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# Making sustainability accountable: Eco-efficiency, resource productivity and innovation

Proceedings of a workshop on the occasion of the Fifth Anniversary of the European Environment Agency (EEA)
28 - 30 October 1998
in Copenhagen

organised by
the European Environment Agency (EEA) and the Factor-10-Institute

in co-operation with
World Business Council for Sustainable Development (WBCSD),
European Partners for the Environment (EPE),
Nordic Council of Ministers and
Austrian Federal Ministry for the Environment, Youth and Family Affairs

Edited by Stephan Moll and David Gee (EEA)

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**EEA's mission:** The EEA aims to support sustainable development and to help achieve significant and measurable improvement in Europe's environment, through the provision of timely, targeted, relevant and reliable information to policy making agents and the public.

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# Part I: Introduction and main conclusions

## Introduction

The objective of sustainable development has been included in the Amsterdam Treaty and the objective of 'integration of environmental considerations into other policies' has been given added emphasis (Articles 2 and 6). Progress towards sustainability and improved environmental quality will come mostly from better economic policies, as influenced by environmental objectives: 'smart growth'. The EEA has to provide information needed to produce sound and effective environmental policies that are integrated into economic activity in order to reorientate socio-economic activity towards achieving sustainable development.

A key objective for all economic sectors will be to monitor and improve their 'eco-efficiency'[1]. Eco-efficiency is a **concept** and **strategy** enabling sufficient de-linking of the **use of nature**[2] from economic activity, needed to meet human needs (*welfare*), to keep it within carrying capacities; and to allow equitable access to, and use of the environment, by current and future generations. Eco-efficiency is only a relative measure, a necessary, but not sufficient condition for achieving sustainability, as, in some case, absolute reductions in some environmental pressures are needed.

In order to help operationalise this concept, the EEA, together with Factor-10-Institute, the World Business Council on Sustainable Development (WBCSD), European Partners of the Environment (EPE), the Austrian Federal Ministry for the Environment, Family and Youth Affairs, and the Nordic Council of Ministers, organised a workshop[3] in order to gather expertise on this concept and to get further ideas and support for future work.

The objectives of the workshop were:

- to introduce and clarify the concepts of 'eco-efficiency' and 'resource productivity';
- to discuss and help to develop indicators for 'eco-efficiency' ('resource productivity') at both economic and corporate level;
- to summarise experience in applying 'eco-efficiency' ('resource productivity') concepts and indicators in some European countries and companies;
- to review the barriers and opportunities for promoting 'eco-efficiency' ('resource productivity') and in particular to explore the role of the EEA in developing and promoting appropriate indicators & best practice.

This booklet contains summaries of presentations, discussions and conclusions of the workshop. Following an introduction (Part I), a **summary of the presentations** (session 1 - 3) is given in Part II, including those sessions which dealt with the concept of eco-efficiency, indicators for eco-efficiency and eco-efficiency targets. The results of three **interactive sessions** are summarised in Part III. The three work groups discussed eco-efficiency indicators, the role of government in fostering eco-efficient innovation, and concepts and targets. Finally, Part IV is a background paper by the EEA on eco-efficiency which was provided to workshop participants.

## Main conclusions for the EEA's work

Four main conclusions as regards EEA's future work were drawn from the workshop discussions.

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[1] See EEA 'criteria for monitoring progress towards sector / environment integration', EEA (1999c).

[2] E.g. 'Sources' of materials & energy; 'Sinks' for wastes / pollution; 'Services' of the environment e.g. water & carbon cycling; and 'Space' for economic activity and aestmetics – see Part IV.

[3] 'Making Sustainability Accountable – eco-efficiency, resource productivity and innovation', 28-30 October 1998, EEA Copenhagen

**(1) Monitoring eco-efficiency on the macro level**

Monitoring eco-efficiency on the macro level is necessary in order to make sustainability accountable. EEA in partnership with Eurostat, can work to provide eco-efficiency ratios for the European economies as well as for the sectors (i.e. industry, transport, agriculture, energy). Examples of such initial eco-efficiency monitoring can be found in the recent EEA report *Environment in the European Union at the turn of the century* (EEA 1999a) and in the EEA's contribution to the global assessment of the 5th Environmental Action Programme (EAP): *Monitoring progress towards integration* (EEA, 1999c).

Eco-efficiency indicators are 'TYPE C' indicators according to EEA's 'Typology of Indicators' (EEA 1999b) which is briefly described in the workshop background paper in Part IV of this booklet. In addition, developing eco-efficiency indicators facilitates the setting of eco-efficiency targets at sector and economy levels.

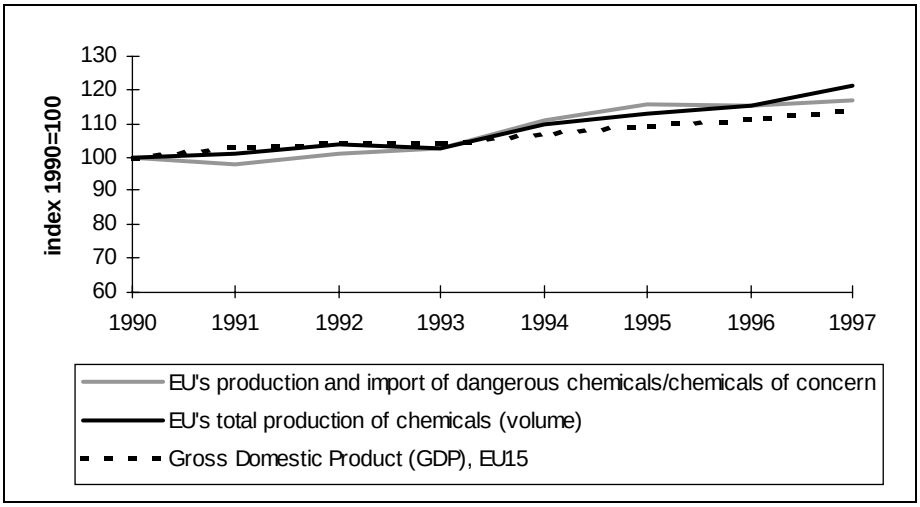
**(2) Environmental 'headline' indicators needed to build eco-efficiency ratios**

Eco-efficiency indicators are ratios of welfare indicators (mainly GDP or gross value added) and environmental indicators (use of nature). During the workshop the EEA proposed a core-set of environmental indicators (see Box in Part III). The general proposal was widely accepted by the participants, and this led to subsequent discussions as to which indicators should be included.

These indicators represent the 'use of nature' consumed in socio-economic processes and highlights a shift towards input flows, i.e. the efficient use of resources, which complement the more traditional output or pressure/impact indicators.

The EEA is now developing with Eurostat a common set of environmental headline indicators. The current draft proposals for EU headline indicators are shown in Table 1. A draft example of one of these, the 'dangerous chemicals intensity EU GDP' is shown below.

Fig. 1 The 'Dangerous Chemicals Intensity[1] of EU GDP, 1990-97'




[1] This is a first step towards developing a 'chemicals intensity' indicator, and is based on EU definitions of 'dangerous' chemicals plus other chemicals of concern, and on production data supplied by chemical companies to the European Chemical Bueau. Significant data limitations need to be overcome before it can be used to monitor progress towards reducing the dangerous chemicals ntensity of GDP. (Source: EEA, 1999a, p. 112)

Table 1: Current proposals for EU Environmental 'headline' indicators

| Issue | 'Actual' indicator(s) | 'Ideal' environmental headline indicator |
|---|---|---|
| Climate Change | Aggregated index of 3 Greenhouse Gas emissions ($CO_2$, $CH_4$, $N_2O$) | Aggregated index of 6 Greenhouse Gas emissions ($CO_2$, $CH_4$, $N_2O$, HFCs, PFCs, $SF_6$) |
| Air Quality | A) Number of days of pollution exceeding standards for different sites<br>or<br>B) Aggregated index of 3 or 4 pollutants ($SO_2$, $NO_x$, $NH_3$, NMVOCs) | A) Number of days of pollution exceeding standards<br>or<br>B) Aggregated index of 4 pollutants ($SO_2$, $NO_x$, $NH_3$, NMVOCs) |
| Water Quality:<br>- inland water<br><br><br><br><br>- marine water | A) Proportion of inland water that comply the EU and national water quality standards of Nitrates Directive<br>or<br>B) N and P concentration in large rivers<br><br><br>Eutrophication: index of nitrogen and phosphorus discharges in coastal and marine zones- indicator to be defined | A) Proportion of inland water that comply the EU and national water quality standards<br><br>or<br>B) European 'river quality index" (to be defined)<br><br>indicator to be defined |
| Water Quantity | Total fresh water abstraction | Intensity of fresh water use (ratio, relating total water abstraction to water availability in terms of renewable water) |
| Nature & Bio-diversity | | - Bio-diversity index based on genetic and habitat variety<br>- Agri-environment programme |
| Land-Use | Growth of built up area | Changes in different uses of land, including the change from natural to built up area and erosion and desertification aspects |
| Chemicals | Index of production and imports of hazardous chemicals/chemicals of concerns | Toxicity weighted index on consumption of toxic chemicals |
| Waste | Volume of landfilled waste | - Volume of landfilled and incinerated waste (with and without energy recovering)<br>- Recycling of selected waste streams |
| Resource Use | Gross inland energy consumption | Total Material Requirement (TMR) |
| Urban Areas | Passenger transport by means of transport | To be identified, possible indicators related first to transport, (air quality and land-use as related themes) |
| Fragile Eco-Systems | | To be identified, possible indicators related to marine water quality and land-use |

Source: EEA, Eurostat

**(3) Eco-efficiency as a conceptual framework serving integrated sustainability analysis**

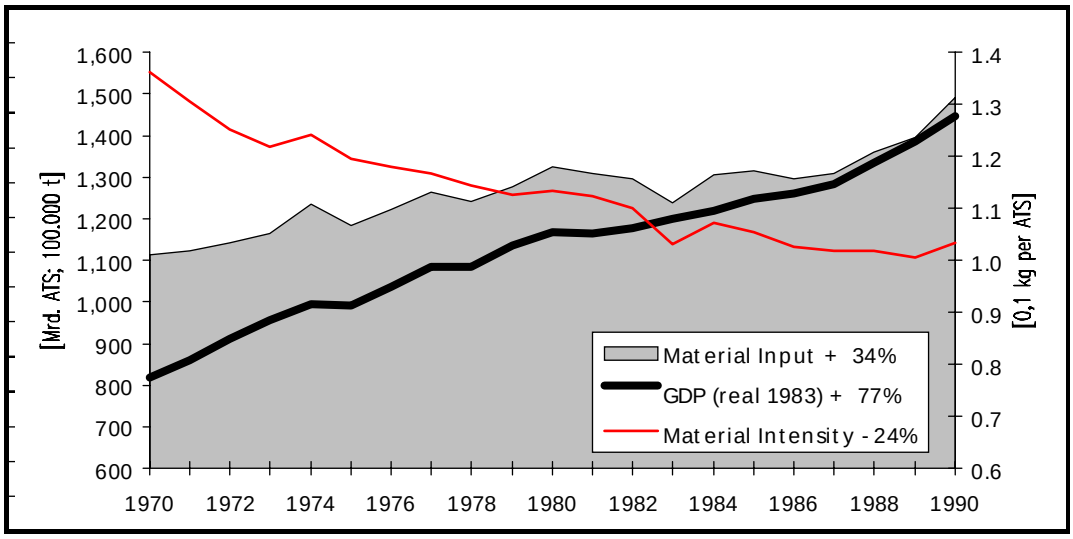
Beyond monitoring – and associated targets –, eco-efficiency can serve as part of a conceptual framework for integrated analysis and assessment of socio-economic developments – one of the EEA's tasks. Such an integrated sustainability analysis is a necessary pre-requisite for the design of policy proposals by governments.

