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Sustainability Indicators - A Compass on the Road Towards Sustainability

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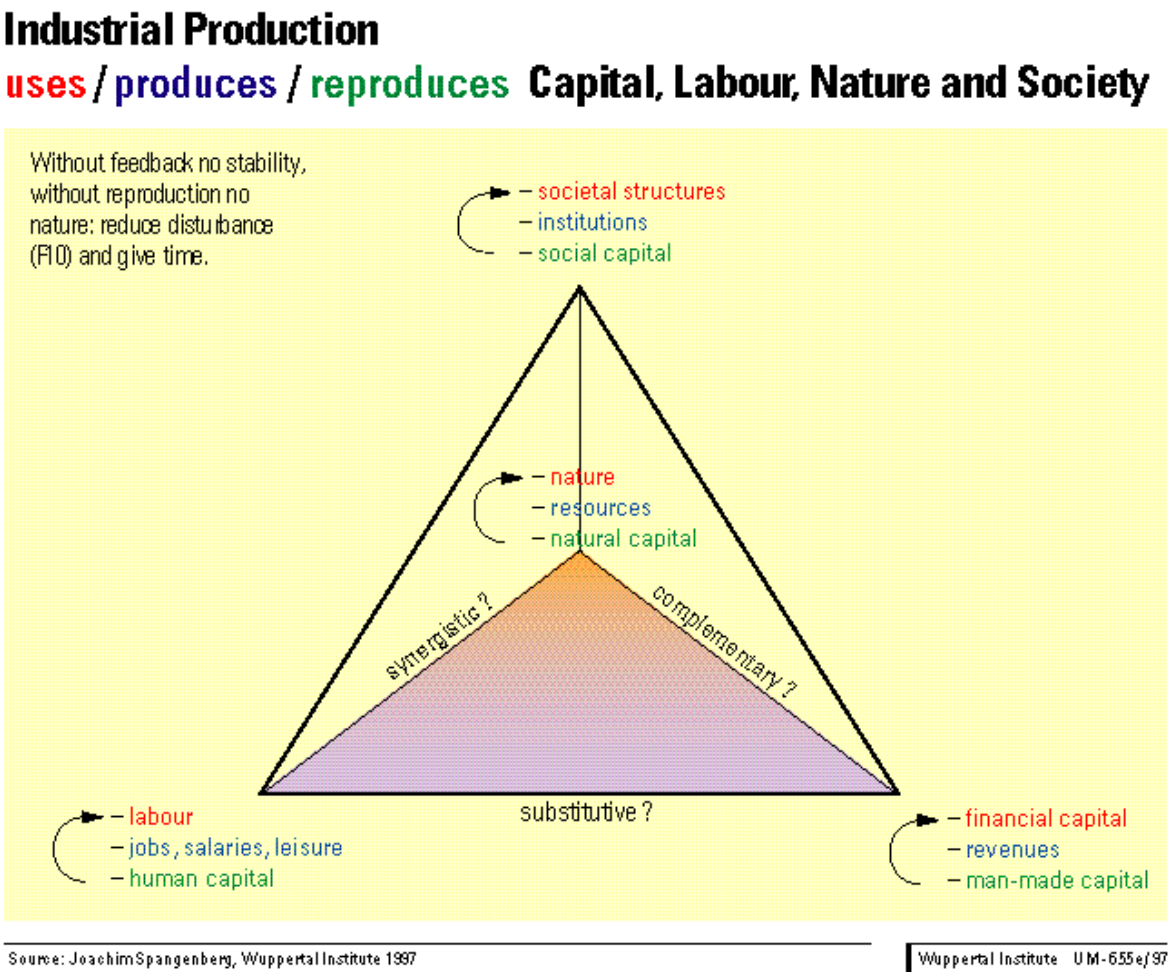


Content

Sustainability Indicators
A Compass on the Road Towards Sustainability

1. The Challenge of Sustainability

Sustainability per definition is a composite and thus ambitious policy target. It comprises environmental, economic and social criteria with equal importance - neither environmental degradation nor violating human dignity by poverty or other threats, nor public or private bankruptcy can be acceptable elements of a sustainable society.

Therefore we will refer to the existing systems of indicators, and then present a draft system of "interlinkage indicators" for the macro level which permits to connect some key driving forces in the fields of environment, economy and social affairs with the corresponding responses in a way which we feel is suitable for policy steering, for transparent communication and in particular for international harmonisation. On the micro level, we will offer a draft set of business sustainability indicators, providing stakeholders with the information they need beyond profitability. This includes an analogue of the UNDP's Human Development Index HDI for the company level, called *Corporate Human Development Index CHDI*. A consequent next step would be to extend the work presented here to elaborate more clearly the linkages between the micro- and the macro-level, taking into account particularly the importance of meso level elements.

The *physical* dimension of sustainability refers to leaving intact - for an infinite length of time - the stability of the internal evolutionary processes of the ecosphere, a dynamic and self-organising structure. An economic system is environmentally sustainable only as long as the amount of resources utilised to generate welfare is permanently restricted to a size and a quality that does not overexploit the sources, or overburden the sinks, provided by the ecosphere. Without this:

- human economies would have to continue to draw on the *stock* of natural resources (e.g. high grade ore, crude oil, fertile soil) or, from an energy viewpoint, they would continue to use up low-entropy resources which sooner (3rd) or later (4th millennium) would be exhausted;

- the immense (and rapidly increasing) *flows* of resources through the global economies would continue to lead to an increase in entropy, resulting in a variety of unpredictable and irreversible environmental impacts [1]. These would include slow, long-term changes such as global warming, as well as short-term irregularities such as storms, stronger hurricanes and

flooding rivers, resulting from the destabilisation of ecological systems. This is equivalent to threatening the life-support system of humankind.

Whereas the size of stocks and their accessibility is an economic issue (and can thus be used as a basis for developing economic indicators), ecology worries about resource flows, since these are what contributes to environmental impacts. Thus, the *environmental* condition of sustainability for our economic system is a physical steady-state ([2]), with the smallest feasible flows of resources at the boundaries to the ecosphere. Moreover, these impacts are characterised by non-linear dose-response relationships and unpredictable time-lags between stresses and responses. An unknown quantity of these effects can neither be detected within human time horizons, nor - were they found and measured - could they be attributed to distinct causes ([3]). This precludes the observation or theoretical calculation - and thus quantification - of the totality of concrete consequences of human (economic) activities on ecosystems ([4]) *ex post* and even more so any *ex ante* damage assessment and illustrates the limited power of cost-benefit analysis in shaping environmental policies.

2. Why Indicators ? What Indicators ?

Given these difficulties, a coherent normative concept of sustainable development including a cost-benefit analysis of policy strategies is a contradiction in terms, but what we can try is to provide all actors with two new kinds of tools that help steering decision making towards sustainability: On the one hand, a vision of a sustainable society, useful as a compass, not a route map (or, even worse, a blueprint), and on the other hand indicators which help to measure progress, distance to target, and failures of plans or their implementations. Indicators suitable for this behalf must be *simple* and *directionally safe*. To be *simple*, the number of indicators must be limited and the methodology of calculating them transparent. *Directionally safe* means that it should be obvious what they indicate is *relevant* in terms of importance for sustainability, and *significant*, i.e. open to change and thus able to signal progress or the absence of it, on the particular level of application.

The major systematic questions under discussion on the macro level today are:

- what is the maximum number of indicators that can simultaneously be applied, given the complexity of the economic and social system and the resulting limits to steering capacity ?
- what is the minimum number of indicators necessary to properly reflect the key threats to sustainability, given the complexity of economic, social and ecological systems ?
- will these indicators be better obtained by aggregating data or by systemic reasoning ?
- which then *are* the most helpful indicators for describing progress towards sustainability ?

For the micro level, similar but different questions apply:

- which of the indicators already used by companies is meaningful to sustainability ?
- which combination of available indicators is best suited for strategic decision making ?
- which gaps do exist, and how are they to be filled, preferably by already existing data ?
- how should such a set of sustainability indicators be used in decision making at the company level ?

3. The Macro Level: Established Indicator Systems

The three main purposes for which the use of indicators is being discussed at present are the following:

- summarising analysis: all indicators must be based on world-wide recognised methodologies and valid data. The number of such indicators will usually turn out to be comparably high, in order to cover all relevant aspects in sufficient detail. A well-known example under development is Eurostat's Environmental Pressure Index project ([5]) or, in the field of microeconomics, companies' accounting systems.
- political guidance: indicators should provide links with players, causes and instruments. A limited number is necessary in order to establish a proper link to policy decisions, arguably it should be less than ten.
- communication: vivid, easily understandable indicators are needed, as few as possible, possibly only one as a central communication tool. In economics, the GNP serves this purpose.

For these purposes, a number of indicator systems has been established on the macro level, which will be briefly described here.

3.1 Environmental Indicators: The OECD's PSR-Approach

The *Pressure-State-Response (PSR)* approach, as proposed by the OECD ([6]) and shared (if amended) by other international agencies, like UNstat or Eurostat is dominant in the international debate. "The PSR framework for indicator development is based on the concept of causality:

- human activities exert pressures on the environment
- these pressures change the quality of the environment and the quality of natural resources (the 'state' of the environment).

- society responds to these changes through environmental, general economic and sectoral policies (the societal 'response'). Thus societal responses form a feedback loop to pressures through human activities. Indicators may be developed for each phase in the framework." ([7])

The PSR system, however, contains some inherent, rather serious problems. Based on existing data, its focus is on predetermined environmental stresses, which at a particular time appear to be of major political concern. Consequently the issues chosen are mainly issues of the state of the environment like forest decline, biodiversity, climate change, as under discussion at a given time (a problem inherent to many systems environmental indicators, and to virtually all approaches to monetarise environmental damages: the unknown has no price). . Only remaining stocks are seemingly of interest, inputs from the ecosphere to the techno- or anthroposphere are not covered at all. This, however, causes a major problem: focusing on the state of the environment will necessarily lead to a very complex analysis, without providing appropriate links to the important driving forces leading to environmental degradation ([8]).

