth (Wackernagel et al. 2000), made possible by the use of fossil resources. The annual use of carbon is greater than the earth can fix each year in the form of organic matter. If we decide that biological productivity may not be higher than that provided naturally by the earth, then the use of fossil fuels will have to be reduced by about 75%. This assumes that it will be much more difficult to cut back on agriculture, forestry and housing.

				1999)
Agricultural products: food, materials and fuels ▪ grains ▪ meat	 74% 60%	 74% 60%	 2.1 3.2	1.5 in the next 25 years with a declining availability of fertile soils

Table 4: Forecast growth of natural resource use

The third column in Table 4 shows the growth that would take place if the use of resources was divided equally, based on a population of 9 billion in 2050 and present levels of consumption in the rich countries (average of OECD countries).

Growth in the consumption of resources in poor countries is an inescapable consequence of social and economic development, and is progressing on a large scale in a number of countries. However, it is highly questionable whether growing prosperity in poor countries can be allowed to be accompanied by a per capita consumption of resources comparable with that of the rich countries now. If in 2050 the population of the world consumes natural resources at the levels now enjoyed by the 'rich countries' of the world, it would consume 2 to 7 times the present amount of natural resources. This would multiply current environmental problems by 2 to 7 times as well, while the goal is an absolute reduction of environmental impacts. This is illustrated in Figure 1 for the greenhouse effect.

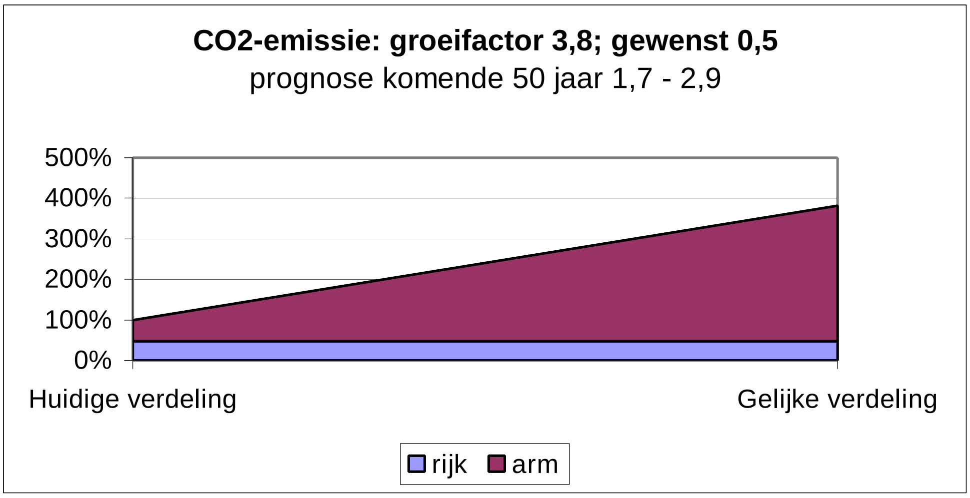

Figure 1: The effect of an equal distribution of resource use on the growth in CO_2 emissions
CO_2 emissions: growth factor 3.8; desired 0.5
Prognosis for the next 50 years 1.7–2.9
Current distribution of resource use
Equal distribution of resource use

This presents us with a big challenge: to raise the efficiency of resource use, in some cases by a factor 10 (90% reduction), and achieving a comparable reduction in environmental impacts. For the use of fossil fuels, for example, efficiency needs to be increased by a factor of 7.6 (3.8/0.5).

The tasks facing the industrialized and the developing countries are different, though. The industrialized countries will indeed have to find ways of considerably reducing their use of raw materials and natural resources per head of the population. This will require great changes in the production and consumption of resources. For developing countries, the task is to generate growth in prosperity using efficient technologies, which are now hard for them to obtain.

Many natural resources processed or consumed in the rich countries are extracted and produced in poor countries, generally because of natural circumstances, such as climate and the presence of mineral ores, and because wages are low. Under prevailing power structures in these countries the local population usually comes off worst (Spapens 1998). Pay and working conditions in mines are generally bad, and mining activities often cause sweeping changes in the environment of the local population. Wages and working conditions also tend to be poor on plantations owned by multinationals, where many food crops, such as banana, tea and coffee, are grown.