One element of such an analytical framework is the distinction between relative and absolute eco-efficiency. The case of Austria, which was the first country to adopt the Factor 10 target in its national environmental plan, illustrates the difference between relative eco-efficiency gains (24% between 1970-1990) and the continued rise (+34%) in the absolute use of resources due to the 77% increase in economic growth (Figure 2).
The 'total material requirements' (TMR) of Germany, the Netherlands, the USA and Japan[1] also show the large gap between current eco-efficiency and what is needed from

[1] See Part IV background paper

OECD countries if global sustainability is to be achieved in the next few decades. Since the October workshop the EEA has commissioned Wuppertal Institute to produce TMRs for the other EU countries.

Figure 2: Eco-efficiency and material flows in Austria




Source: Schuster,1997, reprinted in EEA, 1999a

Another element would be to analyse innovation in terms of a shift from labour productivity towards resource productivity (natural capital productivity -> Lovins, A., Korten, P. (1999): Natural Capitalistm. The UN, through both the 'Rio+5' declaration and the 'GEO 2000' report (UNEP, 1999), has endorsed the target of Factor 10[1].

**(4) Partnerships with business**

Since business actors are crucial to achieve a more eco-efficient performance of our economies, partnerships with business are essential. The European Eco-Efficiency Initiative (EEEI) is a multi-stakeholder project to promote eco-efficiency in business which is funded by DGIII and organised by EPE and WBCSD. The EEA workshop encouraged the harmonisation of eco-efficiency indicators between micro and macro levels. The WBCSD working group on eco-efficiency metrics is now proposing a similar set of indicators to the EU level 'headline' indicators proposed by the EEA (see Box 1):

Box 1: WBCSD set of core corporate indicators to monitor eco-efficiency

| Environmental influence: | Product/Service value: |
|---|---|
| energy consumption | unit of product/service |
| materials consumption | net sales |
| GHG emissions | |
| net water consumption | |
| ozone depl. subst. emissions | |

Source: WBCSD Newsletter, Jan. 1999

[1] 'A tenfold reduction in resource consumption in the industrialised countries is a necessary long-term target if adequate resourced are to be released for the needs of developing countries'. GEO-2, UNEP, 1999

The EEA will work more closely with WBCSD and others on corporate eco-efficiency and sustainability indicators that complement those being developed at the national and EU levels. Other business-EEA partnerships are on LCA (EEA 1997), Clean Production, EnviroWindows, etc. (see www.eea.eu.int/Projects/envwin/mangconc.htm).

Finally, the EEA, in partnership with Lund University, International Institute for Industrial Environmental Economics (IIIEE), will shortly publish a report on *Corporate Environmental Reporting, Performance Measurement and Communication* (EEA, forthcoming), which is intended to encourage the financial sector to persuade companies to improve the eco-efficient use of capital.

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EEA (1999c): Monitoring progress towards integration: a contribution to the Global Assessment of the 5EAP, EEA: Copenhagen

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# Part II: Summary of the plenary sessions (1-3)

## Session 1: Frameworks, concepts, targets

The main objective of the 'warming-up' session was to introduce and clarify the concept of eco-efficiency in order to guarantee a common understanding and terminology. Another objective was to locate the rather new concept of eco-efficiency in the broad area of sustainable development.

**Prof. 'Bio' Schmidt Bleek** (Factor-10-Institute and former Vice President of the Wuppertal Institute) explained the beginnings of the concept. When he worked for IIASA in the 80's, he was confronted for the first time with the transition of environmental policies in the former Eastern block countries and developing countries. It became obvious that those countries would never be able to follow the same method or strategy of environmental policy as the Western economies – simply due to the lack of money. Until then, Western environmental policy had been characterised by capital intensive end-of-pipe technologies like expensive waste or waste water treatment plants, 'cleaning' or 'repairing' damages at the back end of economic processes. However, a far more efficient solution must be found somewhere else. These considerations led Schmidt-Bleek and others to the reasonable conclusion that the sustainable use of natural assimilation capacities and resources should be applied at the **front** end of the economic processes ('Sustainability will be achieved on the market, or it will not be reached at all'). Optimising every single process as regards the efficient use of natural resources would contribute to making the expensive end-of-pipe system obsolete. As a quantitative yardstick Schmidt-Bleek advocates an increase of **resource productivity** by **factor 10** in developed countries over the next decades. **Innovation** is the crucial variable within this strategy, i.e. the technological terms of production and consumption processes have to be steered towards enhanced resource productivity through appropriate policy and institutional changes. As a measure to identify and monitor this development Schmidt-Bleek has proposed a concept called **MIPS** (material input per service unit).

A related but slightly older concept is **Cleaner Production**. **Jacqueline Aloisi de Larderel** (Director UNEP-IE) explained its origins and introduced the 'International Declaration on Cleaner Production', adopted recently. Cleaner Production is the continuous application of an integrated, preventive strategy applied to processes, products and services in pursuit of economic, social, health, safety and environmental benefits. The signatories to the declaration committed themselves to:

- using their influence to encourage the adoption of sustainable production and consumption practices through their relationships with stakeholders;
- building capacity by developing and conducting awareness, education and training programmes within their organisations, and by encouraging the inclusion of the concepts and principles into educational curricula at all levels;
- encouraging the integration of preventive strategies within environmental management systems, by using tools such as environmental performance evaluation, environmental accounting, and environmental impact, life cycle, and cleaner production assessments;
- creating innovative solutions by promoting a shift from end-of-pipe to preventive strategies in our research and development policies and activities, and by supporting the development of products and services which are environmentally efficient;
- sharing their experience by fostering dialogue on the implementation of preventive strategies and informing external stakeholders about their benefits;
- taking action to adopt Cleaner Production by: setting challenging goals and regularly reporting progress through established management systems; encouraging new and additional finance and investment in preventive options; and promoting environmentally-sound technology co-operation and transfer between countries.

A business perspective on eco-efficiency was given by **Markus Lehni** from the **World Business Council of Sustainable Development** (WBCSD) – which had introduced the concept of eco-efficiency in the early 90's in 'Changing Course: A Business Perspective on Developments and the Environment (1992). Lehni outlined the basic idea standing behind the concept, i.e. 'making the challenge of sustainability a business opportunity'. The contributions from the private sector are more efficient processes, new and better products and changed marked mechanisms.

**David Gee** (EEA), joint author of the EEA background paper (with Stephan Moll, EEA & Wuppertal Institute), concluded the first session by describing the objectives for the following sessions.

## Session 2: Developing and implementing eco-efficiency indicators

In formal terms, 'resource productivity' is a ratio: welfare / use of nature. This 'eco-efficiency' ratio expresses how much benefit or welfare is achieved from one unit of 'nature'. Increasing 'eco-efficiency' means therefore, 'achieving more from less' which is an important element of sustainability. The discussion and outcome of session 2 should be related to the question: **which operational indicators are appropriate to measure 'welfare' and 'use of nature' on the macro as well as on the micro-level?** The main question at stake for an institution like the EEA – which has the task to monitor progress towards sustainability – is how to operationalise the nominator and the denominator, i.e. which indicators can be used to build 'eco-efficiency' ratios.

On the macro-economic level, GDP is the most often used indicator of 'welfare'. However, some alternatives have been proposed such as the Human Development Index (HDI) of UNEP or the Index of Sustainable Economic Welfare (ISEW). On the firm or product level there is a variety of indicators such as price, turnover, service-unit etc.

For the 'use of nature', we can chose from a wide range of environmental indicators. Maybe one reason for the current ignorance of environmental concerns in economic decision-making processes is 'information overload' from too many environmental indicators. Thus, a limited set of environmental indicators representing the 'use of nature' may help to promote 'eco-efficiency' ratios in economic decision making.

**Stefan Bringezu** (Wuppertal Institute) illustrated the benefits of **Material Flow Accounting** in order to indicate the 'use of nature'. The environmental performance of human activities is widely determined by the quantity and quality of the associated material flows. Where information on the specific impacts of various materials is limited or lacking, the volumes of the different flows can be analysed in a systematic way. In a first step, the material inputs and outputs (throughput) of a national economy can be shown in a material balance. Such a **domestic material flow account** provides a structured and policy-relevant information basis. In a second step, the 'ecological rucksacks' of the imports can be considered in order to approximate the global **Total Material Requirement** (TMR) of an economy. TMR is regarded as a highly aggregated indicator of 'use of nature' associated with the physical basis of an economy. The TMR indicator is based on the MIPS concept.

**Peter Bosch** (EEA) gave an introduction to the several **EEA activities on indicators**. The main product in this area will be a regular indicator report to be published for first time in 1999. Although data availability and comparability is a limiting factor at the EU15 level, several eco-efficiency ratios (relating GDP to some environmental indicators) can already be computed for the EU15 – as **Stephan Moll** (EEA) exemplified. For example, energy productivity increased by 9% from 3855 ECU/TOE in 1985 to 4199 ECU/TOE in 1990. However, since 1990 energy productivity has slightly decreased to 4103 ECU/TOE in 1996 (Eurostat data).

An **OECD** progress report on their various activities on eco-efficiency was given by **Laurie Michaelis** (OECD). According to OECD, eco-efficiency is defined as the efficiency with which ecological resources are used to meet human needs. Eco-efficiency can hence be considered as a ratio of output to input. Eco-efficiency as a strategy comprises the

development of goals and criteria; measures to bring about innovation in behaviour, technology and ways of thinking. Eco-efficiency indicators serve to monitor those strategies, i.e. giving feedback and enabling adjustments of the strategy. **Compared to the rapid growth of labour productivity (GDP/hours work) resource productivity is developing rather more moderately** and, in case of most environmental variables, is lower than GDP growth. Hence, the potential for rapid resource productivity increases has to be investigated more thoroughly. Knowing more about the role of factor prices, technological innovations, and R&D policies etc. seems to be essential to an understanding of the dynamics of productivity increases in general and for an eco-efficient strategy in particular.