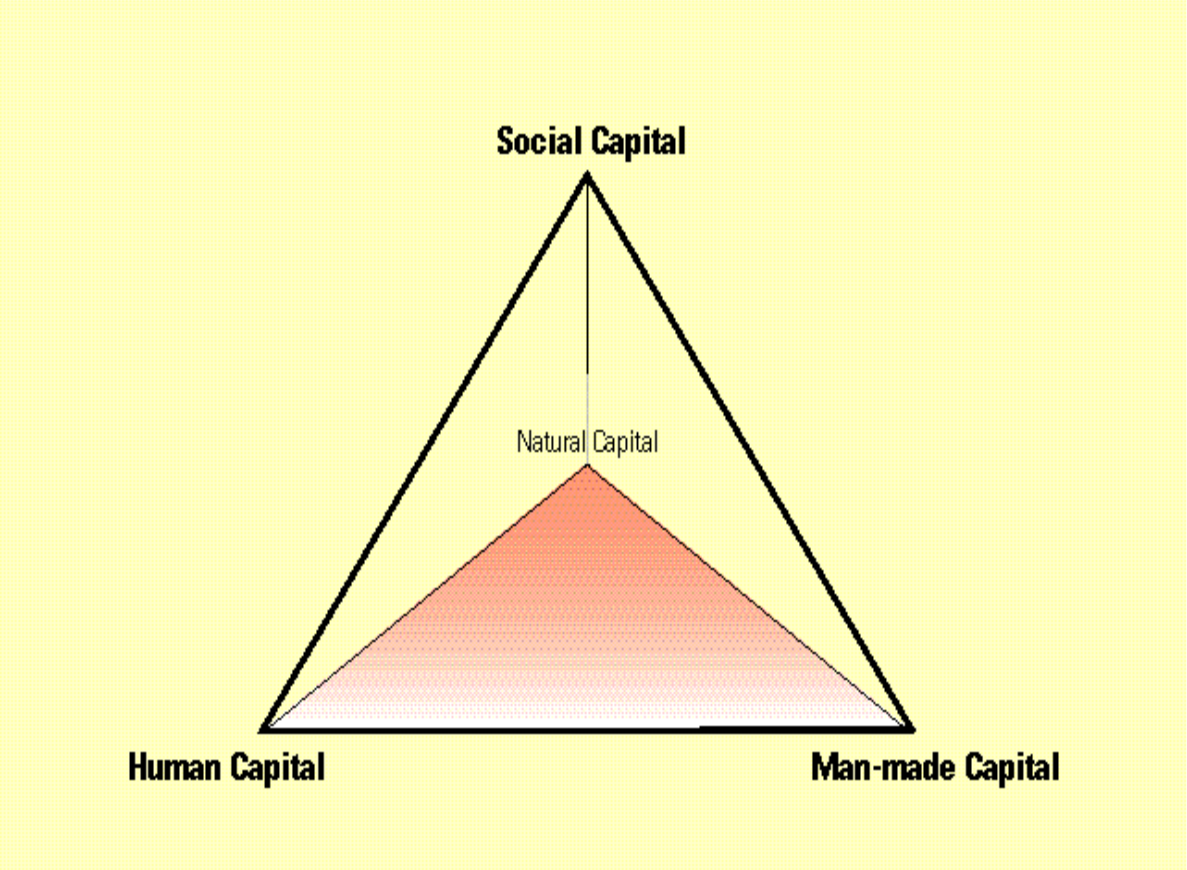
Furthermore, deriving responses from the selected states, i.e. the symptoms and episodic events, necessarily results in the development of (short term) curative politics, preventing the development of cause-oriented approaches. In this respect the PSR system reflects a kind of political 'end-of-the-pipe-thinking' and thus cannot fully meet the requirements of proactive environmental policies.

3.2 From Environment to Sustainability: The World Bank Indicators

The set of environmental indicators published by the World Bank in 1995 ([9]) specifically focuses on the applicability in policy development. They are essentially sorted according to the PSR scheme, however they provide additional information and are more comprehensive as compared to the OECD's initial set:

- although more rudimentary, social, economic and institutional criteria have been included.
- the World Bank recognises the need for *sustainability targets* in order to evaluate progress towards sustainability. Indicators linked with such sustainability targets are termed *performance indicators.*
- finally, and maybe most significantly, the concept of "wealth of nations" is evaluated and the need for a comprehensive definition extending the narrow economic definition is stressed. The conclusion "traditional economics gives disproportionate attention to finance and produced assets at the expense of natural capital and human resources" is illustrated by some impressive figures ([10]).

Types of Capital (according to Serageldin, World Bank 1996)



Source: Joachim Spangenberg, Wuppertal Institute 1997 | Wuppertal Institute UM-653e/97

The inclusion of human and natural capital is an important, the development of the concept of social capital an innovative element. However, the notion of non-economic capitals is problematic and may be misguiding ([11])

The World Banks Vice President Ismail Serageldin even goes one step further ([12]): the notion of social capital (briefly introduced by the bank as "social infrastructure") is elaborated as a fourth, quantifiable component of wealth, reflecting attitudes, social climate, preferences, and all other kinds of institutions, i.e. the meso level of economic (and all other) activity. The resulting ranking produced by Serageldin, although an outspoken draft, is highly interesting, in particular as compared to rankings according to other systems of indicators (see annex 2).

3.3 The Socio-Economic Dimension: UNDP's Human Development Index HDI

Unemployment and social security, access to housing, clean water, food, gender equity, income distribution,...all these are indicators of social development. The UN Development Program UNDP, however, has undertaken to develop *one* Human Development Index HDI, which can at first glance indicate progress or decline in human development. It is not based on a PSR approach, does not take into account the environmental dimension of sustainability (although

such an amendment has been long proposed ([13])), and - unlike the World Bank - it does not attempt to monetarise all aspects of sustainability.

The HDI includes two main features from the broad spectrum of social indicators: education (measured by the literacy rate) and health (measured by the life expectation), linking them with a more economic indicator: average per capita income. The simplicity of the HDI and its extensions (gender and income distribution adjusted HDI) can be used to compare progress country by country and develop rankings. Its main target group are developing countries, although the HDI ranking has been informative (and thus disturbing) for OECD countries as well.

The bottleneck for the construction of one single HDI was to find a common measure for the socio-economic "distance to target" in these very different areas of development politics. To come to meaningful comparisons amongst countries, a normalisation procedure for the data was needed. According to the methodology developed in 1994 ([14]), for each component a relative global minimum (the minimum of the past 30 years) and maximum (a maximum expected for the next 30 years) is set, so that the current situation in each country can be expressed by a figure between zero and one. The average of three factors gives the final HDI:

- *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 between 0% and 100% and mean years of schooling, with a minimum of zero and a maximum of 15 years taken into account ([15]).
- *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$) with the minimum set at 200 PPP$ and the maximum at 40,000 PPP$. Based on the premise of diminishing returns from income for human development, the higher the income relative to the global average income of 5,120 PPP$, the more sharply diminishing returns are calculated by an increasing devaluation rate at which the income is taken into account for calculating the standard of living.

Since national averages tend to hide internal disparities, the HDR team has since 1991 produced "adjusted HDIs", the most important being the ones reflecting gender imbalances and income disparities ([16], see annex 2). In 1996 the HDR focused on economic growth and human development, pointing out a significant delinking of the development of HDI and national income, but assuming that this delinking (at least for the poorer countries) can only be sustained for a limited amount of time ([17]). The report quotes as well empirical evidence that

- human development is a necessary precondition for economic development.

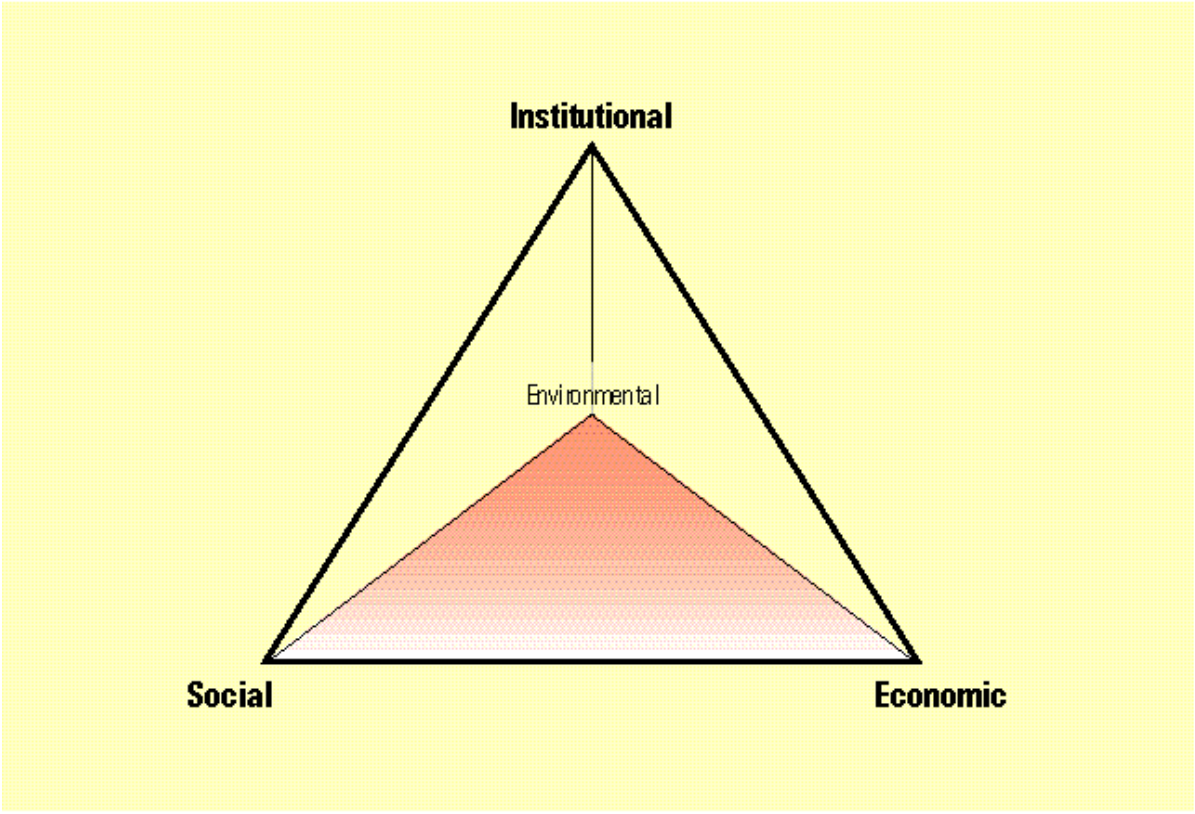
- the most profitable investments are those in human capital (education, training, higher qualification of the labour force)
- economic development need not be linked to increasing income disparities, and
- economic development can be combined with strengthening participation.

Since the first publication of the HDI, there is a lively discussion of the whole approach ([18]), the criticism being both scientific and political. However, despite all possible weaknesses the HDI is a very stimulating proposal to the international debate and offers a lot of food for thought as well a cornucopia of concrete data about real wealth ([19]) and sustainable human development beyond GNP.

3.4 Sustainability Indicator Systems: UN-DPCSD's Approach

The United Nations Department of Policy Co-ordination and Sustainable Development DPCSD has developed its own program on the development of sustainability indicators. Based on input from different UN agencies and a number of individuals they have decided to use the OECD's PSR-system as a starting point, but to broaden its scope. Non-environmental dimensions of sustainability were added to the PSR approach, resulting in the *DSR (Driving force - State - Response)* scheme.