The current skewed distribution of production and consumption of natural resources results in resources being taken from poor countries and added to the reserves in the economies of rich countries. This will enable the rich countries to cope with a future scarcity of primary resources much better than their poor cousins. For example, rich countries have large stocks of recoverable metals in products and waste – which makes the high demand for primary metals from the rich countries highly suspicious.

3.4 The challenge facing the Western world

The Western world faces two challenges concerning the use of natural resources. First, that of achieving a fair distribution of resource use. Achieving this will require a literal 'dematerialization' of consumption. About 70% of the greenhouse effect is caused by the use of fossil resources. Of this 70%, more than half is used in the industrial production of raw materials, components and products. The potential for reducing the greenhouse effect by making changes to the energy system is limited by the demand for materials efficiency in the production of goods. To achieve a 50–75% reduction in the emission of greenhouse gases will be very difficult without large increases in efficiency of the materials system (and certainly not cost-effective). The basic position of Dutch policy on the greenhouse effect is that these problems must not be transferred to biodiversity and food production. Dematerialization of the use of foodstuffs and wood will help free up land for the biofuel crops and carbon storage needed to combat global warming This, by the way, must not compete for land with the growing demand in developing countries for good food and timber.

	Contribution to global warming	Main reduction measures
Agriculture	20%	Control of emissions from agriculture (N_2O and CH_4)
Land use changes	14%	Resist conversion to agriculture and forestry
Food production	16%	Increase greenhouse gas efficiency of the energy system, dematerialization by preventing waste, substitution, etc., resulting in a lower demand in agricultural production
Other products	20%	Increasing greenhouse gas efficiency of the energy system, dematerialization by system substitution, prevention and reuse
Direct use of energy by consumers	30%	Increase greenhouse gas efficiency, reduce demand from consumers by system substitution and more efficient use

Table 5: Contributions to global warming (IPPC 1996, Blonk 1992, Spapens 1998, Hekert 2000)

Summing up, to reduce the greenhouse effect by a factor of 4 to 10 (75 to 90%) from 1990 levels, as required by policy and for a fair distribution of emission quota, consumption must be dematerialized. If we assume that half the reduction of the greenhouse effect from the materials system can be achieved by increasing energy efficiency, the other half will have to be achieved by increasing the efficiency of the use of the materials themselves. This means that the demand for primary resources other than fossil resources will have to be reduced by a factor of 2 to 4 (50 to 75%) from 1990 levels. At the same time this will reduce the land take by the same proportion, assuming the same levels of productivity. This extra land can be put to good use for combating global warming and meeting the rising demand for food and timber products, reducing the pressure to bring more virgin land into production. The demand for primary resources from agriculture and forestry must be reduced by a factor of 2 to 4 as well. Given the large contribution to total land use made by these sectors, this is more significant than for minerals.

The second challenge facing the Western world is to produce raw materials within acceptable local environmental and social conditions, and in doing so contribute to meeting global sustainability targets. For the extraction of minerals and fossil resources this means that local environmental impacts must be minimized and international conventions, for example on working conditions and child labour, must be respected. Food and timber production must take global sustainability targets into account, such as reductions in global warming and the prevention of clear felling, soil erosion and biodiversity loss.

	Challenge facing the Western world Reduction in use from 1990 levels	Environmental impact targets for production	Social and economic targets for production
Use of fossil resources	Factor 4–10	Limit local environmental impacts	Production within acceptable social and economic conditions
Use of minerals	Factor 2–4 in relation to greenhouse effect	Limit local environmental impacts	Production within acceptable social and economic conditions
Use of wood fibres as fuel and material (forestry)	Factor 2–4 in relation to greenhouse effect	No use of timber for primary forests, conservation of biodiversity, sustainable forest management	Production within acceptable social and economic conditions
Use of agricultural products: food, materials and fuel	Factor 2–4 in relation to greenhouse effect	No new agricultural land, integrated agriculture, organic agriculture	Production within acceptable social and economic conditions

Table 6: Challenge to the Western world in relation to dematerialization and natural resource use

To help third world countries to achieve sustainable production the Western world should start by reassessing its imports from these countries. Radical changes are needed in the market structure. At present most natural resources are bought on world markets without full knowledge of their origin, let alone how the raw materials are produced. In future, each supplier of raw materials should be able to justify their production methods.