A project (commissioned by DGIII and in co-operation with Eurostat) was briefly introduced by **Fabienne Planès** (Anite Systems). The project aims to develop a first set of **sectoral eco-efficiency indicators** on NACE Rev. 1 sections level.

Measuring eco-efficiency on the corporate level is also an emerging criteria for investors. In addition, monitoring performance and setting targets is an effective management tool for businesses. This is why the WBCSD started a project on '**eco-efficiency metrics and reporting**' which was introduced by **Markus Lehni** (WBCSD). Unfortunately, there is a lack of comparability of corporate reports so far. Thus, the project aims to develop a framework of eco-efficiency metrics and their reporting which is accepted and used by the world business community and its stakeholders. Project deliverables will be clearly defined terms, widely accepted metrics principles, a limited set of cross comparable metrics, guidelines for metrics selections, reporting and benchmarking, testing and pilot applications, and a final report including useful guidance for implementation.

## Session 3: Role of government and other stakeholders in achieving eco-efficiency targets (e.g. Factor 4/10)

Whereas the second session addressed more technical issues on indicators for eco-efficiency (i.e. how to provide relevant information for decision making and target setting) the third session focused on the role of governments and other stakeholders in helping to achieve eco-efficiency. The obvious first step is to set eco-efficiency targets, be it on governmental or corporate level (see contribution of Henseling). The second step is far more challenging; to develop strategies to achieve those targets. More thorough analyses (like the four Nordic case-studies) are needed to identify the areas where improvements in eco-efficiency are relatively easy to achieve and where they are not. Enhancing eco-efficiency means implicitly influencing technological development and steering structural change, so that production and consumption processes are optimised. Hence, Research & Development strategies seem to be one essential part of eco-efficiency strategies (see contribution of Tschulik). As the business examples from the WBCSD show, improvements in corporate eco-efficiency performance imply both cost-reductions and advantages in competitiveness.

Eco-efficiency and Factor 4/10 is a general target set by the Nordic countries. **Elisabeth Wickström** (Nordic Council of Ministers) introduced a project steered by the Nordic Council which aimed at the political **implementation of Factor 4/10**. Four case studies for each of the Nordic countries were conducted.

The **Danish case study**, introduced by **Henrik Gudmundsson** (National Environmental Research Institute Denmark), investigated the car traffic sector ('Reduction of Environmental Pressure from **Car Traffic** by Factor 4/10'). Four potential components were identified in this sector to reduce material consumption, energy use and CO2 emissions: improved technology (vehicle technology, fuel types, energy carriers, recycling); change of transport organisation (modal change, car-sharing, carpooling, cycling); change in spatial structures (urban development, densities, access to public transport) and changes in lifestyle (use of IT for commuting, shopping etc.).

**Antero Honkasalo** (Finnish Ministry of the Environment) presented the **Finnish case study** on the forestry sector ('Possibilities and Limitations to Implement Eco-Efficiency and Factor 4/10 in the **Forestry Sector**').The main significant environmental problems associated with forestry are loss of bio-diversity and releases to air and water. The latter have already been addressed during the last decade, i.e. technological potentials to improve eco-efficiency in forestry sector are already widely exhausted. Hence, changes in the use phase of forestry end-products such as paper (in particular extension of lifetime, re-use and recycling) seem to bear a potential to achieve factor 4/10.

The **Norwegian case-study** on 'Possibilities and Limitations to Implement Eco-Efficiency and Factor 4/10 in the **Building and Real Estate Industry**' was presented by **Katharina Bramslev** (Grip Centre Norway). Main components for achieving factor 4/10 in this sector are energy saving technologies (including change in energy carriers, e.g. more solar energy), more efficient use of floor space, extending lifetime of buildings and materials, and new production and construction methods.

**Cecilia Perrson** (Swedish EPA) presented the **Swedish case-study** entitled '**Sustainable Food Chain**: Possibilities and Limitations to Implement Eco-Efficiency and Factor 4/10 on Production and Consumption of Food'. In order to attain increased eco-efficiency, a radical reduction in the use of resources such as energy and phosphorus is required. Potential for such reductions was identified in technological developments, better organised food flows and a change of consumers and companies behaviour. Clear and consistent rules and regulations can promote radical eco-efficiency, including a good climate for technological development, effective instruments and committed producers. Changes will be needed in retailing and agriculture: but the options identified would only deliver two or three improvements by2030. Key conclusions from the Nordic Council Report (now published – see Refs) are included in Box 2.

## Box 2: Key conclusions from the Nordic Council Case Studies on Factor 4 and 10

The case studies show that with the use of technology already available, it is possible to head in the direction towards Factor 4 and 10 targets. But it is not possible to reach the targets of Factor 4 in 2030 and Factor 10 in 2050 without considerable changes in individual and social values as well as regulatory regimes. Here, changes in consumer behaviour appear to be very important.

The governments have an important role to play in implementing strategies of eco-efficiency and Factor 4 and 10 targets. The measures that the case studies have suggested for enhancing eco-efficiency include a mix of instruments, i.e. economical, legal, informative instruments, instruments of following up and not least R&D.

In order to move closer to eco-efficiency and sustainability, it is important that actors at all levels of society co-operate. This means that business, industries, trade, academics, NGOs, authorities at all levels and not least consumers must be involved. A platform needs to be built in society on which actors in one sector could meet other sectors and exchange experiences.
There is stil a range of different views and interpretations of the concepts of eco-efficiency and Factor 4 and 10 – also expressed in the different sector studies. Further policy development is therefore needed in this area, as to clarify the concepts and develop a common understanding among governments and other actors.

It is of crucial importance to measure eco-efficiency through indicators and material flow statistics, at the macro- and micro-economic level. Work should therefore be intensified in this area.

Source: Nordic Council, 1999.

**Karl Otto Henseling** (Federal Environment Agency Germany) introduced the **German 'Environment Barometer'**. The theory is that sustainable development should be measurable. If environmental considerations are to occupy its proper place in the political debate on sustainable development it should be possible to describe environmental development – similar to economic development – by a few key indicators. To this end, the 'Environment Barometer' for Germany was introduced as a proposal for measuring sustainability. Adequate environmental information and indicators are essential for the implementation of eco-efficiency.

**Austrian experiences on eco-efficiency** were introduced by **Andreas Tschulik** (Austrian Ministry for the Environment, Youth and Family Affairs). In Austria, several initiatives have been undertaken to increase the eco-efficiency of industrial production and to reduce its overall environmental impact. The strategic direction for these activities has been set by the Austrian National Environmental Plan, where an overall reduction target of a factor 10 concerning material flows in Austria's economy is laid down. In 1996 the contribution of eco-efficiency initiatives to the achievement of public policy targets was evaluated, with a particular view on environmental, technology and regional development policy. Several programmes have been launched, for example the 'Environmental Management Programme' of the Innovation and Technology Fund and the 'Ecoprofit Graz Cleaner Production Programme'. In June 1998 the first 'Factor 4+ Trade Fair' was organised together with an international symposium on 'Resource efficiency – a strategic management goal'. The trade fair showed that resource productivity for many companies is already daily business: about 100 companies and institutions presented eco-efficient products, technologies and services.

Finally some business examples from members of the WBCSD were given. **Urs Gujer** (Novartis International AG) introduced the key objectives of Novartis – a life-science company. The objectives are to manufacture their products and services as eco-efficiently as possible, to develop products with superior benefit-risk profiles and to gain acceptance for innovative technologies providing progress towards sustainability. In order to achieve those objectives Novartis introduced several eco-efficiency indicators in their reporting mechanism such as resource consumption per ton output or environmental impact by value added. **Lars Finsen** (Danfoss) presented the so-called environmental impact index (EII). The EII is a relation between two indexed figures, e.g. index of electricity consumption by index of industrial activity. Danfoss publishes a time series of those indices

in their yearly environmental statements in order to evaluate to what extent the company complies with its commitment to continuously improve their environmental performance.

**Reference**

Nordic Council (1999). 'Factors 4 and 10 in the Nordic Countries' (Transport, Forests, Building, Food)', Terra Nord No 528, Nordic Council, Copenhagen.

# Part III: Interactive session (Work groups)

## Work group A: Indicators

The objective of this working group was to discuss the following question: 'Where should the EEA focus its activities on macro level indicators in the next 12 months so as to best support policy makers and businesses in their activities on eco-intensity / resource productivity indicators at the macro / micro levels?'

The work group started with a general discussion on the use of indicators, the addressees of indicators, the issues standing behind the specific indicators, micro-meso-macro-link, and Cardiff integration requirements etc. It became clear that a limited number of environmental 'headline' indicators would be needed to operationalise the 'use of nature'. Those could be used to relate them to 'welfare' indicators such as GDP to get eco-efficiency ratios. Hence, that kind of environmental 'headline' indicator is a highly aggregated piece of information which should be used like socio-economic indicators (e.g. GDP, unemployment rate, inflation rate etc.) in order to communicate 'use of nature' to the public. Such indicators facilitate target setting. Obviously, such highly aggregated information may not be sufficient for comprehensive policy analysis and problem management. For this purpose either the 'headline' indicators have to be de-composed or sectoral specific indicators have to be added. It became clear that such a core-set of environmental 'headline' indicators should more or less cover all prominent environmental issues / themes and that those they are also applicable on a micro-level (i.e. firm- or corporate level).

The EEA proposal for a core set of environmental 'headline' indicators was discussed in detail. The initial EEA proposal comprised nine 'headlines' or issues (Box 3) covering both material or resource input issues (MIPS-like thinking, following the precautionary principle) and environmental issues on the output flows identified as problematic (emissions, waste).

### Box 3: Nine possible environmental headline issues/indicators

| Inputs (resource use): | Outputs (impact/pollutants): |
|---|---|
| raw-material input | greenhouse effect |
| gross inland energy consumption | acidification |
| land-use | ozone depletion |
| water consumption | (hazardous) waste |
| | chemicals |

Source: EEA

The work group recommended to add further 'headlines' or issues:
- biodiversity
- eutrophication / nutrient flows / water quality
- summer smog / urban issues

In general it was recommended to add some 'State' indicators (water, air)[1] .

[1] There is clearly a bias on 'Pressure' indicators in the proposal. One reason might be that 'Pressure' issues are closer to the causing 'Driving Forces' and hence more likely to be influenced. Another reason might be that 'Pressure' indicators support the precautionary principle.