The Four Dimensions of Sustainability (according to CSD 1995)



Source: Joachim Spangenberg, Wuppertal Institute 1997

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It intends to reflect the economic, social and institutional dimensions of sustainability on equal footing with the environmental concerns. Furthermore, it tries - often unsuccessfully ([20]) - to structure them according to this "causes, symptoms and solutions" scheme. The system provides no advice which of the responses listed are considered effective in reducing the pressures and in redirecting the driving forces and/or improving the state, in particular when considering the interdependencies with constraints in other sectors. Even more, the measures proposed are not necessarily *intended* to combat the driving forces mentioned, some are curative measures and many categories simply expose blanks.

Another obstacle to systematic use of the system is its focus on the situation in developing countries, so that many indicators are not too meaningful for industrialised countries. This obvious weakness has been realised by DPCSD, however, and measures have been taken to overcome it by proposing an additional set of indicators in the framework of another program called *CCPP, Changing Consumption and Production Patterns.* The indicators proposed under this program are much more focused on the specifics of northern societies. Together, the two proposals from DPCSD provide a highly useful and comprehensive descriptive framework for reactive and curative measures to be taken, as will be proven in the pilot phase of application in about 20 countries from all parts of the earth in the period 1997 - 1999. This has been achieved by structuring the CCPP indicators as well according to the DSR scheme.

One weakness, however, cannot be overcome: the identification of cause-oriented, proactive policy guidance remains weak at best. This is why we propose to amend the DSR system with a limited set of proactive indicators, referring to the interlinkages ([21]) and mainly designed for policy steering. Furthermore, to improve their operationability, we will make a proposal how to integrate them into the predominant DSR-scheme.

4. Proactive Policy Steering: The Wuppertal Institute's Amendment

4.1 Proactive Indicators and the Role of Targets

Proactive indicators cannot focus on symptoms or damages, which only permits an ex-post analysis, but have to concentrate on the underlying trends in order to permit ex-ante measures to be taken on emerging problems (therefore, they will usually be *response* indicators in the PSR terminology). Furthermore, they need not only to meet scientific criteria, but additionally they have to match communication and steering needs. Therefore they have to be communicatable, transparent and reproducible, limited in number, but reflect main stresses in a directionally safe and long term reliable manner. For this behalf, they will have to be "performance indicators", i.e. to be linked to quantifyable policy targets ([22]). Such targets, however, cannot be set by scientists, but have to be agreed upon by the society at large ([23]) and codified by legislation or other binding means of policy enactment.

While the prevailing approaches mainly reflect (national) environmental protection policy priorities - which themselves change over time - as well as administrative procedures already in place, it must be our goal to develop indicators, which help to identify policy options and future administrative initiatives best suited to counteract some of the key driving forces towards unsustainability.

From our point of view, one such driving force is the steadily increasing physical throughput of our economies, which has to be adjusted to the upper limits set by nature as lined out in the introductory chapter of this paper ([24]). It is therefore considered necessary:

- to define (and reach international consensus on) global *resource input reduction targets* which would yield at least corresponding decreases of outputs (emissions, effluents, waste). Their enforcement would as well allow the elimination of known eco-toxic pollutants through the appropriate choice of the new technologies required to achieve the agreed dematerialisation (material flow reduction) targets,
- to base the assessment of the maximum permissible use *"environmental space"* per capita ([25]) on the earth's carrying capacity , expressed as the global flux of resource extraction possible without deteriorating the global environment. The necessarily accessible minimum amount of resources and thus the minimum environmental space in a sustainable society is estimated as the amount needed for leading a dignified life (including the satisfaction of basic human needs). ([26])

4.2 Which Inputs ?

Every use of environmental space needs: a realm where it can take place, materials as the physical basis of the agents and their instruments and energy. These are three at least partially-independent variables: the relation between the amount of tonnes of materials, Kilo joules of energy and hectares of land used to produce one item varies from product to product and from service to service ([27]). Thus, we propose these three - energy, materials and land - to be the core categories of environmental inputs. Each of them can - as necessary - be split up into environmentally relevant subcategories such as e.g. air, water, soil, biotics and minerals for materials, fossil, renewable and nuclear for energy or build-up, pasture and agricultural for land use ([28]).

We propose characterising the physical aspect of the use of environmental space through a quantification of the flow (or throughput) of energy, materials and land of a given economy, based on computations of inputs.

The respective reduction targets then are set according to best available knowledge:

- for energy: -50% global reduction compared to current levels to meet the IPCC recommendations to limit climate change,
- for material: -50% global reduction compared to current levels to prevent further global environmental disturbances, and
- for nature protection and land use: qualitative standards regarding the main pressures on biodiversity and soil fertility ([29]) instead of introducing quantitative targets, since the loss of naturalness and biodiversity are important buy hardly quantifiable environmental damages. ([30])

These are reduction needs in absolute terms based on the 1990 consumption levels; for their implementation we propose a time frame of 50 years, from a scientific point of view probably the maximum acceptable time span and from a political point of view the minimum time required for such dramatic changes. Both implies that we have time enough to act, but absolutely no time to loose.

These three targets and their corresponding indicators define a directionally safe normative system of *environmental performance indicators*. Combined with appropriate economic and social targets and indicators, they could be developed into a system of *proactive sustainability indicators*, addressing the inherent dynamics of our economies as well as the quality of life for their citizens. This step is a necessary prerequisite to develop a set of indicators with a policy steering capacity, but not necessarily included in environmental policy target setting.

4.3 Interlinkages

Focusing our work exclusively on the four dimensions of sustainability would carry with it the risk to loose the coherence of the approach and begin to „compromise“ between different goals instead of looking for integrated approaches and win-win-situations. Therefore, and because the interlinkages often turn out to be closely linked to most important fields of policy making, we have to pay due attention to properly define targets and indicators for the interlinkages as well - otherwise, any system of indicators would lack operational qualities. ([31])

The limitations proposed so far have been referring to the total amount of resources globally extracted from the environment ([32]). Equally important for sustainability, however, is the level of equity in the distribution of access to these limited resources. The distribution of access is thus our first proposed *socio-environmental interlinkage indicator*, the target being equitable access (on a per capita basis). This constitutes a kind of "human right to resource use", to be implemented nationally according to national distribution standards. ([33])

This goal of "fair shares of environmental space" ([34]) modifies the previously mentioned reduction targets significantly: For Europe equitable distribution means that for material use the

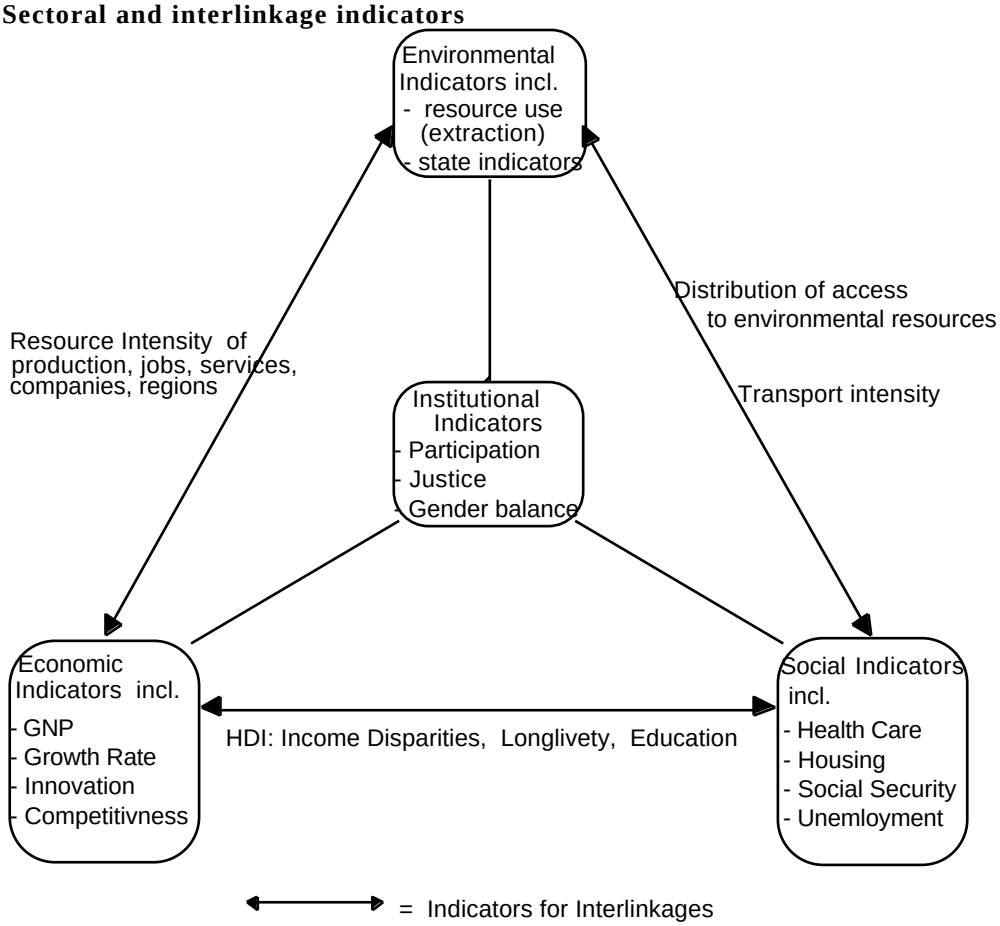
reduction need is no longer by half, but by a factor of 10 (90%), for energy by a factor 4, and land use must be further reduced to compensate for „land imports“ from other continents. For the South, however, this means as a global average the access to twice the amount of resources as compared to today's levels.

Furthermore, the transport intensity provides a good indicator for the direction our societies are developing (infrastructure, production-, distribution- and consumption patterns included). Therefore it can be used as a *socio-environmental disturbance indicator* which does not only reflect energy, material and land use by the transport system, but as well social aspects like travelling distances and the corresponding shortage of time to be spent with friends or the family. As a first target a reduction of transport volume by half seems plausible.

4.4 The Linkage to Socio-Economic Sustainability

Drawing the link to the economic dimension, the resource intensity per unit of output can be calculated on the macro as well as on the micro level. The result - material input per unit of service, *mips* ([35]) - serves as our *enviro-economic interlinkage indicator*. Similarly, the transport intensity of goods and services - which might be called *trips* - can be calculated ([36]).

Graph: Sectoral and interlinkage indicators



For a constant level of services, the reduction targets directly translate into necessary resource productivity increases. In the case of a growing economy however, the task gets even harder: with an average annual growth of 2% over the next 50 years, a factor ten translates into a factor 27, and with 3% growth the factor becomes 45.