4 Indicators of the pressures on reserves of natural resources

4.1 Type of indicators

There are various indicators that can be used to monitor the use of physical resources and materials. First, of all, there are indicators that represent all the material streams in society, aggregated in one figure. An example is the TMR, the Total Material Requirement (Adriaanse 1997), which aggregates the use of resources by society into one score by adding up all the weights of resources used. This approach has two important disadvantages:

1. The total score is heavily influenced by the large resource streams and movements of these effectively determine the score, while there is no reason to suppose that these streams are in fact the determining factors in the total pressure on natural resources. The use of sand has a completely different impact than the use of copper, for example. An environmental impact score is needed to indicate this.
2. The total score is a sum of natural resources, the pressure on a number of reserves and movements of resources. Figures as different as the use of potatoes and the amount of eroded soil are all added up together. This combination of different units is highly confusing.

A theoretically more satisfactory approach is to add up all the environmental impacts caused by the various resource streams. However, this places high demands on the method and procedure for aggregating environmental impacts and requires much data. The attempt by Pré (2000) to do this using the LCA method must therefore be viewed as an exploratory exercise. The LCA method used is not suitable for expressing the most important environmental impacts caused by the use of resources, such as loss of biodiversity and the environmental impacts of agriculture. Moreover, the data on the extraction and production of imported raw materials used in Pré study are very sketchy.[2]

Another approach is to use ‘key resources’. Instead of looking at the actual extraction of specific resources such as ores and minerals, this method focuses on the use of reserves of a few specific resources that are ultimately essential for the functioning of the earth and human society. These key resources are energy, the use of land and biodiversity. The ecological footprint method is based on the same thinking. It expresses everything as a (weighted) land area (the ‘footprint’) and has the advantage of allowing comparisons, for example between the use of sand and copper, via the claims made on a few key resources. The disadvantage is that it involves long and difficult calculations and considerable uncertainty. And the definition of ‘key resources’ is itself a subject for debate. How can the consumption of energy be defined? And how can the use of biodiversity be calculated (see for example Blonk 1997)?

A more practical approach is to identify the resources streams that make up a substantial part of all resources used and the environmental impacts caused by the use of resources.

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[2] The Pré study does provide insight into some environmental themes and a number of interesting conclusions are drawn. One third of the pressure on the environment exerted by consumption in the Netherlands takes place abroad. The study also shows that the Netherlands is a recipient of environmental pressures exerted by consumption in the EU region (particularly Germany) because of the country’s geographical situation and economic structure.

The WWF takes this approach with its six indicators for consumption (WWF 1998): grain consumption, marine fish consumption, timber consumption, consumption of ‘drinking’ water, and CO_2 emissions. This report draws partly on the issues selected by WWF.

4.2 Consumption indicators for the Western world – the Netherlands as example

Production and consumption activities require different indicators of resource use. Consumption indicators are designed to reflect developments in consumer demand. The final use of resources, such as land, fossil fuels and biodiversity, and other environmental impacts can be obtained by combining these indicators with data on the environmental efficiency of production (such as energy consumption and emissions from production processes, materials reuse and losses from the production chain). Production indicators reflect production activities within a country and are more suitable for monitoring the environmental efficiency of specific production activities.

The OECD (1999) has developed a number of indicators for monitoring changes in the sustainability of consumption. This list of indicators, along with the WWF methodology, is used in this report.

The indicators shown in Table 7 provide a good impression of the use of resources by the Dutch population.