Conclusions:

- EEA should focus on the development of a core set of environmental headline indicators: the top of the information hierarchy on the environment. EEA could steer the several efforts on Member State level in order to get an harmonised European set. (Some MS current proposals for environmental headline indicators are shown in Table 2.
- Those headline indicators have cross-cutting character. For sectoral purposes, they can be decomposed. In addition, sector specific indicators are to be developed (e.g. the Transport and Environment Reporting Mechanism (TERM) in the case of transport sector, which is being developed by EEA, Eurostat and the Environment and transport Directorates of the European Commission (EEA, 1999).
- Preferably, the chosen headlines/indicators should be applicable on the macro (national economies) and micro level (firms, companies).
- The preliminary proposal (9 headlines) should be revised and issues mentioned above should be supplemented. EEA should prove the applicability of them.
- Since the proposed headlines/issues are mostly 'Pressures' according the DPSIR scheme, the general role of 'State' indicators in a core set of headline indicators should be considered.

Table 2: Synopsis of national sets of environmental headline indicators

| Environmental Policy Themes & Indicators, The Netherlands | Environment Barometer (Germany) | Sustainability Counts (UK) | 'Gröna Nyckeltal' (Sweden) |
|---|---|---|---|
| Climate change (greenhouse effect & depletion of ozone layer): Index based on emissions of $CO_2$, $CH_4$, $N_2O$, and production of Chlorofluorocarbons (CFCs) and Halons | Climate: $CO_2$ emissions | Climate Change: emissions of greenhouse gases | Climate Change: emissions of $CO_2$ |
| | | | |
| Acidification: Indicator based on depositions of $SO_2$, $NO_x$, $NH_3$ | Air: emissions of $SO_2$, $NO_x$, and $NH_3$ | Air Pollution: days of air pollution (urban and rural sites) | Acidification: emissions of acidifying substances ($NO_x$ and $SO_2$) |
| Disturbance: Percentage of Dutch people affected by noise and odour in Neq (noise equivalents) | | | Urban Air Quality: benzene levels in the atmosphere (winter half-year mean value in various urban areas |
| Waste disposal: Index based on the total quantity of solid waste dumped annually | | | Waste: waste for landfill (deposited quantities of waste material in Sweden) |
| | Water: percentage of flowing waters at which the mandated goal of chemical quality class II for AOX and total nitrogen is achieved | Water quality: rivers of good and fair quality (percentage of total river length) | |
| Eutrophication: Index based on emissions of phosphates and nitrogen to soil and water | | | Coastal Areas & Eutrophication: load of nitrogen and phosphorus into the sea |
| | Nature: ecological priority areas (absolute and as percentage of non-settled area see also *Soil* | Wildlife: populations of wild birds (index) | Nature: protected forests (as a portion of productive forest land) |

| | | | |
|---|---|---|---|
| Toxic and hazardous pollutants: Index based on the dispersion of agricultural pesticides, other pesticides, priority substances (cadmium, polyaromatic hydrocarbons, mercury, dioxin, epoxyethane, fluorides, copper), and radioactive substances | | | |
| | Soil: increase per day in area covered by human settlements and traffic routes | Land use: new homes built on previously developed land (percentage) | |
| Resource dissipation: not included in Adriaanse | Resources-Materials: resource productivity (GDP per ton raw materials)<br>Resources-Energy: energy productivity (GDP per primary energy consumption) | | Energy: use of energy (energy consumption related to GDP), electricity for heating |
| | | Transport: road traffic (vehicles miles) | Transport: environmentally adapted means of transport (the portion of journeys to and from work and school taken on food, by bicycle or public transport), (private transport by car in kilometres per person aged 6-84) |
| | | | (Sustainable Enterprises): number of environmentally registered enterprises (EMAS or ISO 14001)<br>(Agriculture): recovery of phosphorus in sludge to agriculture |

Sources:

Department of the Environment, Transport and the Regions (DETR) (1998): Sustainability Counts. Consultation paper on a set of 'headline' indicators of sustainable development, London
Federal Ministry for the Environment (1998): Draft Programme for Priority Areas in Environmental Policy, Bonn
Ministry of Housing, Spatial Planning and the Environment et al. (1998): National Environmental Policy Plan 3, The Hague
Ministry of the Environment (1998) Key indicators for ecologically sustainable development. A proposal from the Swedish Environmental Advisory Council, Stockholm

## Work group B: Innovation and the role of government & business

The objective of this work group was to discuss the question 'How can governments provide a framework for business to achieve innovation through the concept of eco-efficiency?'

The general objective is to meet human needs with less environmental resources. Realistically, economic growth will continue in the near future. On the other hand, we want to reduce the use of natural resources. Hence, the crucial variable to be addressed by governmental strategies is eco-efficiency (or 'smart growth' as it is being called in the USA).

Eco-efficiency is clearly an economy related concept. In contrast to the traditional environmental policy (command & control) eco-efficiency strategies are clearly addressing economic activities, i.e. production and consumption processes. In principle, eco-efficiency

strategies aim to use market mechanisms. Eco-efficiency strategies can be distinguished according to the two constitutive economic activities: **production** and **consumption:**

**a. Production**

The strategic objective is to enhance the eco-efficiency of all production processes, producing equal or greater output with fewer natural resources and less waste. The techniques used to produce goods and services have to be designed to be more eco-efficient. Enhancing eco-efficiency in production hence implies influencing technological development by stimulating innovation.

The concept of eco-efficiency incorporates a potential for win-win situations. Improvements in eco-efficiency often also imply cost reductions for the producer whilst the environmental impact is decreasing.

***Instruments***

- Research & Development programmes or pilot projects in order to stimulate and disseminate new production technologies;
- Support of Corporate Environmental Management Tools (e.g. EMAS) in order to raise firm's awareness of their 'eco-efficiency-performance' (generating strategic information through monitoring);
- Economic incentives: eco-tax, tradable permits (following the approach 'setting the prices right' or 'internalisation of external costs');
- other strategies to influence structural change towards an information / service economy (supporting / promoting development / design of new products, i.e. eco-efficient services, e.g. car-sharing, repairing, leasing etc.).

**b. Consumption**

Consumption (final demand) and production are complementary. There is clearly a 'conflict of objectives' in that total consumption (final demand) in monetary terms is expected to increase while the 'use of nature' associated with total consumption is expected to decrease. I.e. total consumption has to be 'dematerialised'.

The strategic objectives addressing consumption are:

- changing the composition of final consumption: more consumption of eco-efficient produced goods and services including more consumption of immaterial services,
- extending the use phase of products;
- improving (household) processes (heating, water use, etc.);
- a shift from products to services, e.g. from selling solvents to selling degreasing services; or from pesticides to pest-management services; and from carpets to floor-covering services.

***Instruments***

- information strategies addressing consumers behaviour, awareness raising, e.g. eco-labelling, 'be happy with less material goods!', 'use more services than material-intensive goods' (see Box 5 for an example of consumer guidelines);
- programmes / incentives to improve typical household processes (as energy and water use efficiency programmes).

Box 5: Some MIPS-guiding principles for sustainable consumption

1. It is not necessary to buy everything, if you want to use it.
2. Second-hand purchase saves money and environment.
3. Watch out for the ecological rucksack of materials.
4. Prefer products with less transport.
5. Save energy and water while using products.
6. Maintain and repair products to use them as long as possible.
7. Keep garbage low.

Source: Wuppertal Institute

**Barriers**

The working group also discussed and identified the main barriers to an improvement of eco-efficiency. Market failures constitute one big cluster of barriers. The relative costs to businesses of labour, capital and natural resources in terms of energy and materials are among the most important influences on the direction of innovation and technological development. The relative costs of natural resources (energy and materials) tend to be the smallest. Hence, shifting the balance from taxation of labour and capital to natural resources would provide an economy-wide incentive to improve eco-efficiency (see also OECD 1998, p. 46ff). Further barriers such as like low public awareness and behavioural 'lock-in' were also raised.

**Reference**

OECD (1998): Eco-efficiency, OECD: Paris

## Work group C: Concepts/targets

The objective of this work group was to discuss the question 'What are the practical implications of 'S' in MIPS[1], and how can it be operationalised for achieving a Factor 10 target?'.

**What is 'Service'**

The working group started with a brief discussion of what is 'Service'? The *initial rational* behind it is the question 'Why do consumers buy something?' and the answer that they are looking for a use/function, i.e. a benefit. The question arises whether it wouldn't be possible to meet the consumers need in a more efficient way?

Hence, one crucial behavioural element would be to raise consumer awareness of the fact that they often do not need the actual product but the benefit/use or the function that it provides . It is not the use of the (material) product itself but the (immaterial) function it delivers to us (products = service-delivering-machines). As Aristotle stated: 'the real richness is lying in the use/function of goods and not in the ownership'. What is needed is a change of perception; from ownership to function of products. One societal reason for the current ownership-oriented behaviour is the desire to possess. Hence, consumers need to develop a more function-oriented relationship to goods.

In the current model (industrial economy), the focus is laid on the monetary value of a product at the moment when it is sold. In the new model (service economy or service society) the question is: What is the use of my product? What kind of service does it provide to what standard and for how long? What are the total costs over the whole life-time? The value of a product would not be at the moment when it is sold. Instead, the product's value would be the qualitative usefulness during its whole life-span. It makes a difference whether one optimises (in ecological and monetary terms) a system according to the old or the new model (see also Schmidt-Bleek 1998).
The issue is not totally new. It was Georgescu-Roegen (1971) who concluded that the ultimate objective of economic processes is not the physical good itself but the service it

[1] Material Input per Service-unit

delivers to the consumer. While Georgescu-Roegen used the term ‘enjoyment of life’ Schmidt-Bleek (1994) called ‘service’.

**Shortcomings: no operational measures for ‘S’ so far !**
In order to raise consumer’s awareness and to change consumer’s behaviour, appropriate information about the *amount of services* delivered by a certain good has to be available. Unfortunately, no common accepted indicators have been introduced so far. Hence, the development of operational measures for ‘services’ should be given high priority.

Finally, the eco-efficiency concept was compared with the MIPS approach and the convergence of both approaches was considered.