Finally, the linkage of the economic and the social dimension of sustainable development has to be considered. Here, we propose to use the HDI as the *socio-economic interlinkage indicator*. Of its three components, the income as a key characteristic for the richness of countries or regions will have to be amended by the income disparities as the crucial criterion in industrialised countries. This will be crucial if the transformation towards sustainability, which will cause (like all fundamental transformations) severe social tensions is to find public acceptance.

The second component of the HDI is meaningful in our context as well: longevity. Depending not only on the health care system, but as well on hygienic standards, availability of healthy food and drinking water, frequency of accidents (cars, drug abuse,...) and diseases, longevity integrates a significant amount of factors determining the quality of life.

Education is a key element of the institutional settings of a society, but also dependent on social and economic factors. We suggest that the access to education as measured by the HDI is in most countries as well characterising the degree to which equity of opportunity is given to the non-privileged sectors of society.

The gender issue could be treated like in the HDI again: being as well an element of the institutional characteristics of any given society, it could be used as a devaluator for the calculated ranking identified so far.

Other important characteristics of a sustainable economy and society, like the innovative capacity of economies, and the future character and quantity of labour will have to be characterised by additional economic and social indicators, which are not considered here.

4.5 Integration into the PSR/DSR System

Whereas sector specific indicators are the backbone of the existing PSR-/DSR-system, interlinkage indicators are hardly included. By way of example, we herewith suggest a way of doing so. For the *environmental* indicators we have proposed following definitions, at least plausibly based on causal links:

pressure = resources used/extracted, removed from their natural sites,
state = depletion of sinks and stocks (sometimes referred to as natural capital ([37])),

response = target values, quantification of the sustainability gap for energy, material and land use, transport intensity and income distribution.

Given these definitions, the proactive sustainability indicators developed fit into the framework of the DSR-indicators as *response indicators*, amending the existing system and providing a long term oriented, directionally safe guidance for decision making. Obviously, the other interlinkage indicators proposed in this chapter could be integrated in a similar way (for some of them, see the table below).

Unlike the DSR system proposed by DPCSD so far, the set of response indicators in the table is directly targeted at the main pressures identified (respectively the driving forces behind them) and thus is in a better position as regards policy guidance. The limited number of indicators makes it a handsome tool for decision makers in politics, administrations and business, and the simplicity of the basic principles as outlined here makes it useful for communication purposes as well. This way it could help to overcome some of the restrictions inherent in the DSR - system, as described above; others it shares by way of integration into the DSR scheme, like the problematic linear structure of cause response relations and the lack of systematic evaluation of the appropriateness of the responses proposed.

For the latter, an approach might be explored, which was developed for the assessment of damages following the release of toxic chemicals, the concept of outreach assessment ([38]). Outreach in more general terms can be understood as an assessment of the spatial range (the maximum area affected by the effects of a specific event or measure), and the persistence (the maximum duration the effect or disturbance will have). Such proxy measure, applied to pressures and - as far as possible - to driving forces, might serve as a quick check whether the responses proposed are of equivalent outreach ([39]). If not so, they will either not be able to mediate damage in full scale, or they will become an irritant in themselves, once the primary effect has faded away.

Table: A proactive PSR/DSR system

	Driving Force	**Pressure**	**State**	**Response (sust.)**
Energy	energy intensive growth	increasing CO2-emissions	climate change ante portas	- 80% consumption
Material	material intensive growth	non-quantifiable damages	increasing amounts of waste	-90% throughput
Land use	CAP, Commodities trade	erosion, fertility losses	%degraded, % farm land, % pasture	-30% (land import, biodiversity etc.)
Transport	globalisation, growth	urban sprawl, congestions, noise	NO_X concentrations, forest decline	ca. -50% transport
Income level	State of development	poverty	% malnutrition	double for South
Income distribution	socio-economic system	dissatisfaction, unrest	access to schools, health service,...	redistribute fairly

The system of proactive interlinkage indicators proposed here offers a significant extension and thus modification of the existing DSR-system, which can be useful for both policy monitoring and development: it puts measures into a perspective. Furthermore, it provides a quantitative element in a qualitative management/decision making process. It is admittedly rough, but even best computing powers and cost-benefit analyses will never give a „true“ or „objective“ direction for decision making. However, since this approach leaves out any analysis of the state, for reporting purposes (i.e. for the efficiency control of the measures proposed) it must be used together with a description of the state like the one provided by the existing DSR system: steering policy development and monitoring policy enforcement are two different, but necessary and complimentary tasks.

5. Some Corporate Sustainability Indicators and the Corporate Human Development Index CHDI

So far, the indicator development undertaken for all aspects of sustainability on the macro as well as on the micro level has been almost completely unlinked (with the material intensity analysis for products, companies, regions and countries a remarkable exemption of a multi-level economic-environmental interlinkage indicator). However, in the mean time hope for convergence seems to be merging, with work on economic indicators on the macro level and the integration - although so far rudimentary - of social and some institutional aspects on the company level, e.g. as an extension of the WBCSD eco-efficiency program ([40]). Since the process is still in its very infancy, there are no established procedures whatsoever so far, but the time seems due to stimulate the debate with some coherent proposals. Therefore we dare to conduct the experiment, aware of the unavoidable weaknesses inherent to any pilot attempt, hoping for critical feed back and a constructive debate.

For the establishment of an approach which establishes linkages between the micro and the macro level, we try to apply the basic concept of sustainability to the micro level and develop a first draft proposal for a system of Corporate Sustainability Indicators CSI, based on concepts established at the macro level. As of today, the dominant economic concepts tend to reduce business to profit maximising and cost minimising by stressing the role of costs in competition. The pressure of competition, to which firms are exposed but that they generate as well, reinforces the focus on short time economic performance ([41]) and does not - at least in first instance - make sustainability management economically attractive. Consequently, most firms' typical response, when considering the necessity to integrate environmental aims into their strategies, is fear of loss of competitive advantages due to an increase of production costs ([42]).

This, however, is exactly the opposite of what we consider as strategic sustainability management: it should proactively identify the environmental and social as well as the economic risks and see the opportunities for new products and markets in the changes induced. We understand a *proactive* corporate sustainable management as:

- adoption of medium to long term sustainability targets, and introducing them as a constitutive element of the corporate identity. For this behalf, they should be made explicit and translated into annual improvement goals.

- using all the opportunities given, identifying and exploiting win-win-situations, no-regret solutions and more, as long as e.g. the economic sustainability is not at risk (versus containing environmental and social measures in the minimal framework of legal constraints).
- actively promote changes of the existing (institutional, legal etc.) framework if it constitutes barriers to sustainable performance, not only -as usual so far - for the economic component, but as well for the social and environmental dimension. To gain success, however, social affairs and environmental issues must become a part of the quality competition, and (not least to increase the credibility of company communication) co-operation with other parts of the civil society must be sought.

Consequently, for a company to actively support a move towards sustainability, new management tools are needed which provide the necessary information on the strategic level to keep business operations "on track". For this purpose, after a brief review of existing indicators, we propose of a core group of corporate sustainability indicators including a Corporate Index of Human Development CHDI. Following the recommendations of the UN Commission on Sustainable Development, they should

- "alert decision-makers to priority issues,
- guide policy formulation,
- simplify and improve communication,
- foster a common understand of key trends" ([43]).

Furthermore, like at the macro level, we try to reduce their number by systemic reasoning and building interlinkages in order to avoid the emergence of conflicts between economic, ecological and social interests. For decision making at a lower level (e.g. operating level), we refer to the existing specific indicators. Although the changes needed to achieve sustainability are different in each market sector, some overall conclusions can and will be drawn in the following paragraph.

5.1. Economic Indicators and Criteria for Economic Sustainability

In market economies, economic sustainability is usually defined as firm's ability to persist durably on the market under competition constraints. The core group of indicators for assessing this narrow definition of economic sustainability is constituted of:

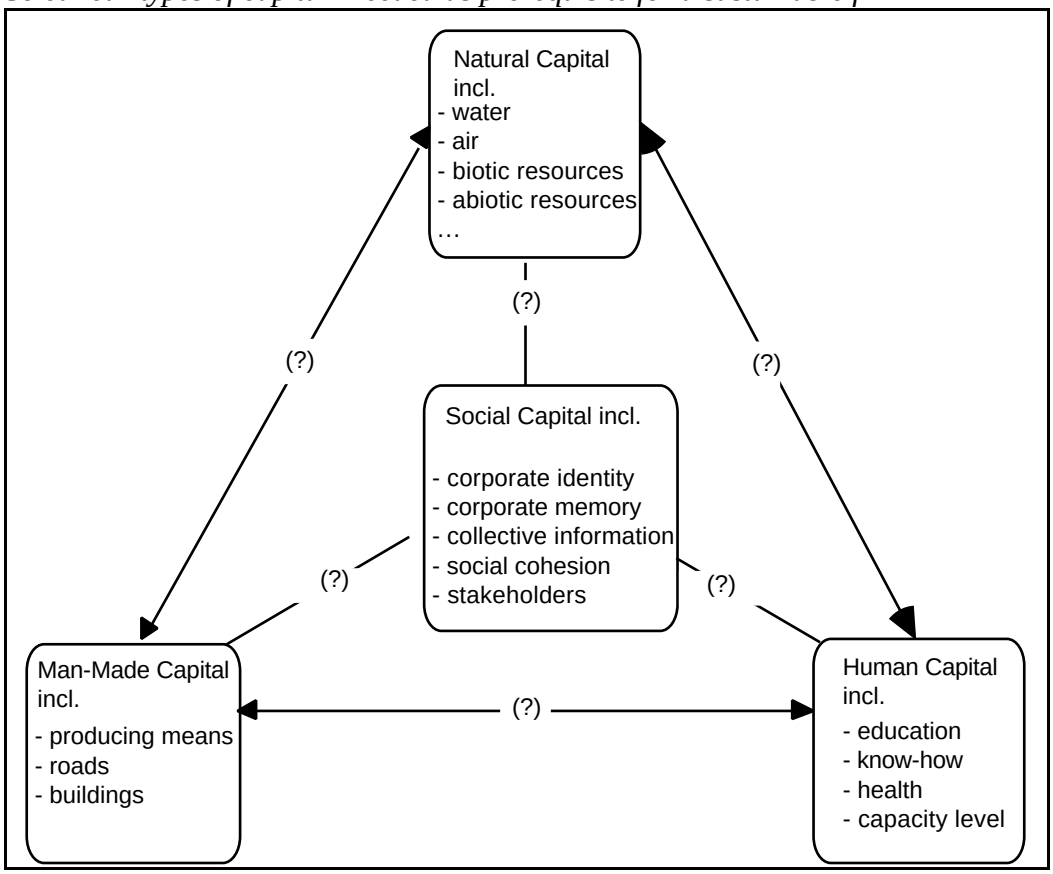
- liquidity / solvency ratios (working capital, level of indebtedness, etc.)
- profitability ratios (RoI, capital and labour productivity, Price Earning Ratio, etc.) and
- growth ratios (relative market share, returns, profits, etc.).