Direct indicators	Contribution to environmental impacts from consumption			
	Land use	Damage to biodiversity	Greenhouse effect	Ecotoxicological impacts
Fossil fuels	<1%	<1%		
– total fossil fuels			80%	Approx. 65% of acidification
– direct energy consumption for passenger transport			20%	
– direct domestic energy consumption			20%	
– indirect energy use by consumers			40%	
Wood				
– total wood	56%	15%	10%	
– consumption of non-certified tropical hardwoods		15%	3%	
Food				
– total food	36%	75%	30%	Approx. 90% eutrophication and pesticides
– meat consumption	13%	60%		
– consumption of dairy products	8%			
– consumption of vegetable oils	10%	15%		
Metals	<1%		5%	Heavy metal emissions and accumulation
– use of steel				
– use of aluminium				
– use of zinc				
– use of copper				
Indirect indicators	**Indicates:**			
– household waste	Use of articles with a short life			
– building and demolition waste	Loss of materials due to changes in the housing stock			

Table 7: Indicators for Dutch consumption and contribution to environmental impacts (Vringer 2000, Blonk 1992, Ros 2000, De Vries 1994, Blonk 1992)

Important criteria for the choice of indicators are:

- Contribution to the environmental impacts of Dutch consumption
- Provides insight into the losses (‘leaks’) from the production–consumption chain
- Availability of data

<u>Direct indicators</u>

The material categories – fossil fuels, firewood, food – make a very high contribution to environmental impacts in the Netherlands. At the moment, Statistics Netherlands (CBS) and RIVM monitor these directly in only a limited way. With a few calculations, good consumption figures can be derived from the statistics (Vringer 2000, Koster, 2000, Kramer 2000). The use of metals is a good indicator of losses from consumption, derived from net primary use after consumption (Blonk 1992, Spapens 1998). The use of zinc and copper leads to an increase in the use and emissions of cadmium because this is a by-product of their extraction.

Indirect indicators

Both the amount of household waste and residual building and demolition waste are monitored. Trends in the amount of household waste (or packaging waste) produced says much about changes in the use of products with a short life, and the composition of household waste also provides an insight into the use of metals. The amount of residual building and demolition waste is a global indicator of the materials efficiency of changes in the housing stock.

5 Trends in natural resource use – the Netherlands as example

To gain an impression of the changes and environmental impacts of resource use in the Netherlands we must first identify three trends:

- Volume changes in the consumption of goods in the Netherlands
- Environmental efficiency of Dutch production
- Environmental efficiency of Dutch imports and other sustainability aspects

Volume changes

During the last 10 years the consumption of most natural resources has risen (Figure 2)

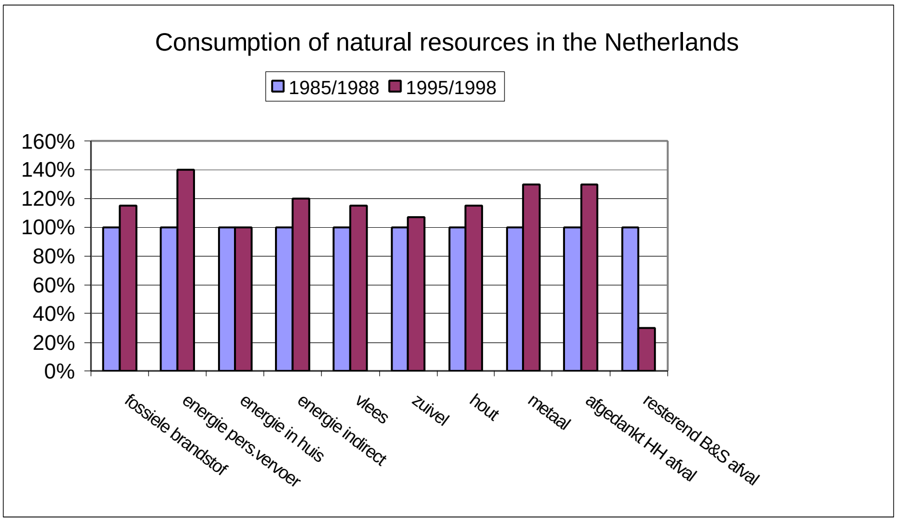

Figure 2: Changes in a number of consumption indicators of resource use (RIVM 2000a, Spapens 1998, Vringer 2000)
Fossil fuels
direct energy consumption for passenger transport
domestic energy consumption
indirect energy consumption
meat
dairy products
wood
metal
household waste
residual building and demolition waste

Only the material efficiency of the processing of building and demolition wastes has improved significantly. All other consumption indicators have risen. The use of fossil fuels for consumption – for which the highest reduction targets, a factor of 4–10, have been set – has been rising for years. The proportion of energy used indirectly in the production of food and goods and the treatment of household wastes is gradually becoming more significant in the overall picture (Figure 3). Dematerialization will play an important role in reducing this direct and indirect consumption of energy.