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Georgescu-Roegen, N. (1971): The Entropy Law and the Economic Process, Cambridge, Mass. (Harvard

Schmidt-Bleek (1994): Wieviel Umwelt braucht der Mensch? MIPS Das Maß für ökologisches Wirtschaften, Birkhäuser: Basel, Boston, Berlin

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# Part IV: Background paper for eco-efficiency workshop ‘Making sustainability accountable’ 28-30 October 1998, Copenhagen

David Gee & Stephan Moll (EEA)

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## 1. Introduction – purpose and contents of the workshop

- to introduce and clarify the concepts of 'eco-efficiency', 'eco-intensity' and 'resource productivity';
- to discuss and help to develop indicators for 'eco-efficiency', 'eco-intensity' and 'resource productivity', at both economic and corporate level;
- to summarise experience in applying 'eco-efficiency' (and 'eco-intensity'/'resource productivity') concepts and indicators in some European countries and companies;
- to review the barriers and opportunities for promoting 'eco-efficiency' (and 'eco-intensity'/'resource productivity') particularly the role of EEA in promoting appropriate indicators & best practice.

## 2. Policy context on eco-efficiency

- The Amsterdam Treaty of the European Union emphasises the integration of environmental concerns into Community policies. On the occasion of the European Council in Cardiff (15-16 June 1998) a mandate was given to start the integration process in transport, energy and agriculture policies, with further policies to follow for industry etc. (**Box 1**).

- Consideration of environmental issues in other policy fields requires information on the environmental performance of economic activities. The provision of such information is a task of the EEA which is now needed to help to develop monitoring tools for the integration of environmental concerns into all policy fields.

### Box 1: The challenge of integration into other policies

'The real challenge facing the Community is to find a way of developing action which meets all of its objectives in an integrated way. This is the challenge of sustainable development, a concept too often perceived as purely environmental, but which brings together concerns for social and economic development alongside protection of the environment. The current pattern of economic development too often entails conflicts between development and environment; this cannot be permitted to continue. Policies that result in environmental degradation and depletion of natural resources are unlikely to be a sound basis for sustainable development.
The development of new technologies and practices shows that we have the know-how to find solutions to some of these problems. Solutions which are frequently shown not only to be cost effective for industries concerned but also generating broader benefits to the economy through the creation of value added and employment, thus generating a genuine double dividend. However achieving desired results will require more far reaching behavioural and policy changes in many sectors of society.'

European Commission 1998, p. 5

- 'Eco-efficiency' and eco-intensity/resource productivity are at the heart of the integration issue – see **Box 2** – and could lay the conceptual basis for developing monitoring tools and reporting mechanisms.

- The concept and strategy of 'eco-efficiency' aims to achieve more welfare with less use of nature. The Business Council for Sustainable Development introduced this concept in 1992 and defined it as follows:

  'Eco-efficiency is the delivery of competitively-priced goods and services, that satisfy human needs and bring quality of life, whilst progressively reducing ecological impacts and resource intensity throughout the lifecycle, to a level at least in line with the Earth's estimated carrying capacity'. (BCSD 1993)

- The European Commission has stated that sustainability calls for a new economic development model. The current development model seems to be extremely inefficient in using the primary production factors, labour and nature:

  'The serious economic and social problems the Community currently faces are the result of some fundamental inefficiencies: an 'under-use' of the quality and quantity of the labor force, combined with an 'over-use' of natural and environmental resources. … The basic challenge of a new economic

development model is to reverse the present negative relationship between environmental conditions and the quality of life in general, on the one hand, and economic prosperity, on the other hand.'
(European Commission 1993)

- Strengthening 'eco-efficiency' has also been identified by the OECD as one of the major strategic elements in its work on sustainability (see also OECD 1998):

  'As a key strategic direction to its work on environmental issues, the OECD should begin placing as much emphasis on improving resource efficiency as it has traditionally put on improving labour productivity. This would promote eco-efficiency in the broadest meaning of the term. The OECD should also accelerate efforts to shift some of the burden of taxation from employment and savings to resources and pollution, to decrease the use of perverse and environmentally damaging subsidies, and to integrate more closely environmental with trade and investment rules.' (OECD 1997)

## Box 2: Criteria for assessing integration of environmental concerns into sectoral policies

| A | Economic Integration | Examples of actions |
|---|---|---|
| 1 | Have eco-efficiency targets and indicators been developed and used to monitor progress towards more 'well-being from less nature'? | E.g. the Austrian 'factor 10' target and intensity of material use/GDP indicator (Austrian National Environment Plan 1997). |
| B | Market Integration | |
| 2 | Is there qualitative identification of all environmental costs/benefits? | E.g. for Energy, Transport, Agriculture and Industry; but little action on Households and Tourism. |
| 3 | Is there quantification of environmental costs/benefits? | E.g. the EU 'Externe' project on the environmental externalities for Energy supply. |
| 4 | Are all external costs internalised into market prices? | E.g. road freight prices in UK are only 70% of full environmental progressively costs. The vehicle fuel 'escalator' tax is now internalising full costs (Royal Commission on Environmental Pollution, UK, 1997). |
| 5 | Are economic instruments designed to achieve behaviour change rather than just revenue raising? | E.g. $SO_2$ and diesel fuel taxes in Sweden (EEA 1996. Environmental Taxes.. |
| 6 | Are environmentally damaging subsidies being withdrawn or re-focused on environmental benefits? | E.g. within water, agriculture, transport and energy sectors? |
| C | Institutional Integration | |
| 7 | Is there environmental impact assessment of projects and products before implementation? | E.g. use of EU EIA Directive |
| 8 | Is there strategic environmental impact assessment of policies, plans and programmes at different spatial levels? | E.g. strategic environmental assessment of the TENs transport projects and of Structural Funds? |
| 9 | Is environmental procurement a cornerstone of purchasing strategy? | E.g. government supplies evaluated against green 'purchasing criteria'? |
| 10 | Are there environmental measures within the sector and monitoring of their implementation? | E.g. the agri-environment regulation in the CAP; or packaging directive in industry. |

Source: EEA 1998

## 3. Concepts and definitions

- More *welfare* for all, with less *use of nature* is the goal (see **Fig. 1**);

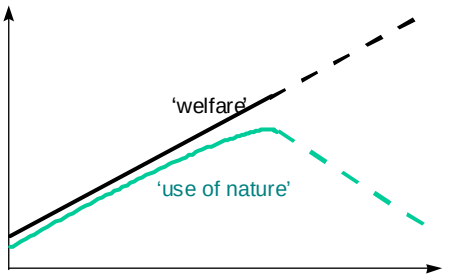



Fig. 1

- **eco-efficiency** is a strategy or an approach aimed at de-coupling resource use and pollutant release from economic activity – but current definitions, e.g. from WBCSD and OECD can lead to different interpretations because they involve several concepts such as 'input', 'output', 'pressures', 'impacts', 'resource intensity' etc.;

- **eco-intensity** and its inverse, **resource productivity,** are the two generic indicators for monitoring progress towards achieving 'more service outputs with less resource inputs'; these however are **relative** indicators, that need to be supplemented by

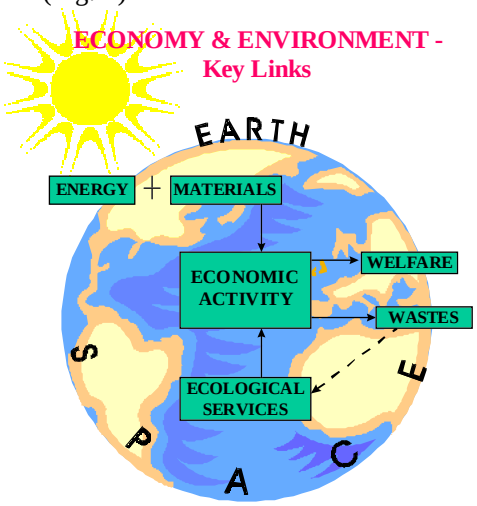
- **absolute** reductions in resource flows, which are necessary to remain within **carrying capacities** of the earth;

- in addition **equitable access** to resources by current & future generations is required for sustainable development.

- Environmental stress /load, ecological space and ecological rucksacks and other definitions are included below (see Annex I).

## 4. Economies depend on the environment

- The economic sub-system is dependent on the 4 basic functions of the environment system: ***S**ources (of energy & materials); ***S**inks (for wastes); ***S**ervices (water flow regulation, carbon cycling) and ***S**pace (for living, economic activity and aesthetics) (Fig. 2)




**Economic activity depends on:**

'Sources' of Energy and Materials

'Sinks' for Wastes

'Services' such as Water Flow Regulation

'Space' for Economic Activity & Aesthetics

Fig. 2 Source: EEA

## 5. From wasteful and inequitable economies…

- 'Developed' economies with only 20% of the world's population, consume 80% of it's resources whilst

- sharing less of the world's increasing wealth with the 80% of the population in less 'developed' countries than 30 years ago; despite

- consuming large proportions of resources from developing countries.

- the 4 developed countries studied (Germany, the Netherlands, Japan and the USA) use about 80 tons of materials pppa (**Fig. 3**)

- This flow of materials has been relatively stable over the last 20 years; and mainly consists of fossil fuels, mining waste, or construction material; (**Fig. 4**) and

- much is 'hidden' from conventional accounting (**Fig. 5**); and large proportions are imported (**Fig. 6**).

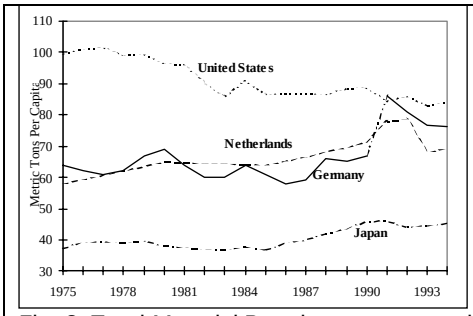



Fig. 3: Total Material Requirement - annual flows per capita

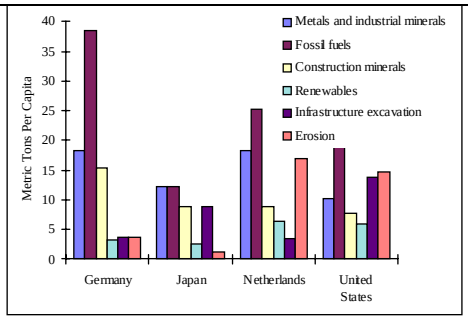



Fig. 4 Primary contribution to TMR, 1991

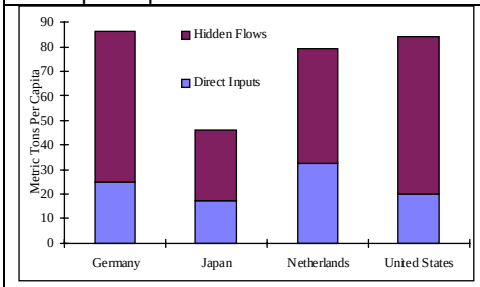



Fig. 5: Hidden Flows as a Proportion of TMR, 1991

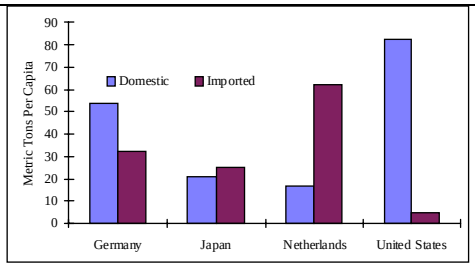



Fig. 6: Domestic and Foreign Components of TMR, 1991

Source: Bringezu 1998 (based on Adriaanse et al. 1997 with revised Dutch data)

- This material flow leads to wastes, some of which are hazardous, and to irreversible loss of natural capital, such as soils and biodiversity, as

- the 'carrying capacities' of the earth are exceeded, causing, for example, acidification, climate change, collapsed fish stocks, species loss, air pollution standards exceeded; and to partial loss of the 4 functionalities with which the environment underpins economic activity (Sources, Sinks, Services & Space).