However this perception of economic sustainability is one-sided: Western economies' firms have developed along particular paths with an emphasis on industrial growth, efficiency (defined in narrow monetary terms) and performance. Result of this emphasis is an *"economic blindness"*. One of the most obvious paradoxes of today's business consists of destroying parts of its own constitutive basis: the ecosystem or, specifically, natural capital without which firms are not able to produce goods or to provide services: existing economic indicators do not take into account this fundamental precondition for sustained activities.

obviously, in analogy to the argument that the mere consideration of the GDP cannot characterise the real welfare of a country ([44]) and even less its sustainability, the exclusively monetary quantification of flows and stocks at the micro level is not able to reflect firm's level of sustainability or its improvements. We stumble over similar problems as those on the macro level, e.g.:

- investments in "end-of-the pipe technologies" are de facto embodied resources and therefore resource *consumption*, but are accounted for as *increasing of the firm's value* by investment.
- investments aiming at reducing environmental impacts at the source of the damages (e.g. by re-design of production processes and/or products) are accounted as research *costs* .
- de-investments processes of material goods (like means of production) accounted by firms as a monetary capital depreciation ([45]) lead to a monetary depreciation of the material flows embodied in the good, although the amount of the flows taken from the ecosystem remains the same. De-investments are particularly influenced by short legal depreciation time of producing means and the possibility of tax-deductibility which plays a major role in determining their real life span.
- Using dynamic investment models like the "net present value" implies that the total cash flows produced by the investments should cover not only the borrowed capital but also interests and capital depreciation. Since the borrowed capital becomes regularly more expensive on the time scale, firms are "obliged" to grow in order to finance the discounted value of investments ([46]).

So called "types of capital" needed as prerequisite for a sustainable firm



- Cost competition implies, on one hand, mass production (economies of scale, experience curve) and on the other hand, to reduce the use span of products by shorting the economic life (acceleration of product innovation, improved design, etc.).
  On the other hand, competition can establish new levels of operational best practice leading to higher resource efficiency at lower cost.

Furthermore, preserving available Human and Social Capital as represented in the following graph obviously constitutes a element of a firm's sustainability as well.

5.2 Corporate Environmental Indicators and Criteria for Enviro-Economic Interlinkages

As opposed to the macro level, no programs towards a harmonisation of corporate ecological indicators exist: environmental schemes like the EU Environmental Management and Audit Scheme EMAS or norms like the ISO 9000 and 14000 series' can only provide a framework. The EMAS helps establish management systems and measurements for environmental performance, however limited in scope (only environmental), in scale (only in-house effects, no product chain assessments) and not referring to comparable standards or indicators (it is still open whether or not some or these weaknesses can be overcome in the ongoing revision process

this year). Whereas ISO 9000, the standard for quality management, is attractive for economic reasons and helpful in setting up management structures which can be the backbone of a sustainability management system, ISO 14000 offers only procedural standards without reference to performance and not suitable for the development of meaningful sustainability indicators as a communicatable management tool ([47]). Consequently, there is no such thing as a business standard so far, and a multitude of companies' own indicators has been developed, either as management tool to monitor the implementation of *environmental legislation* norms ([48]) and standards, or as communication tools for environmental reporting and PR. They can be categorised in four major types: *immission, emission, toxicology* and *waste* indicators.

Besides these, *indicators of material consumption* are generally used by firms for *costs evaluation*, e.g. water consumption, energy consumption, material consumption and waste. Absolute figures of resource consumption are often translated into productivity ratios (e.g. material productivity). Nevertheless, it should be kept in mind that such productivity ratios are only derived for a monetary purpose, not as a management tool in their own right. Consequently, only the total amount of natural resources *bought* is reported as being important (the relevance being dependent on current price levels, not on absolute scarcities or environmental impacts). The use of free goods like air is not taken into account, and even less the total amount of materials activated by a certain production process (the "ecological rucksack") ([49]). This, however, must be the basis of reporting if the total environmental impact of a firm's activities is to be assessed and to diminished, following the dematerialisation approach described earlier.

The starting point for assessing the dematerialisation of production processes, and thereby of a firm's environmental performance, is accounting their total environmental impact measured as Material Input (MI), expressed in mass units (t or kg). MI represents the sum of all material used, i.e. set into motion, from "cradle to grave" in order to produce a certain product or generate a service ([50]).

The macro level dematerialisation targets discussed earlier are calling for an absolute reduction of MI of production processes. The term "absolute" stresses here that a quantitative comparison between the global resource consumption for producing goods and services of a national economy at any point of time (t) compared to that in a future point of time (t+x) clearly shows that the whole MI has been diminished, i.e. $\mathbf{MI_{t+x} < MI_t \text{ for all } x>0}$ ([51]). However, we cannot simply transpose the targets set at the macro level (i.e. a reduction of MI use by 90%) down to the firm level. Nevertheless, a comparison between MI used for production of a firm with the average of its sector can give a first impression of its relative environmental performance.

Given the material input data as well as the production statistics, the *material intensity* ([52]) can be calculated as MI in t per t of product, resulting in a first enviro-economic interlinkage indicator. In a similar way, indicators can be calculated for the *intensity of energy or land use* ([53]) or, as an important socio-environmental disturbance indicator, *transport intensity*.

Resource Intensities

In order to characterise the *resource intensity* of a production process (produced goods or services per material input, land input or energy input) characterises the environmental efficiency of a production process. For this behalf, energy intensity of goods (a well known indicator) should be complemented by *material intensity* ([54]) and *land use intensity* ([55]), per company and per unit of turnover or profit. Furthermore, the material input per unit of output (in t per t) can be used as a kind of material efficiency coefficient.

Transport Intensity

The transport intensity represents the severe environmental impacts (not to ignore the health and social consequences) of the current spatial pattern of production and consumption. It is measured in tkm (ton-kilometers) or pkm person-kilometers) per unit of service delivered. This indicator is helpful if a firm aims at improving the environmental performance of its provisions or to evaluate the soundness of its distribution channels, and assuming that on the national as well as on the EU level adequate policy measures are taken, any reasonably costly strategy of transport minimisation will turn out to enhance a firm's future competitiveness. The preliminary target from an socio-environmental point of view has been set at -50% by the year 2010 for the macro level.

Application at the Company Level

Spontaneously one could assume that the criterion for sustainability, based on the categories and targets elaborated for the macro level, would be an overall reduction of resource consumption and transport volume irrespective of the economic development of the firm. However, what is obvious on the macro level, looks different from a micro perspective. A firm's contribution to the total reduction of material flows mainly comprises of two interwoven elements:

- A firm can improve its resource and transport productivity in a way that - irrespective of the growth rates reached - its total material consumption and transport efforts stays on the decline.
- A firm with a high relative resource and transport productivity compared to its sector reduces the total material consumption TMC as well as the total transport effort of its national economy by outcompeting more resource and transport intensive goods and services, i.e. by increasing the market share of "leading edge products".

Thus any general call for reducing or stopping growth of firms is nonsense, since those firms winning growing market shares for products with a particularly high resource efficiency as compared to their competitors, are actively contributing to the overall resource efficiency of a national economy ([56]). The absolute capping of resource consumption can only be enacted on the national level, enforcing competition on the access to scarce resources and providing a first mover benefit to the leading companies, resulting in a competitive advantage. Together with *firm's resource efficiency*, we thus have to consider the *allocative efficiency of the economy*, i.e. a clear regulatory framework without loopholes, undisturbed, non-monopolised markets and prices that to some degree reintroduce the externalities into economic decision making. Given these incentives, firms should act in a such way that the economy as a whole uses natural resources efficiently. Since the key sustainability criterion for the firm must be an annual increase in resource productivity, we have proposed to found a "5% Club" of environmental front-runners which could unite cross-sectorally those defining best practice.

Economic productivity of resource use

In order to assess not only the efficiency level of resource use but also the correlated income creation, we link the material inputs (in physical units) to the monetary ones, describing the expenditures needed to purchase the respective inputs and to transform them into a marketable good. This relation between physical input and financial gains can be expressed by the ratio *Returns Per Material Input* expressed as returns in monetary units per MI in tons, along firm's value chain.

This indicator can be used to asses the resource productivity of a whole company and its production, or parts thereof (e.g. of several product groups). As soon as a politically induced physical or economic scarcity of resources (e.g. by tradable, regularly devaluated extraction certificates, or by gradually increasing taxes on resource consumption) begins to shape business planning, this indicator will be of key importance indicating the potential profit from the given, limited amount of accessible resources.

Furthermore, this indicator can be used for comparisons between different production processes for functionally equivalent goods or services in terms of their respective economic attractivity for a company.

Resource productivity of investment

Given that a firm is willing to invest in reducing resource consumption, the aim of this indicator is to demonstrate the *effectiveness in financial terms* of the steps planed by a firm in order to reduce material consumption, it is expressed by MI-savings in tons per investments in monetary units). Furthermore, the indicator can be used as tool for investment choice between several options to reduce resource consumption.

The effectiveness of a given investment option *in environmental terms* can be described by an indicator called *MI Saving on Investment* , expressed by the ratio Reduction of MI during the economic life cycle of the investment per ecological rucksack of the investment. This indicator is useful to prevent environmental nonsense investments like those in some end-of-the-pipe technologies with an extremely high ecological rucksack, which would overcompensate any material flow reduction achieved during their use time. Derived from the preceding indicators, we can consider the *MI payback time*, i.e. the number of years needed until the material savings made due to the physical investment (e.g. a new technology) are equal to the material use for its creation, i.e. calculated as ecological rucksack of the investment good divided by the yearly MI-reduction caused by the investment.

Summarising it should be mentioned that a dematerialisation target can become economically unsustainable, *ceteris paribus*, if a firm does not succeed in decoupling its resource consumption from its profits / returns. Delinking means increasing added value (return - production costs) or at least maintaining it at the same level while decreasing resource consumption ([57]). Otherwise with a reduction of the resource consumption, returns would obviously drop at least proportionally ([58]). Any such business evolution is obviously unsustainable, economically as well as socially (e.g. dismissals). As indicator of the delinkage between resource consumption and returns, we propose to measure the ability to generate returns per resource unit (tonne or kilogram), not as a productivity indicator as it has been explained earlier in this paper, but as a scale elasticity:

Scale elasticity $_{\text{Returns/MI}} = (\Delta \text{ returns } _{tx} / \text{returns } _{t}) / (\Delta MI_{tx}, / MI _{t})$ ([59]). The lower the elasticity, the less firm's economic sustainability is sensible to variations (price, scarcity, ...) of its natural environment.