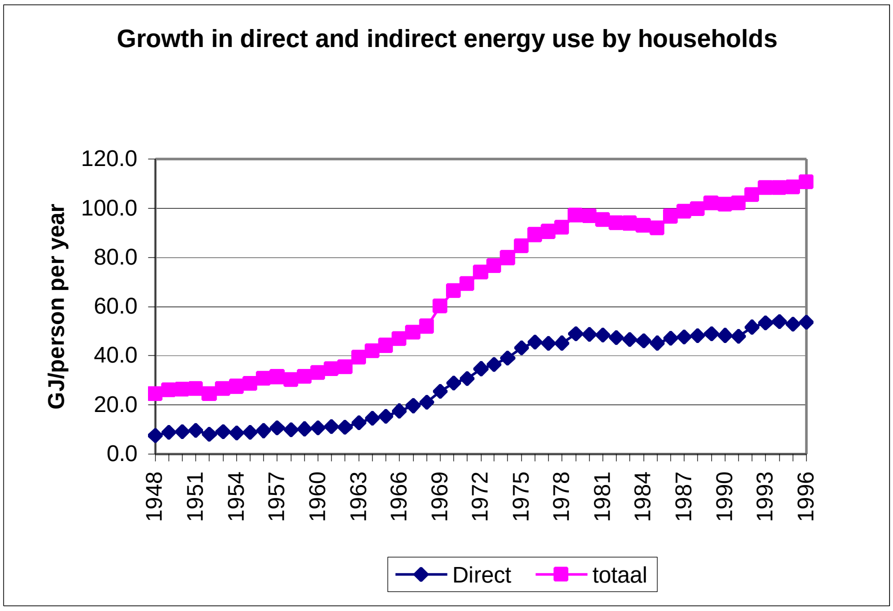

Figure 3: Growth in direct and indirect energy use by households (Vringer 2000)

<u>Environmental efficiency of production in the Netherlands</u>
Some progress has been made in improving the environmental efficiency of material production and use in the Netherlands. Important gains have been made in the area of ecotoxicological impact through reductions in the emissions of acidic substances from fuel combustion and emissions of metals and other toxic substances. In a number of areas results have been disappointing. Emissions of CO_2 per unit of energy are hardly falling at all; and while Dutch agriculture is getting cleaner, emissions of pesticides and nutrients are falling very slowly.

<u>Environmental efficiency of production abroad</u>
The demand for foreign resources for Dutch consumption has risen, although some progress has been made and resource use is rising less rapidly than demand. The efficiency of converting feed into meat has risen and the reuse of certain materials has increased. Another positive development is the demand from retail organizations to be informed of the conditions under which food crops are produced. In 2001 European producers will be obliged to provide this information, launching a process that has potential to strengthen the role of environmental and social aspects in production and consumption.

In general, though, the trends are still the wrong way, reflecting continuing growth in consumption. The improvements in environmental efficiency per unit of production are mainly being made within the Netherlands. The environmental efficiency and the social and economic conditions of foreign production for consumption in the Netherlands – of great significance for timber, meat and metals production – have hardly improved at all.

6 Reduction targets and strategies

The challenge facing the Western world is to cut fossil fuel consumption by a factor of 4 to 10 and reduce the greenhouse effect, land take and consumption of other resources by a factor of 2 to 4. This challenge goes much further than the automatic process of improving material and energy efficiency in the production of materials and products. Fundamental changes are needed, such as

- Bringing materials use in line with functional use
- Limiting wastage of materials and energy in production and consumption chains
- Making better use of resources in the economy (recycling and cascading)
- Developing new products and services
- Using alternative raw materials and resources

Half of the consumer use of fossil fuels is for passenger transport and domestic activities. Current technologies allow great savings to be made here. ‘Zero-energy’ houses are a possibility, in which gas consumption is a tenth to a twentieth of the amount used in existing homes. It is also possible using current technologies to reduce the fuel consumption of cars by a factor of 4 (Weiszacker 1997). The introduction of these technologies is progressing more slowly than hoped, partly because existing products have a long life and so replacing and adapting them will take a long time.