- 90% of materials used (bio-mass and non-renewable material) is wasted, with only 10% being consumed in useful products (Schmidt-Bleek 1998).

- increasing transport intensities of traded goods impose large environmental costs that are not included in the prices of these goods equivalent to about 1 ton of materials for every 1000 kilometres moved by a 40 ton truck (Schmidt-Bleek 1998).

- only 1% of the fuel put into the average car is used to move the passenger: the rest is 'lost' in moving the car and in friction etc. (Fussler 1996).

- 5-20% of the working population in OECD countries is unemployed, representing a huge loss of social capital, as well as financial costs.

- the large increases in labour productivity (which mainly explain the unemployment) have been achieved at the expense of declining productivity of natural capital. In Germany, for example, labour productivity rose 300% over the last 30 years whilst capital productivity declined by almost 50% (Federal Statistical Office 1998).

## 6. ...to producing and sharing more, with less nature but more people

- via the more elegant and equitable use of resources,

- eco-intelligent products, and

- a focus on meeting needs more from labour intensive ***services*** than from capital intensive ***products***,

- via ***innovation*** in the use of resources and labour, and for which

- new measures of accounting will be needed

## 7. Making sustainability accountable

- The basic equation ($Y=Y/M \cdot M$) to be operationalised comprises just two variables:
  ($Y$): a measure of *welfare* deriving more or less from economic activity, and
  ($M$): human *use of nature*.

- This section will addresses the question of which indicators may represent these two variables. A separate indicator to indicate the target variable eco-intensity ($M/Y$) or resource productivity ($Y/M$) is not needed since these are simply calculated by the ratio of the mentioned variables or indicators respectively:

$$\text{eco-intensity} = \frac{\text{use of nature}}{\text{welfare}} \qquad \text{resource productivity} = \frac{\text{welfare}}{\text{use of nature}}$$

- Indicators condense information in order to be used in decision making processes. Their main task is
  - to carry information to decision makings;
  - to be directionally save (i.e. cover the phenomenon or problem in a significant way);
  - to be simple and limited in their number; and
  - should link to targets (either *sustainable* or *political* reference values – see EEA 1997).
- The EEA has developed a 'Typology of Indicators' (see **Box 3**) according to which eco-efficiency indicators are typical 'Type C'-indicators.

Box 3: EEA's typology of indicators

The EEA 'Typology of Eco-Indicators' classifies indicators into 4 simple groups which address the following questions:

Type A *'what is happening to the environment?'*
e.g. 'vehicle kilometers driven, '$SO_2$-emissions' 'water quality in lakes'. etc These are Type A or 'Descriptive Indicators'. They are useful but whatever trend they show provokes the question:

Type B '*does it matter*?'
It does matter, if the numbers are near to, or above, some kind of reference value, like a 'critical load', a 'carrying capacity' or a health standard, or if they are far from policy target values. Examples include nos. of citizens exposed to above the Air Quality guideline for NO2, or the removal rate for Nitrogen from sewage treatment plants compared to a national target rate. These indicators are called Type B, or 'Performance Indicators'. They are particularly valuable for 'distance to target' analysis. However, they can't be generated if there are no 'sustainability reference values'(SRVs), which are mainly determined scientifically, or policy target values (PTVs), which are mainly politically determined steps along the way towards SRVs. The EEA has recently compiled a data base of SRVs and PTVs for 14 environmental problems-it is accessible on http://salmon.eea.int/star/
If the performance indicator shows there to be a problem, or, in the absence of any SRVs or PTVs (as with much of biodiversity), if the Type A indicator suggests there could be a problem, the next question from the policymakers,or the public, would be:

Type C *'are we improving?'*
This is mainly answered by indicators that measure the 'eco- efficiency' of production and consumption processes. E.g. energy use /GDP emissions/ vehicle km.; kg building waste/family house'; 'water use/liter beer'; or Material Input Per unit of Service etc. These are called Type C or 'Efficiency Indicators'. They can often be compiled by merging two type A indicators,such as NOx output and passenger kilometres to give NOx/passenger kilometre, which is a measure of the eco-efficiency of transport with respect to NOx pollution.
In general,performance (B) and efficiency indicators (C) are of most use to decision makers, although a comprehensive view is often necessary, particularly, where any gains in eco-efficiency are insufficient to get below critical loads, or where non-linear, threshold, time-lagged, or cumulative environmental effects are possible. However, most current indicators e.g. on transport, from the EU or Member States are Type A.
Finally, some measure of overall sustainability is needed in order to answer the question:

Type D *'are we on the whole better off?'*
e.g. a kind of 'Green GDP', such as the Index of Sustainable Economic Welfare (ISEW) etc. These are called Type D, or 'Total Welfare Indicators' and are currently outside the EEAs work programme.

- This 'Typology of Indicators' has recently been applied to the transport sector to help produce the proposed new 'Transport & Environment Reporting Mechanism' (TERM) for the EU (EEA 1999).

### *7.1. Indicators for the nominator: welfare/economic output (Y)*

- The *gross national product* (GDP) is the indicator used as a surrogate for measures of welfare or well-being. The GDP is a measure for the value of all economic activities within a national territory in one year. The calculation of GDP is based on the U.N. System of National Accounts (SNA), which provides the accounting data that underpins the GDP. However, GDP as a measure of welfare or well-being has often been criticized. Hence, several indicators have been developed in order to measure more accurately welfare or sustainable welfare (see **Box 4**).

Box 4: Alternative measures for welfare

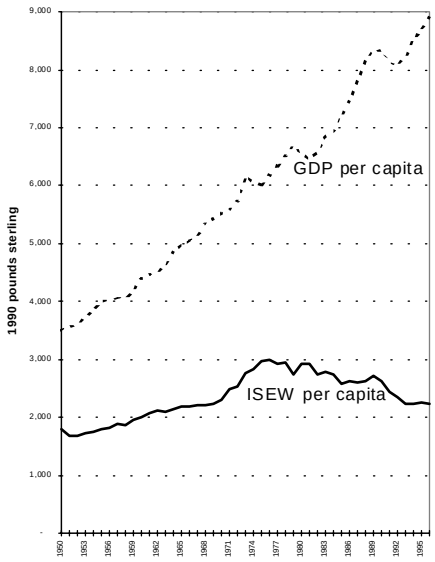



Figure: Development of ISEW and GDP in UK 1950-1996 (source: Jackson et al. 1997)

The *Index of Sustainable Economic Welfare* (ISEW) was originally pioneered for the United States (Daly and Cobb 1989) and further developed in the UK (Jackson et al. 1997). The ISEW methodology starts with the standard economic measure of 'private consumer expenditure'. This is adjusted by five means in order to consider (Jackson et al. 1997): inequalities in the distribution of incomes; non-monetarised contributions to welfare from services provided by household labour; certain defensive expenditures 'to defend ourselves from the unwanted side-effects of production' (Daly and Cobb 1989) like e.g. expenditures on health and education; changes in the capital base, e.g. the human capital stock; and the loss of future services as a result of the depletion of natural resources, the loss of habitats and the accumulation of environmental pollution. ISEWs have been computed for the UK, Sweden and Germany, as well as the USA. They all show a similar pattern, i.e. a de-coupling from GDP up from a certain time point ('threshold hypothesis' see Max Neef 1995. In UK, a lower growth rate than GDP about the mid seventies which was followed by a decline since then, results in a standard of welfare in 1996 that is little higher than in 1966 (see figure).

The United Nation Development Program (UNDP 1997) has developed the *Human Development Index* (*HDI*). This indicator aims to indicate the overall progress or decline of welfare. The HDI, which explicitly does not take into account the environmental dimension of sustainability, comprises three factors which are normalised (after Spangenberg/Bonniot 1998, p. 8):
*longevity*, measured by life expectancy at birth, with the minimum set at 25 years, and the maximum at 85 years;
*knowledge*, measured by two educational stock variables: adult literacy and mean years of schooling;
*standard of living*, measured in terms of purchasing power, based on real GDP per capita adjusted for the local cost of living and resulting in purchasing power parity Dollars (PPP$).
Since 1991 several adjustments of HDI have been made reflecting e.g. gender imbalances and income disparities. Empirically it is interesting to observe a significant de-linking of the development of HDI and national income (UNDP 1997).

- On the meso-level of branches or economic sectors *gross value added* (GVA) is the most often used indicator. GVA allows a sectoral breakdown of GDP.

- On the micro-level (i.e. company, firm, product, service) a comparable monetary measure to GDP could be profit + wages + depreciation + taxes - subsidies, or more simple the price of goods (products and services).

- The counter-part of 'real' welfare or benefit on the level of goods could be the service delivered to the consumer. The question is: What is the use of my product? Which kind of services does it provide in which quality, for how long? Which are the total costs over the whole life-time?

- Following this service or function oriented approach the products value is the qualitative utility during its whole life-span. However, defining measures for the service of a good (what is called *functional units* in the LCA[1] world) is difficult and generally accepted measures are not available.

- Further research to operationalise 'service' is needed.

[1] Life-Cycle-Assessment

### *7.2. Indicators for the denominator: use of nature (M)*

- There is as yet no such comprehensive and well accepted indicator like GDP for the *use of nature*.
- However, indicators for eco-intensity / resource productivity must meet several criteria to be useful (see **Box 5**).

## Box 5: Some criteria for indicators of use of nature

'When attempting to develop measures for describing the ecological stress potential … measures should meet the following conditions:

- They must be simple, yet reflecting essential environmental stress factors. …;
- They should be based on characteristics which are common to all processes, goods and services;
- The selected characteristics should be straightforwardly measurable or calculable, irrespective of geographic location;
- Obtaining results with these measures should be cost-effective and timely;
- The measures should permit the transparent and reproducible estimation of environmental stress potentials of all conceivable plans, processes, goods, and services from cradle to grave;
- Their use should always yield directionally safe answers;
- They should form a bridge to economic models;
- They should be acceptable and usable on all levels: locally, regionally and globally.'