5.3 Social Sustainability and the Concept of Human and Social Capital

Social sustainability is here understood as the combination of distributional justice (access to resources and education, distribution of income,...) and the satisfaction of human needs (identity, health, comprehension, ...). Like at the macro level, improving social sustainability at the firm level requires to simultaneously improve *social and human capital.* While the maintenance and the development of human capital is more targeted to the knowledge and experience of individuals, social capital refers to the institutional interaction between individuals on all levels of a company, a process which constitutes the social system "firm" and its coherence. For this reason, the notion of social capital cannot be delinked from organisational and institutional aspects.

Corporate Human and Social Capital

Corporate human and social capital are strongly dependent on each other for instance in innovation processes ([60]). A variety of examples for economic mischiefs by depleting social capital has emerged from *down-sizing* (i.e. staff cutbacks), a predominant business strategy in current past based on the implementation of information and communication technologies. A recent enquiry ([61]) of firms having introduced down-sizing strategies showed that the reduction of personal costs is frequently outweighed by a loss of corporate memory and internal cohesion, resulting in diminished innovation capacities. From this background, it would be interesting to analyse impacts of outsourcing practices on corporate memory and innovation power in a comparable manner.

Capacity building on the shop floor level

Enhancing the human and social capital of a firm is understood to comprise of three elements:

- "maintenance" of human capital by education and training in order to keep the knowledge updated and available, promoting the active use of competencies by management systems and flat and flexible hierarchical structures in the firm.
- income levels which permit to lead a dignified life in the respective societies, well above the minimum income set by legislation or negotiation. For this behalf, not only the level, but the distribution if income ([62]) between genders, top an bottom income groups etc. is of crucial importance.
- satisfaction of human needs (social security, identity, satisfaction,...) not only by high levels of workplace safety and by paying adequate salaries, but by organisational structures which support independent decision making, competence and responsibility in each job, and promote active participation and co-decision on all levels of the company.

These measures help to develop innovation potentials and creativity, to create an atmosphere of shared responsibilities, and thus contribute to build a corporate identity. Today, this is considered one of the most promising management strategies for the future, since traditional approaches of increasing labour productivity have reached limits; however many firms are still reluctant to apply these insights at the shop floor level. Although this fact is not least due to concerns about power, position and perception (self-image), it is backed by weaknesses in economic theory. For instance, investments in human capital (education) are reported as costs in firm's accounting, suggesting that a firm's performance suffers instead of benefiting from maintaining and developing it.

A firm is not an island

Furthermore, social sustainability cannot be thought of as independent from culture and history ([63]). Cultural identity, ethic codex and working atmosphere are constitutive parts of social sustainability of each company, but are dependent on factors outside the companies own reach. Consequently, dealing with social capital of the firm level requires to take into account processes on and demands from the meso level ([64]): With regard to company-society relations, it should be emphasised that taking into account socio-economic macro targets (e.g. customer satisfaction, employment) and staying in touch with the corresponding stakeholders is a *conditio sine qua non* for a firm to obtain the legitimisation of its existence. Legitimisation should be understood as a tacit or explicit acceptance of a firm and its business practices by the society at large, i.e. by consumers, employees, credit institutes, trade unions, etc.

5.4 The Corporate Human Development Index CHDI

Although corporate social and human capital are extremely helpful concepts to understand the driving forces behind a company's success, they are hardly quantifiable - the same problems apply as on the macro level. In order to provide at least a certain degree of measurability, we propose another approach to quantitatively assess a firm's progress towards sustainability: the development a Corporate Human Development Index CHDI. It should be based on the approach and be inspired by the criteria UNDP has developed for the quantitative assessment of the human development of nation states, but it obviously must be developed as an index in its own right in order to suit firms. Like the HDI, the index will be derived from a limited number of selectively chosen indicators which are integrated to give the CHDI as a performance figure between 0 and 100%. A socio-economic indicator for firms, leaning on the established concept of the HDI offers two main advantages:

- it permits to follow the same logic, philosophy and comprehension of sustainability on the firm level as on the macro level, making a wealth of literature e.g. about the value and meaningfulness of the HDI applicable to the micro level.
- it supports the coherence between and the integration of sustainability requirements on the micro and the macro level.

The CHDI as proposed here is a first response to the need for a socio-economic business performance indicator on the company level. Adding to the information for shareholders, this index intends to inform stakeholders about the attitudes of a company and its behaviour towards staff members. As mentioned when discussing the HDI, the environmental dimension could easily be added, resulting in an integrated non-monetary *Corporate Sustainability Index CSI.*

The three main components of the HDI are longevity, knowledge and material standard of living. We have tried to define equivalent criteria for the firm level and propose to use durability of the relationship employee/firm, education and income res. its distribution (we refer to UNDP's Human Development Reports for methodological details of minima and maxima definitions and the integration by weighting). Almost all the data needed for its calculation are already available in each firm, mainly in the personnel management divisions. These variables are detailed as follow:

Quality of industrial relations and labour conditions

- Personnel rotation (fluctuation of the personnel, average duration of employment) and average duration of a contract as indicators of the reliability of employment from the employees' perspective, and the former as well for the corporate memory.
  We propose to set lifelong employment (from education until full retirement benefits are granted) as 100% and short term contracts (less than 1 year) as 0% in the first case, for the contact duration we propose duration of contract * 10 (10 years and more/permanent counted as 100%)
- Amount of regular work hours annually lost due to consequences of labour conditions (i.e. accidents, job-induced diseases, early retirements,...). Whereas the minimum (equivalent to 100%) is a clear zero, the maximum (0%) is proposed to be set as the maximum loss documented in the last three decades in OECD countries. Regular work hours include overtime as well as work in a different job during times of recovery etc.

Education: Input and maintenance of Human Capital

- The quantity of "embodied education" brought into a firm by the employees ("purchased" human capital), measured by the average duration of school, university or other educational enrolment amongst employees, with 0 years giving 0% and 15 or more years representing 100% ([65]),
- Consideration of maintenance or improvement of human capital: Average amount of hours invested in education and training of skills per year and capita (in-house seminars and workshops, external training, educational holidays including personality development other than training for the job). The obvious minimum is zero, the maximum should again be based on best successful practice.

Income level and distribution

- The income level is best judged by expressing the minimum income paid by the company as a multiple of the national social aid standard, and a matching of both would be given 0% (we are aware that in different countries a certain minimum is guaranteed by legal means or sectorwise negotiated salary structures). The definition of 100% could then be derived from

comparing the hourly pay to the national average. Income represents here the sum of all monetary contributions during a year.

- To represent income distribution within a firm, a figure could be reported representing the relative size of CEO/board member income as compared to the average shop floor worker, with 100% set according to recent e.g. Japanese standards (about a factor of 10 to 20, details to be based on empirical data for a standard year) and 0% on the extremes of current US habits with disparities exceeding the factor 100.

Like for the HDI, there could be adjusted versions, amendment and redefinitions. One obvious adjustment, again based on the HDI, would be a *gender adjusted CHDI*, taking into account income inequities as well as female representation in top decision making positions. The educational indicators might be improved by developing a measure of how a firm's organisation influences learning, thanks to e.g. structures allowing exchanges of experiences. This would reflect the need for a company to be a "learning organisation" as a precondition for long-term competitiveness as well as for the successful management of the transition towards sustainability, a demand recently articulated by the WBCSD and other business sources.

In analogy to the HDI, the next step would be to integrate these three main variables. An open question concerns the relative importance of each factor for sustainability, i.e. the necessity (or not) to introduce weighting factors. Moreover further research is needed with regard to the integration of firm's Social Capital into the CHDI/CSI. However, The CHDI as proposed here, combined with eco-efficiency measures and economic indicators as pointed out, is the first coherent approach to develop a comprehensive set of indicators, which links business performance on sustainability to the overall performance of a country. Being a first attempt, it can admittedly not claim to be the final solution, in particular since tests on the company level (and the resulting adjustments) still have to be performed.

5.5 Management Strategies for a Sustainable Firm

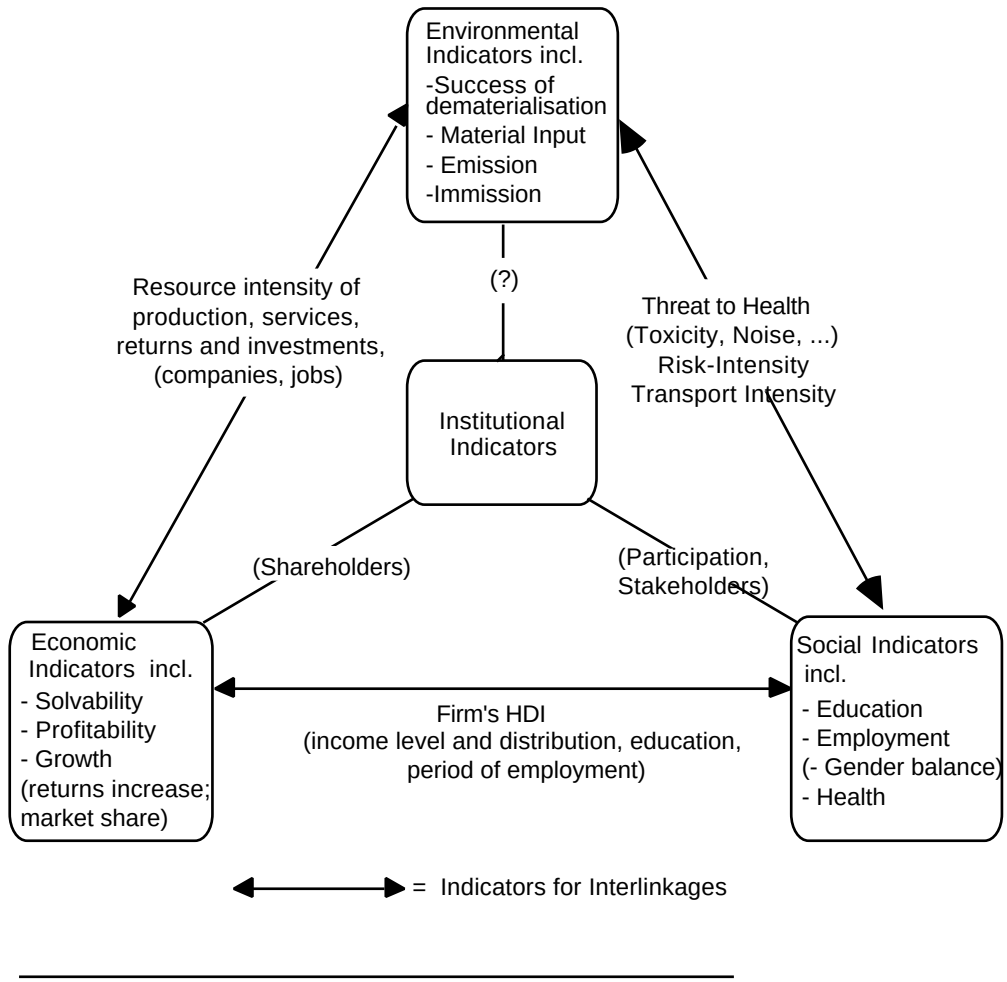
Any management approach, in order be really sustainable, must be a *proactive* one, i.e. grasping the opportunity from necessary change and promoting it. The indicators proposed here, although not complete yet (the „missing links“ are included in the graph below), are considered a useful starting point. By regular compilation and publication, they can form the backbone of a reporting system intended to keep the company „on track“ as regards its long term objectives, which tend to be sidelined in day-to-day business.