The indirect use of fossil fuels for the production and waste treatment of products accounts for about half of the total use of fossil fuels by consumers. Food consumption takes up almost half of this. Food is lost throughout the whole chain (UNEP, RIVM), not only from spoilage during the various production phases and consumption, but also because of wasteful diets with too much protein and calorific content and an unnecessarily high proportion of meat. Reduction in the use of fossil fuels in food production by a factor of 4 seems to be technically feasible (Carlston 1998). The same reduction in energy consumption (to a quarter) is also the target for wood products and metals. To achieve this, considerably more material will have to be recycled and some processes will have to be replaced by others.

Technical feasibility is probably not the biggest problem. Much more important in the long run is how to make these changes in a society with growing levels of consumption and a strong international orientation.

7 Policy requirements

SNM believes it is high time we made a start with reducing our consumption of natural resources. We need to take direct action in response to the alarming signs of the damage being done to the biosphere. The rich and technologically advanced countries have a responsibility for global problems, and the countries of the European Union should take lead by example. A policy to substantially reduce resource use should include a number of elements.

- *Communication and awareness raising*

The threats to the biosphere do not get the attention they deserve from companies or consumers. The Government should prepare a policy document setting out a course of action, backed up by a clear analysis. This SNM report is intended to start the ball rolling.

We argue that considerable changes are needed in Dutch consumption patterns and in the production of imported raw materials. A communication strategy aimed at companies and consumers should be drawn up and implemented.

- *Objectives*

The government should formulate indicative long-term and short-term objectives for various resources and reserves (space) for reducing the environmental impact of consumption. The European Union must translate the challenge facing the Western world – the literal dematerialization of material and resource use and achieving sustainable production of raw materials – into definable objectives. Ensuring, of course, that production respects the limits imposed by the environment.

	Reduction targets for the Netherlands (from 1990 levels)	Reduction of environmental impacts from production
Use of fossil resources	Factor 4–10	Limit local environmental impacts
Use of mineral resources	Factor 2-4 for greenhouse effect	Limit local environmental impacts
Use of wood fibres as fuel and material (forestry)	Factor 2-4 for greenhouse effect and land take	No use of timber from primary forest, conservation of biodiversity
Use of agricultural products: food, material and fuel	Factor 2-4 for greenhouse effect and land take	No new agricultural land; integrated agriculture, organic agriculture

Table 8: Goals for reducing resource use

These targets will have to be further specified for the most important resource streams. SNM proposes that specific targets for the 16 'indicator' resource streams shown in Table 5 are derived and adopted as policy targets.

- *Strategy and action plan*

SNM argues for making 'products' the central target of policies for reducing resource use. An approach based on the production chain can ensure that all companies will be involved in reducing the use of resources. Products are also the most relevant point of entry for policies aimed at consumers too.

Putting 'products' at the heart of the approach also places the responsibility for implementing policies for reducing resource use with companies, at least as far as changes to products or services are involved. To avoid a 'rebound' effect, government will have to influence consumer behaviour through market mechanisms, confronting consumers with the costs of environmental impacts via the prices they pay for products. Government strategy should distinguish between 'pioneer companies', which can be stimulated to reduce their use of resources (through market mechanisms, experiments, pilot projects, etc.), and the rest. Regulations are needed to stir most companies into action, with government setting product standards (e.g. via an independent 'product bureau') which should eventually enable policy targets to be reached. This will take off more quickly if the costs of the burden on the environment is reflected in the price of raw materials and products. The same goes for other necessary legislative measures, such as environmental liability and the right of return.

- *Monitoring*

Monitoring resource use at the consumption level is highly important. The data obtained are not only needed to convince parties of the necessity of the policy and the targets, but also to manage policy and determine whether the objectives have been achieved. SNM proposes to start monitoring immediately using the 16 indicators in Table 7 and to publish these each year.

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