Source: Schmidt-Bleek 1998b, p. 18

- Indicators need to embrace enough of the known scientific complexity of what's happening in the environment to be credible, but without overwhelming policymakers and the public with too much detail. The initial sustainability indicators from OECD (1993), the United Nations Commission on Sustainable Development (UN 1996) and from the UK (Department of the Environment, UK 1997), for example, contained 90-130 indicators. This large number of environmental indicators may partly account for environmental issues being rarely considered in decision making.

- Recently, there have been determined moves to develop 'core' sets of 5-20 environmental indicators (see **Box 6**) which are clearly more appropriate to use for eco-intensity / resource productivity ratios.

## Box 6: Proposals for 'core' sets of environmental indicators

| Organisation | Title of publication | number of environ-mental indicators | internet source |
|---|---|---|---|
| UN- DSD/DESA (1998) | Measuring Changes in Consumption and Production Patterns | 17 of which 8 indicators for key resources and associated environmental issues, and 9 indicators for consumption | gopher://gopher.un.org:70/00/esc/cn17/1997-98/patterns/mccpp5-9.txt |
| The Netherlands (1998) | National Environmental Policy Plan 3 | 9 indices | http://www.minvrom.nl/environment/nepp3/ |
| Germany Minister for the Environment (1998) | Draft Programme for Priority Areas in Environmental Policy (Environment - Barometer) | 6 environmental fields; 7 key indicators | http://www.bmu.de/english/programme/barometer.htm |
| Sweden (1998) | 'Gröna Nyckeltal' | 11 'key indicators for ecologically sustainable development' and 6 'future key indicators' | http://www.regeringen.se/info_rosenbad/departement/miljo/sou98_15/ |
| UK (1999) | Sustainability Counts | 6 headline indicators on effective protection of the environment and 1 headline indicator on prudent use of natural resources | http://www.environment.detr.gov.uk/sustainable/sustcounts/index.htm |

- At this early stage of trying to make sustainability accountable it is important to encourage as much innovation and fresh thinking as possible. One innovative proposal

is the MIPS concept (see **Box 7**) which focuses on material flows (Material Inputs, MI) involved in resource consumption, and the material flows involved in energy carriers, but without any explicit forms on the impacts of using nature i.e. on environmental pollution and other negative impacts. The rationale for this is (Schmidt-Bleek, 1998b, p. 13):

- 'it is scientifically impossible to **ever** know all important *'specific environmental problems'* ($CO_2$ was not a *'specific environmental problem'* until 1989), '

- 'once *'specific environmental problems'* were recognised (**and** politically acknowledged) in the past, it has always been rather difficult and costly to deal *ex post facto* with and correct them on the economic and political levels'

- 'Environmental damage is caused not only by pollution but also by the processes involved in extracting resources. In fact, resource extraction is the more significant cause, since all materials taken into an economy end up sooner or later as emissions and wastes. Thus, reducing the costs of environmental damage requires both bringing down emissions and reducing the flow of resources drawn from nature in the first place' (1997 Carnoules Statement of the Factor 10 Club).

- Reducing total environmental load is then a means of anticipating environmental impacts and of minimizing their size (see also EEA 1998b).

### Box 7: Material Inputs (MI) – a denominator indicator according to the MIPS approach

Schmidt-Bleek and others developed the MIPS concept (material input per service unit) to monitor the life cycle sum of material inputs required to provide a certain service (i.e. economic goods), thus providing an overall indicator for the environmental impact potential induced by this service (Schmidt-Bleek 1994).
MIPS (Material Input per Service Unit) is a concept aiming to operationalise the environmental impact potential of a certain service. MIPS comprises two factors: the environmental impact potential (MI) and the service unit (S).
The Material Input (MI) is the life cycle wide physical displacement of natural materials by humans related to a certain good or service unit. The Material Input (MI) is expressed by summed up mass units (tons), whereby five categories are distinguished: abiotic materials, biotic materials, erosion, water, and air.
Obviously, the Material Input (MI) of a good is higher than the weight of the good itself. The difference between the life cycle wide MI and the weight of the good itself is called 'ecological rucksack'. The 'ecological rucksack' indicates the amount of materials used to produce the good but not incorporated in the good itself.
The MIPS concept is applicable to both the economy and to products. The TMR (Total Material Requirement) indicator was developed (Adriaanse et al. 1997, Schütz/Bringezu 1998) which accounts for the life cycle mass sum of all material inputs (without water and air) induced by the sum of economic activities of a national economy.

- As sufficient is known about some negative impacts from the *use of nature*, such as acidification, ozone depletion, climate change and some toxicities / eco-toxicities, any 'core' set could include 5 'impact' or output indicators, as well as 4 resource use indicators (see **Box 8**).

Box 8: Nine possible issues/indicators for 'use of nature'

| Inputs (resource use): | Outputs (impact/pollutants): |
|---|---|
| raw-material input | greenhouse effect |
| gross inland energy consumption | acidification |
| land-use | ozone depletion |
| water consumption | (hazardous) waste |
| | chemicals |

- Any 'core-set' of environmental indicators needs to cover both:
  (1) the material input side issues (MIPS-like thinking, following the precautionary principle), and
  (2) environmental impact issues identified so far (covered more or less by the proposed indicator-sets by several institutions).

- There is clearly an element of 'double-counting' in accounting for both input of materials and output of pollutants. However, it is not possible at this stage to focus just on either material inputs or pollutants in order to monitor progress towards sustainability: and 'double-counting' is at least erring on the side of caution.

- Whilst duplication with other organisations must be avoided, there is an urgent need for developing, testing, rejecting and improving a menu of 'core set' indicators from which Member States and Commission Services can adapt to their own needs.

## 8. Targets and timetables

- Targets help to make policy accountable. Every target also needs a target period, i.e. the time period by which the target is to be achieved. We have to distinguish two target variables and hence two kind of targets:

- (Y/M): resource-productivity (or eco-intensity M/Y), which is a **relative** measure,

- (M): use of nature, which is an **absolute** measure.

- Factor 10 addresses absolute *use of nature*(M), whereas Factor 4 addresses the relative concepts of 'eco-intensity' and/or resource productivity (Y/M). (see **Boxes 9** & **10**)

Box 9: Factor 10

The 'Factor 10' target addresses the absolute amount of nature consumption/requisition (M) and not the 'eco-efficiency' (Y/M).
One assumption of the 'factor 10' target is that global use of nature should be halved. Another assumption is that the use of or access to natural resources should be distributed equally all over the world.
This leads to an absolute reduction in the use of nature (M) by a factor 10 for industrial economies.
The target period is 'within one generation', which is usually taken as 25 years (Carnoules Declaration of Factor 10 Club, 1997)

Box 10: Factor 4

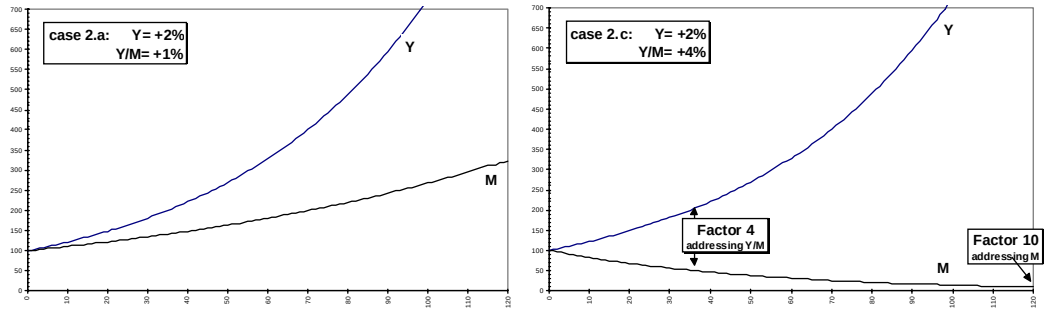
The 'Factor 4' target states 'Doubling Wealth - Halving Resource Use'. Hence, it addresses the 'eco-efficiency' (Y/M) ratio and not the absolute amount of nature consumption/requisition (M).
Again, the assumption is that global use of nature should be halved. At the same time, global welfare should be doubled. Thus, at a global level the 'eco-efficiency' has to increase 4-fold, i.e. using 4 times less nature for one unit welfare.
No explicit target period is given.

(Weizsäcker, Lovins, Lovins 1997)

- It is important to emphasize that targets addressing the ratio (i.e. eco-intensity or resource productivity) do not necessarily lead to an absolute reduction of the *use of nature*. As long as the growth rate of welfare or GDP ($\Delta$ (Y)) is higher than the growth rate of resource productivity ratio ($\Delta$ (Y/M)), the total amount of *use of nature* will increase (see **Box 11**).

Box 11

if $\Delta$ (Y) > $\Delta$ (Y/M) , then $\Delta$ (M) will increase (2.a)
if $\Delta$ (Y) = $\Delta$ (Y/M) , then $\Delta$ (M) will be around 0 (2.b)
if $\Delta$ (Y) < $\Delta$ (Y/M) , then $\Delta$ (M) will decrease (2.c)




## 9. Case studies on reducing eco-intensities

- The CSD has asked the Nordic Council of Ministers to analyse how the general concepts of eco-efficiency and factor 4/10 can best be developed into policies that can be implemented at the Nordic level.

- To make it possible to answer these questions, the Nordic Council of Ministers have decided to make four case-studies, one case-study in each Nordic Country, Denmark, Finland, Norway and Sweden. Denmark has made a case-study on the transport sector, Finland on the forestry sector, Norway on the real estate and building sector and Sweden on the food chain. Each case-study focus on a description of the sector before and after implementing factor 4/10 targets. The case-studies also discuss the role of the government in implementing factor 4/10 and responsibilities and opportunities for business and industry, academic and NGOs.

- One of the several conclusions that the case-studies have in common is that it is not possible to reach factor 4 and 10 in 2030 and 2050 without considerable changes in individual and social values as well as regulatory regimes. Changes in consumer behaviour seem to be very important.

- The governments have in principle a number of powerful policy options available which may help to accomplish changes. Core elements in the approach are
  - internalisation of environmental costs,
  - legal and economic instruments,
  - elimination or reform of subsidies detrimental to sustainable development,
  - improved education and awareness for sustainable development,
  - indicators to measures eco-efficiency and energy productivity and time-specific national targets.

- It is also important to introduce measures which encourage a 'bottom-up' change, including processes involving development of new forms of technology, life organisation, learning and innovation and subsequent changes of values.