However, we are aware that, given the prevailing political and juridical circumstances, even best intentions do not easily translate into practice. Many of the indicators developed are directly or indirectly influenced by the legal and fiscal framework, by public moods, the state of affairs

between business and trade unions, the presence or absence of a culture of co-operation and consensus in a specific and so forth.

Therefore we propose as a definition that a sustainable company can be identified by having a plan for sustainable development for the future, putting it into practice wherever possible, and by joining hands with all other driving forces of sustainable development.

Overview of corporate sustainability indicators



(1) Of particular interest in this respect is the analysis of the delinkage between returns and MI as well the ecological efficiency of environmental investments (i.e. saved MI per monetary unit)

6. Outlook

With the approach presented here, we have undertaken a first step to establish an integrated system of sustainability indicators, covering national politics as well as the business world. There is, however, a significant need to address additional actors: the households on the micro level, plans and projects on the regional (often sub-national) level ([66]) and a harmonisation with the indicator work at UN level.

On all these levels, work is under way in our working group, and in addition research is under way on the future of labour in a sustainable society: all this has to be integrated to come to a

really comprehensive system of sustainability reporting. So far, however, it remains to be seen whether or not the approach presented here will have its merits in the additional fields as well, as a core set of indicators, as a satellite to other indicators, or not at all.
Furthermore, the DPSR-indicators currently tested on behalf of the CSD ([67]), and the EEA's DPSIR system have only limited overlaps with the HDI/CHDI presented here. It will be important to involve all stakeholders on all these levels in a process of harmonisation ([68]), if the potential benefit of indicator systems is not to be wasted by organisational lack of communication (including institutional jealousies).

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Annex 2: Rankings of European Countries

Ranks according to GNP 1992, the HDI 1992, 1995 and their adjustments, and to Serageldin 1995, indicating the share of natural capital in total wealth.

Country	**HDI '92**	**GNP/cap., rank 1992**	Income dispar. adjusted HDI	Gender adjusted HDI	**HDI '95**	GDI '95	GEM '95	**Sera-geldin 1990** (of 192 states)	thereof % natural capital
Switzerland	**2**	**1**	9	17	**14**	18	12	**4**	3
Sweden	**4**	**4**	2	1	**8**	1	2	**6**	29
Norway	**5**	**5**	6	2	**5**	3	1	**11**	30
France	**6**	**13**	7	5	**7**	7	40	**13**	7
Netherlands	**9**	**16**	5	10	**4**	10	8	**19**	2
United Kingdom	**10**	**19**	8	11	**15**	13	18	**22**	3
Germany	**11**	**12**	4	13	**17**	16	7	**15**	5
Austria	**12**	**14**	-	14	**12**	12	10	**16**	7
Belgium	**13**	**15**	3	16	**11**	14	16	**18**	2
Iceland	**14**	**8**	-	6				**7**	61
Denmark	**15**	**7**	15	4	**16**	6	3	**10**	7
Finland	**16**	**6**	12	3	**6**	5	4	**21**	38
Luxembourg	**17**	**2**	-	20				**3**	4
Ireland	**21**	**26**	-	24	**18**	23	23	**29**	9
Italy	**22**	**27**	19	18	**19**	20	13	**20**	3
Spain	**23**	**23**	22	23	**9**	19	25	**25**	9
Greece	**25**	**35**	-	26	**20**	21	60	**40**	11
Czecho/slovakia	**27**	**56**	-	17				**76/98**	19/5
Lithuania	**28**	**63**	-	-				**113**	9
Estonia	**29**	**43**	-	-				**73**	14
Latvia	**30**	**47**	-	-				**94**	12
Hungary	**31**	**55**	31	-	**36**	24	22	**67**	12
Russia	**34**	**48**	-	-				**55**	70
Belarus	**40**	**49**	-	-				**74**	10
Malta	**41**	**32**	-	-				**42**	0
Portugal	**42**	**38**	-	37	**31**	26	24	**41**	7
Ukraine	**45**	**68**	-	-				**105**	6
Bulgaria	**48**	**76**	-	-				**116**	24
Poland	**49**	**79**	44	-	**44**	31	41	**77**	31
Armenia	**53**	**73**	-	-				**143**	4
Georgia	**66**	**80**	-	-				**131**	6
Azerbaijan	**71**	**92**	-	-				**139**	6
Romania	**72**	**89**	-	-				**128**	13
Moldova	**75**	**81**	-	-				**117**	4
Albania	**76**	**86**	-	-				**99**	10

Source: Human Development Reports 1994, 1996, Serageldin op. cit.

Annex 3: Footnotes and Literature

[1] The term „entropy“ was first transposed from physics to economy and popularised there by N. Georgescu-Roegen; current work includes e.g. R.U.Ayres, K.Martinàs, Waste Potential Extropy: The ultimate ecotoxic?, INSEAD Discussion Paper, Fontainebleau 1994; or R.U. Ayres, L.W.Ayres, K.Martinàs, Eco-Thermodynamics: Exergy and Life Cycle Analysis, a contribution to the OIPROS project (Operational Indicators for Progress Towards Sustainability) , Fontainebleau 1996

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[3] Hinterberger, F., Biological, Cultural and Economic Evolution and the Ecology-Economy-Relationship, in: Van den Bergh et al. (Ed.), Towards Sustainable Development, Concepts, Methods and Policy, Washington 1994; Spangenberg, J.H., Evolution und Trägheit, in: Kaiser, G. (Ed), Kultur und Technik im 21. Jahrhundert, Frankfurt 1993

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[5] Jesinghaus, J., What is EXTASY ? A short answer, Eurostat paper, Luxembourg 1994

[6] OECD, Environmental Indicators, A Preliminary Set, Paris 1991
OECD, Core Set of Indicators for Environmental Performance Reviews, Paris 1993

[7] WWF International, Indicators for Sustainable Development, London 1994

[8] good examples for the limited outreach of such indicators, as well as for the immense efforts needed to generate them are - unintentionally - given by K.Rennings, H.Wiggering, Steps towards Indicators of Sustainable Development: Linking economic and ecological concepts, in: Ecological Economics, Vol. 20 No. 1, Jan. 1997 and R.Walz, Report for the Research Project "Further Development of Indicator Systems for Reporting on the Environment" of the Federal Ministry for the Environment, Karlsruhe/FRG 1995

[9] "Natural capital, even when limited to items usually given commercial value, seems to be a larger asset component than produced (human-made) assets in about half of the 192 countries for which crude first estimates of wealth were attempted. [..] Human resources account for a larger share of wealth than do produced assets. [..] Calculations [..] suggest that this is so for 174 of the 192 countries considered. In more than half of these nations, human resources were larger than [..] produced assets and natural capital combined.", The World Bank, Monitoring Environmental Progress - A Report on Work in Progress, Washington DC, 1995

[10] Due to shortage in space available, the methodology cannot be elaborated in detail here. See World Bank, op. cit., p. 57 ff. Although all methods of monetarising natural and human capital are somehow dubious, they are anyway a better measure than the current value of "zero" attributed to these kinds of wealth. In this sense, the following quotation does not reflect a scientific assessment, but a convention on allocating shadow prices, which regardless of its weaknesses (see below) is a significant improvement as compared to the status quo.

[11] F. Hinterberger et al., What is "Natural Capital" ?, Wuppertal Paper 29, Wuppertal 1995 and Hinterberger, F. et al., Ecological Economic Policy, New York 1998, first published as: Ökologische Wirtschaftspolitik, Berlin/Basel 1996

[12] I.Serageldin, Sustainability and the Wealth of Nations, First Steps in an Ongoing Journey, Draft, 2nd Ed., 1996

[13] E.g. in the Human Development Reports themselves, 1992 - 1994. A methodology has been proposed by F.Hinterberger, E.K.Seifert, Reducing material throughput: A contribution to the measurement of dematerialisation and sustainable human development, in: van der Straaten, J., Tylecote, A. (Eds.), Environment, Technology and Economic Growth, Amsterdam 1997

[14] For further technical details and a discussion of the pros and cons of such a procedure, see HDR 1994, p. 91 ff., particularly pp 108 ff.

[15] The differing quality of education is reflected by attributing a weight of two-thirds to literacy and one-third to mean years of schooling

[16] Regional disparities have been analysed for a lot of Third World countries and for Canada, Germany and Poland. For the US significant differences have been found according to gender and ethnic group, for Turkey according to gender and region.

[17] UNDP (Ed.), Human Development Report 1996, New York 1996

[18] See for example A.C. Kelley: The Human development Index: Handle with Care, in: Population and Development Review 17(2), p. 315-24. Even though the focus of the HDI is oriented towards "Third World" development issues, the HDI was critical evaluated for example from South-America concerning its possible (not actual) allocative implications in international development policies and financing.

[19] For more details of the concept of real wealth see Max-Neef, M., in Development Dialogue III/92; Ekins, P., Max-Neef, M., Real Life Economics, London 1992; and Ekins, P., Grundorientierungen auf dem Weg zur

Nachhaltigkeit, in: W. Sachs (Hg.), Der Planet als Patient, Berlin 1994

[20] In particular for the social and even more the institutional part, the criteria are clear how to distinguish e.g. between "diving force" and "state" are not clear. For some good reason the EU has their 1994 environment report (The Dobris Assessment) proposed to differentiate by using driving forces, pressures, state and response as different categories. However, this leaves the dilemma unsolved, that even under the existing reduced scheme an unacceptably number of fields had to be left blank - hopefully, the currently launched test phase will deliver enough additional material to fill the gaps.

[21] Quantitative interlinkage indicators are quite new on the international agenda (see Institut Français de l'Environnement, Notes de Méthode, Vol. 8, C. Rechatin et al., Indicators of Sustainable development, Paris 1997

[22] The term is used here as defined in The World Bank 1995, op. cit.

[23] i.e. they have to be the result of a discourse process involving the major sectors of society (e.g. as defined in the „Brundtland Report" Our Common Future, Oxford 1987, and applied at the UNCED conference). As one recent example, see Deller, K., Spangenberg, J.H., Wie zukunftsfähig ist Deutschland ? (How sustainable is Germany ?), edited by Forum Umwelt und Entwicklung, Bonn 1997 (English translation in preparation)

[24] For a more detailed reasoning see J.H.Spangenberg et al., Material Flow based Indicators for Environmental Reporting, EEA Expert Corner Series, Copenhagen 1998 (i.pr.); for an overview see Spangenberg, J.H., Schmidt-Bleek, F., How do we probe the physical boundaries for a sustainable society ?, in: Ryden, L. (Ed.), Foundations of Sustainable Development, Uppsala University 1997

[25] the basic concept was proposed by Siebert, H., Nature as a life support system. Renewable Resources and Environmental Disruption, in: Zeitschrift für Nationalökonomie/Journal of Economics Vol. 42 (1982), No. 2, pp. 133 - 142, and the term "environmental space" coined by H. Opschoor 1987, as explained in: Weterings, R, Opschoor, J.B., The Ecocapacity as a Challenge to Technological Development, RMNO 74 A, Rijswijk 1992. We use it here as modified in: J.H.Spangenberg (Ed.), Towards Sustainable Europe, A Study from the Wuppertal Institute for Friends of the Earth Europe, Luton et al. 1995

[26] This is of particular importance for the application of sustainability concepts to 3rd World countries, see e.g. Spangenberg, J.H., Towards an Integrated Concept of Sustainability, in CDG (Ed.), Proceedings of the International Symposium Amazonia: Strategies for Sustainable Development in the Debate, Belem May 1997 (to be published in Portuguese 1998)

[27] Consequently, we regard aggregated indices as being of limited scientific value. However, even in their most extreme form of monetary valuation (e.g. by contingent valuation methodologies), they can be extremely helpful in communicating the relevance and significance of environmental damages, even if they are of limited usefulness in designing appropriate strategies towards sustainability and thus fall short of meeting the criteria of indicator selection explained earlier in this paper.

[28] See e.g. the contributions of S.Bringezu in SCOPE (Ed.), Sustainability Indicators, London 1997

[29] like no use of fragile or already degraded soils, phase out of land import, organic agriculture, restoration of soil quality and 10% of land for nature protection purposes, as at least partly already reflected in the EU's NATURA 2000 program.

[30] For erosion and the loss of micronutrients, however, quantitative data can be given: a reduction of about 90% is necessary.

[31] see e.g. Spangenberg, J.H., Environmental Space based Indicators: A Compass on the Road towards Sustainability, in: SCOPE 1997, op. cit

[32] from an environmental point of view it is evident that such target must include all materials, land and energy used, including e.g. overburden from mining as material used and the land used for the production of imported products as elaborated in F. Schmidt-Bleek, 1997, op.cit.

[33] for energy and material, as globally traded commodities, the reference area is the global scale. Land use is considered a continental issue, so trade in land use products should be balanced between continents to achieve equal distribution.

[34] M. Carley, Ph.Spapens, Fair Shares of Environmental Space, London 1997 (i.pr.)

[35] The most detailed description of the methodology in English is given in Spangenberg, J.H., Material Flow Based Indicators, op. cit; for the micro-level adaptation of the indicator systems see below.

[36] See S.Böge in J.H. Spangenberg (Ed.) 1995, op. cit.

[37] Although setting limits to the depletion of the natural capital is in theory a useful description of the limits to human impacts on the environment, since natural capital from its very character is not measurable, this term cannot be made operational. See F. Hinterberger et al.,1995, 1996, op. cit.

[38] Scheringer, M., Operationalisierung von Gerechtigkeitsprinzipien durch die Indikatoren räumliche und zeitliche Reichweite am Beispiel Umweltchemikalien, Discussion Paper, ETH Zuerich 1997
Scheringer, M., Persistence and spatial range as endpoints of an exposure-based assessment of organic chemicals, in: Environmental Science and Technology 30(5) 1996

[39] Berg, M. Scheringer, M., Problems in environmental risk assessment and the need for proxy measures, in: Fresenius Environmental Bulletin 3(8) 1994

40 Lehni, M., World Business Council for Sustainable Development WBCSD, pers com., Bruxelles 1998

[41] See e.g.: Seidel, E., op. cit.

[42] Enquete Commission "Schutz des Menschen und der Umwelt", Nachhaltigkeitskonzepte in der Wirtschaft (business concepts for sustainability), Bonn 1996

[43] Gouzee, N.; Mazijn, B.; Billharz, S., Indicators of Sustainable Development for Decision-Making", report on the workshop of Ghent, Federal Planning Office of Belgium, Brussels 1995

[44] See Welfens M.J., De-materialisation Strategies and Systems of National Accounts, in: Fresenius Environmental Bulletin, August 1993

[45] The stress is put here on producing means and not on material investments made to earn an appreciation like in the housing market. "Depreciation" represents the difference between purchase costs and selling value (+/- variation of the discount rate of capital).

[46] See: Seidel, E. (1994): op.cit., p. 151-152.

47 Lehni, M., World Business Council for Sustainable Development WBCSD, pers com., Brussels 1998

[48] We welcome the efforts e.g. of the WBCSD and its member firms to develop systems of sustainability indicators including all dimensions of sustainability, and in particular as communicatable management instruments to achieve a performance beyond legislation. Nonetheless, these are first steps, yet far from applicability, let alone broad application. The same holds true for efforts in environmental benchmarking (e.g. J. Elkington, SustainAbility/UNEP), ranking (e.g. A. Chesson, Eco-Ranking, CH; M.Braungart, EPEA-Institut, D) and social indicators (A.MacGillivray, New Economics Foundation, UK).

[49] "Ecological rucksack"= sum of all material inputs from "from cradle to grave" needed to obtain a good, minus the weight of the good. In the following paragraph, we signalise with the term "resource productivity" (instead of material productivity) that we consider the whole environmental life-cycle of goods (i.e. included ecological rucksacks). See Schmidt-Bleek, F. 1997, op. cit.

[50] Ecotoxicological and health concerns are not covered by this approach, since they are covered - as far as they are known - by existing legislation including the precautionary principle. Here we propose "measures beyond obligations" as an element for a sustainable management strategy.

[51] It is from very importance to consider the total MI of the production and not of a product: reducing MI per product unit is a nonsense if firms arise their level of production, inducing by this way (over)compensation effects. It is to underline that these effects, called "rebound effects", are induced, in a large part, from economic / monetary interests. See e.g. ECN; Musters, A.P.A., The Energy-Economy-Environment interaction an the rebound-effect, ECN-I--94-053, 1995 or CEA, Mens&Ruimte, Wuppertal Institute, Rebound Effects on Energy Saving Programs, SAVE-Program, Intermediate report. 09/1996.

[52] See: Schmidt-Bleek, F. et al., Handbuch zur Materialintensitätsanalyse (Handbook for Material Flow Analysis), Wuppertal 1998 (i.pr.)

[53] Here, the expression "land use" should understood not only in an agricultural context but also for e.g. area of land used for stocking products into firms or supermarkets (an indicator of land use could be: marketable goods / area in m2).

[54] The material intensity of services, called Material Input per Unit of Service represents the amount of resources, from cradle to grave, used to deliver one service unit of end use (e.g. providing an insurance contract, providing a home page on the internet, etc.). This indicator stresses the welfare delivered to the economy by a good. It is particularly required for analysing allocative resource efficiency. For corporate assessment, it can be linked to economic performance (kg/ECU).
See: Schmidt-Bleek F. et al 1996, op. cit.

[55] Here, the expression "land use" should understood not only in an agricultural context but also for e.g. area of land used for producing, stocking and selling products, as the public infrastructure used.

[56] ceteris paribus, i.e. assuming that no rebound effects occur which could moderate or even compensate the efficiency gains by inducing a growth in total demand / consumption.

[57] Means for delinking can be:
- eco-efficient products and services
- process, product and social innovations
- cross-approach of human resources
See e.g.: Bierter, W.; Stahel, W. R.; Schmidt-Bleek, F., Öko-intelligente Produkte, Dientleistungen und Arbeit, Wuppertal Spezial 2. Wuppertal Institut für Klima, Umwelt, Energie GmbH and Institut de la Durée, Genf/Giebenach, 1996
Schmidt-Bleek, F., Tischner, U., Produktentwicklung: Nutzen gestalten - Natur schonen, Wirtschafts-förderungsinstitut der Wirtschaftskammer Österreich, Wien 1995

[58] Of course a drop of returns can be stopped by an increase of prices but a such strategy seems to be unrealistic since it would influence negatively firm's competitiveness.

[59] (t) symbolises the starting time of the comparison. (tx) symbolises a period of time from (t) to (x). For example if the scale elasticity is equal to 2, a reduction of resource consumption about 30%, whose origins could legal but politic too , would induce a reduction of 60% of firm's returns.

[60] See o.a. Etude du Centre de Prospective et d'Evaluation, Essai sur l'investissement industriel, n° 71/1986. Gaffard, J.L., Innovations et changements structurels, Revue d'Economie Politique, n°3/1990, p.325-382.

[61] See: Fire and forget ?, Economist, April 20th, 1996, And now: upsizing, Economist June 8th, 1996

[62] G. Scherhorn points out that the traditional "Contract Social" of the Fordist societies is no longer kept by the employers, with the consequence of undermining employee's long term labour market opportunities. See: Scherhorn, G., Wird die fordistische Gesellschaft aufgekündigt?, presentation given at the annual congress of the Science Centre North-Rhine Westphalia, Wuppertal, September 1996.

[63] van Dieren, W., Taking Nature into Account, Basel/Boston 1995, p. 121.

[64] They are today as well the two key levels decisive for a company's as well as a country's competitiveness, see e.g. D. Messner, Building innovation networks and promoting technological capacity building, in: Science, Technology and Development 13/2, 1995

[65] Friends of the Earth England, Wales and Northern Ireland, Working Future? Jobs and the Environment, London 1994

[66] in particular for the EU regional policies. However, the indicators developed so far by DG XVI show only few linkages to other European (EEA, DG XI, Eurostat) or international work (CSD, UNDP).

[67] Including the „Changing Consumption and Production Patterns“ Program CCPP, which issued its latest proposal in Feb. 1998

[68] The Roundtable Discussions of UNEP1995, documented in UNEP/ROE (Ed.), Roundtable Discussion on Sustainable Production and Consumption in Europe, Geneva 1997, similar expert work of UN-ECE 1995 and EEA 1996 (see CEAT (Ed.), Report, Roundtable on Sustainability Indicators at the EEA, Brussels 1996) or the CSD-inspired Meetings in Ghent 1996/1997, Prague, Vienna and New York 1998 are promising, but seem to be insufficient.

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