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## Glossary: eco-efficiency, resource productivity etc. — some concepts and definitions

| | | |
|---|---|---|
| 1 | Eco-efficiency | A concept and *strategy* enabling sufficient delinking of the '*use of nature*' from economic activity needed to meet human needs (welfare) to allow it to remain within carrying capacities; and to permit equitable access and use of the environment[1] by current and future generations. |
| 2 | Eco-intensity | An *indicator* for the '*use of nature*' (Materials + Energy + Pollution i.e. M+E+P) per unit of output[2]. *(This indicator <u>decreases</u> in the 'right' direction).*<br>('Output' at the economy or company levels is 'welfare' which is not easily defined e.g. the inadequate surrogate for it is usually GDP: or value added at company level. Other measures of output are being developed, such as 'Service' within the MIPS concept, or the Index of Sustainable Welfare - ISEW).<br>As Eco-intensity could improve significantly but yet not sufficiently to keep economic activity within carrying capacities, or to permit equitable use, the absolute level of resource use within developed countries needs to be reduced. |
| 3 | Resource productivity | An *indicator* for the output per unit of '*use of nature*' (M+E+P), i.e. the inverse of the eco-intensity ratio. (*This indicator <u>increases</u> in the 'right' direction).* |
| 4 | Efficiency (or productivity) change | Increase/decrease of *output per unit of input* (using either current or very different innovations, technologies and techniques). |
| 5 | Intensity change | Increase/decrease of *input per unit of output* e.g. energy, materials transport, chemicals or pollution intensities of output. |
| 6 | Material Input (MI) ('ecological rucksack') | The Material Input (MI) is defined as the life cycle wide total quantity (in kg) of natural material moved (physically displaced) by humans in order to generate a good.<br>The 'ecological rucksack' is the MI of a product (service) minus the weight of the product itself. |
| 7 | Per unit of Service | A measure of functional utility (service) from products or services (similar to 'functional units' in LCA) |
| 8 | MIPS Indicator | A measure of how much resources (M) are used per unit of Service. |
| 9 | Total Material Requirement (TMR) | This indicator is the macro-economic version of MI, i.e. the Material Input (MI) of a national economy. |
| 10 | Environmental load/stress/pressures | The sum of '*use of nature*' (M+E+P). |
| 11 | Carrying capacities (& critical loads) | Ability of eco-systems/the earth to bear environmental load without significant damage. (the threshold is the critical load). A parallel concept exists for humans or biota, i.e. thresholds of harm. |
| 12 | Dematerialisation | *Absolute* or *relative* reduction in '*use of nature*' (M+E+P) per unit of output. |
| 13 | Intensive growth | Increasing '*use of nature*' (M+E+P) per unit of output. |
| 14 | Decoupling - relatively | Decreasing '*use of nature*' (M+E+P) per unit of output, but still rising in absolute terms. |
| 15 | Decoupling - absolutely | Absolute reductions in total '*use of nature*' (M+E+P). |
| 16 | Factor 4 | A target for relative decoupling worldwide that involves a four fold reduction in eco-intensity. |
| 17 | Factor 10 | A target for absolute decoupling in developed countries that involves a ten fold reduction in '*use of nature*'. |
| 18 | Steady state | Stable resources use and stable output (but compatible with dynamic changes in *content* of activity). |
| 19 | Environmental space per person | Equitable access to global resources (M+E) per person. |
| 20 | Ecological footprints | Land use equivalent of '*use of nature*' (M+E+P). |

[1] E.g. 'Sources' of materials & energy; 'Sinks' for wastes / pollution; 'Services' of the environment e.g. water & carbon cycling; and 'Space' for economic activity and aestmetics.

[2] There is clearly an element of 'double counting' in accounting for both inputs of materials and output of pollutants. However, it is not possible at this stage to focus just on M and E, or just on P, in order to monitor progress towards sustainability: both are needed for practical purposes. The 'double-counting' is at least erring on the side of caution.

# Appendix 1: Workshop programme

## Programme

### *Wednesday, 28 Oct. 1998*

| | |
|---|---|
| *18:00 - 20:00* | *Welcome Dinner (at EEA canteen)* |
| | **Welcome:** Domingo Jiménez-Beltrán (executive director EEA) |
| **Session 1:** | **Frameworks, Concepts, Targets**<br>(Chair: Domingo Jiménez-Beltrán, EEA) |
| 20:00 - 20:30 | Friedrich Schmidt-Bleek (Factor-10-Institute) |
| 20:30 - 20:50 | Jaqueline Aloisi de Larderel, UNEP: *Outcome of the Fith High Level Seminar on Cleaner Production* |
| 20:50 - 21:10 | Markus Lehni (WBCSD) |
| 21:10 - 21:45 | Discussion |
| 21:45 - 22:00 | David Gee (EEA): *Conclusions* |

### *Thursday, 29 Oct. 1998*

| | |
|---|---|
| *8:00 - 9:00* | *Check-in* |
| **Session 2:** | **Developing & Implementing Eco-Efficiency Indicators**<br>(Chair: Rolf Annerberg, Swedish EPA) |
| 9:00 | Stefan Bringezu, Wuppertal Institute<br>*Indicating the Material Basis of Industrial Economies* |
| 9:30 | Peter Bosch and Stephan Moll, EEA, Copenhagen<br>*Eco-efficiency Indicators within the Reporting Frame of the European Environment Agency* |
| 10:00 | Laurie Michaelis, OECD, Paris<br>*Defining Eco-efficiency and Resource Productivity: A Progress Report from the OECD* |
| 10:30 | Fabienne Planés, Anite Systems<br>*Sectoral Eco-efficiency Indicators* |
| 10:40 | Markus Lehni, WBCSD, Switzerland<br>*Eco-efficiency Metrics for Companies* |
| *11:10 - 11:30* | *Coffee* |
| **Session 3:** | **Role of Government and other Stakeholders in Achieving Eco-Efficiency Targets (e.g. Factor 4/10)**<br>(Chair: Andreas Tschulik, Austrian Ministry for the Environment, Youth and Family Affairs) |
| 11:30 - 13:00 | **Part I:** four case study presentations by Nordic countries:<br>Henrik Gudmundsson, National Environmental Research Institute, Denmark<br>*Reduction of Environmental Pressure from Car Traffic by a Factor 4/10*<br>Antero Honkasalo, Finland<br>*Possibilities and Limitations to Implement Eco-efficiency and Factor 4/10 in the Forestry Sector*<br>Katharina Th. Bramslev, Grip centre, Norway<br>*Possibilities and Limitations to Implement Eco-efficiency and Factor 4/10 in the Building and Real Estate Industry*<br>Cecilia Persson, Swedish EPA<br>*Sustainable Food Chain, Possibilities and Limitations to Implement Factor 4/10 on Production and Consumption of Food* |
| *13:00 - 14:30* | *Lunch* |
| 14:30 - 16:00 | **Part II** |
| 14:30 | Karl Otto Henseling, Federal Environment Agency, Berlin<br>*The German 'Environment Barometer' - Providing Information & Target Setting'* |
| 15:00 | Andreas Tschulik, Austrian Ministry for the Environment, Youth and Family Affairs |

| | |
|---|---|
| 15:30 | *Eco-efficiency and Resource Productivity: Austrian Experiences*<br><br>Business examples from WBCSD |
| *16:00 - 16:30* | *Coffee* |
| **Session 4:**<br>16:30 - 18:00 | **Interactive Session** 'Making Sustainability Accountable through Indicators of Eco-Efficiency / Resource Productivity'<br>(Chair: Claude Fussler, WBCSD) |
| *18:30 - 20:00* | *Buffet-Reception at City Hall of Copenhagen* |

## *Friday, 30 Oct. 1998*

| | |
|---|---|
| | **continuation Session 4:**<br>(Chair: Claude Fussler, WBCSD) |
| 8:30 - 10:30 | Report back from the interactive session & Discussion |
| *10:30 - 11:00* | *Coffee* |
| **Session 5:** | **Conclusions & Recommendations**<br>(Chair: Yannis Paleocrassas, Factor-10-Institute) |
| 11:00 - 12:30 | Key recommendations on how to make sustainability accountable & discussion |
| 12:30 - 13:00 | Domingo Jiménez-Beltrán: *Conclusions* |
| *13:00* | *End (possibility for lunch at EEA canteen)* |

# Appendix 2: List of participants

| | |
|---|---|
| Ailasmaa, Veera | Finnish Forest Industries Federation |
| Aloisi de Larderel, Jacqueline | UNEP, Paris |
| Andersson, Ingvar | Naturvårdsverket, Sweden |
| Andresen, Solveig | Norwegian Ministry of Environment |
| Annerberg, Rolf | Swedish EPA |
| Arps, Elies | IMSA, the Netherlands |
| Aubree, Gerard | CEC - DG XI |
| Bartolomeo, Matheo | Fondazione Eni Enrico Mattei |
| Berkhout, Frans | SPPU, University of Sussex |
| Bidwell, Robin | ERM, UK |
| Bøgelund, Pia | Ålborg University |
| Bosch, Peter | European Environment Agency (EEA) |
| Bourdeau, Philippe | Universite Libre de Brussels |
| Bramslev, Katharina | Grip Centre |
| Brandsma, Erik | UN - Division on Sustainable Development |
| Bringezu, Stefan | Wuppertal Institute |
| Chodak, Miroslav | The Regional Environment Center |
| Cloquet, Daniel | Industrial Affairs, UNICE (Union of Industrial and Employers' Confederations of Europe) |
| Dybkjær, Lone | Member of the European Parliament |
| Fernández Pardo, Carmelo | Gabinete de la Presidencia del Gobierno Departamento de Educatión y Cultura |
| Finsen, Lars | Danfoss |
| Fussler, Claude | Dow Europe, Switzerland |
| Garcia-Orcoyen, Christina | Fundación Entorno, Madrid |
| Gee, David | European Environment Agency (EEA) |
| Green, Meg | Department of the Environment, Transport and the Regions, UK |
| Gudmundsson, Henrik | National Environmental Research Institute (NERI), DK |
| Gujer, Urs | Novartis International AG |
| Henriques, Pedro | European Commission, DG III - Industry |
| Henseling, Karl Otto | Federal Environment Agency, Germany |
| Honkasalo, Antero | Ministry of the Environment, Finland |
| Hugenschmidt, Heinrich | UBS AG - Environmental Risk Management Services |
| Jacobsen, Astrid | Danish EPA |
| Jarass, Lorenz | Fachhochschule Wiesbaden, Germany |
| Jensen, Heinricy | City of CopenhagenEnvironmental Protection Agency |
| Jessen, Jacob | Association of Danish Chemical Industries (FDKI) |
| Jiménez-Beltrán, Domingo | European Environment Agency (EEA) |
| Johnsen, Lone | Danmarks Naturfredningsforening |
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