APPROACHING AND MEASURING SUSTAINABILITY

Prof. Dr. F. Schmidt-Bleek
President, Factor 10 Institute in Carnoules/Provence
Founding President, The International Factor 10 Club
Chair, The Future Council, North Rhine Westphalia
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Without dematerialization,
neither sustainability
nor long-term growth
should be expected

Where We Stand

The principle of sustainable development has now been widely adopted. It has also become international consensus that sustainable solutions require that ecological, social and economic development be made mutually supportive at the front-end of the cycle when the goals and policies of society are being set, not at the tail-end after society and the economy has already incurred the damage costs of unsustainable development. However, in the political arena and in business one still notices serious shortcomings in applying this principle.

Political reasons for this shortcoming include the lack of experience in scrutinizing policies with respect to the requirement of satisfying all dimensions of sustainability. While it is common procedure for example to review all intended ordinances and laws with regard to their financial and legal implications before they are promulgated, this is not the case as regards their impact upon attaining sustainability. Thus, recent changes in fiscal and social policies in Germany and France - considered to be of basic importance for economic long-term growth - were designed without regard to their ecological implications. The lack of operational indicators for designing durable policies and monitoring their consequences is evident.

On the *scientific* side, no consensus on *key social goals* exists today. While it may be rather unrealistic to expect that globally harmonized social goals can be agreed upon in the foreseeable future, it would seem feasible to reach understanding of social targets on the national or regional level. The EU is currently attempting to develop a minimum set of key social indicators for the Member countries.

With respect to the *root* causes for *human-induced environmental changes* it is only recent that international agreement emerges on the key importance of the resource productivity of *all* goods and *all* services **1**. However, it is still preferred practice to select certain human generated effects on specific parts of the environment (such as climatic

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1 F. Schmidt-Bleek, "Toward Universal Ecology Disturbance Measures", Regulatory, Toxicology And Pharmacology, Vol 18, No. 3., Acadmic Press Inc., Dezember 1993 (The Wuppertal Position Paper, Mid-1992, in a translated form).

change, waldsterben or water quality) as pilot indicators for the presumed *overall* influence of technology on the ecosystem. It is unavoidable that such selected indicators reflect primarily regional priorities and that they change over time (from lead to asbestos to PCB's to CFC's to CO2). As a consequence, controlling the output side of the economy is still prevalent. Apart from the fact that the economy pays a heavy price for this non-predictable approach, it does not lead to ecological sustainability for theoretical as well as practical reasons [2].

Five Dilemmas

1. There is overwhelming evidence and wide agreement in a number of large industrial countries that the public budget situation is catastrophic and completely unsustainable in view of known future social, economic and ecological needs [3]. The same can be said for lesser economic players in Europe and elsewhere [4]. Heavy overspending since many years, subsidies to the tune of more than 100 billion Euros per annum in Germany alone, demographic developments, shifting the medium age of the population inexorably upward while the total population decreases, a declining labour force that continues to be taxed for supplying the overwhelming part of the public budget needs, and increasing costs for unemployment, public health as well as for combating mounting environmental problems are some of the major reasons for this dilemma.
2. One of the major stumbling blocks for progress toward sustainability today is the growing realization that it is not sufficient to adjust the economic and fiscal framework in little steps as has been the practice hitherto when problems arose. It is rather becoming evident that only *profound* (paradigmatic) policy changes will open the road to sustainability. Such an undertaking is obviously risky in political terms within the confines for democratically elected governments. This is plainly visible in Germany and France today even when only relatively minor fiscal adjustments are being attempted. While the public is aware of the need to change the framework drastically, citizens have apparently lost faith in their leaders to bring about change in a fair and reliable way.
3. The root cause for the growing *ecological problems* is the excessive use of natural resources, including energy carriers, land and water [5]. Today's resource productivity of technology requires roughly 30 tons of non-renewable nature on the average for every ton of product - and 5 to 15 times that much water. A dismal performance. But ITC (Information and Communication Technology) consumes even ten times more non-renewable resources on a ton per ton basis. Since all

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2 F. Schmidt-Bleek, "Wieviel Umwqelt braucht der Mensch – MIPS, das Mass fuer oekologisches Wirtschaften", Basel, Berlin, Boston, 1983 (English in www.factor10-institute.org under the title "The Fossil Makers)

3 See, for instance, Report (in German) by the Future Council of the state of Northrhine-Westfalia, March 2004, Dusseldorf. To be published in English in 2004

4 See, for instance, H. Wohlmeyer (Austria): "Strategische Steuerreform und nachhaltige Naturbewirtschaftung", to be published, h.wohlmeyer@pvg.at

5 Schmidt-Bleek and Coworkers,: The unfolding of the Factor 10- and MIPS- story *(in English)* at the Wuppertal Institute, Special Issue of the Fresenius Environmental Bulletin, Birkhaeuser, August 1993.

services require the availability of increasingly complicated and interlinked technology - even when rendered from person to person – delivering modern services is extremely resource intensive, too. On the average, every European consumes 70 tons of non-renewable natural resources per annum (while the average Vietnamese consumes between 3 and 4 tons). The massive replacement of human labour by machines and ITC in all parts of the economy contributes to this consumption.

4. Prizes govern economic choices. Today, prizes of natural resources are distorted through tax systems, perverse subsidies, historical cost-free extraction- and use rights and other politically motivated priorities [6]. As a consequence the market is in disarray and leads to massive misallocation of natural resources. The market dis-functions as regards preserving life-sustaining environmental services while it stutters along within the economic framework conditions of yesteryear [7].
5. More than two planets earth would be needed for providing the natural resources necessary to allow a western life style for the whole world. On the one hand such a development would eventually push the price of natural resources upwards and thus slow down their use, even though some rich and powerful countries may still continue to subsidize (and/or fight wars for) the exploitation and use of energy carriers and other resources for a while. On the other hand, it seems very likely that price hikes do to scarcity would be felt far too late to stop and reverse ecological destruction. It is furthermore quite unlikely that resource prices would climb in tune with their "*ecological rucksack"* [8], that is in tune with their respective resource intensity.

Approaching Sustainability

Governments

Incomes and salaries must be freed
from taxes and other overheads
before the reduction of unemployment
to socially acceptable levels
can be achieved In Germany
and other industrialised countries.

According to a recent report to the government of Northrhine-Westphalia [9] by its *Future Council*, the existing tax and levy-system in Germany steers the economy in the

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6 Schmidt-Bleek, "Das MIPS-Konzept – Faktor 10" Droemer, Munich 1998. Franz Lehner and F. Schmidt-Bleek, "Die Wachstumsmaschine – Der oekonomische Charm der Oekologie", Droemer, Munich 2000

7 See Recommendations and Statements of the International Factor 10 Club, www.factor10-institute.org .

8 The Ecological Rucksack has been introduced by Schmidt-Bleek in 1993 and is defined as the sum total inputs of natural resources needed to produce a good in kg minus the weight (mass) of the good in kg.

9 Report "NRW 2015 – Ressourcen nutzen, Regionen staerken", (in German) by the Future Council of the state of Northrhine-Westfalia (NRW), March 2004, Dusseldorf. To be published in English in 2004 Northrhine-Westfalia includes the most densely industrialized part of Germany, the Ruhr District. With 18 Million inhabitants, NRW is one of the bigger "countries" of the EU.

wrong direction. The Council recommended to reduce spending within the present budget by at least 15% in order to regain the freedom for financing urgent new needs.

The existing levy and tax system, so the Council argued, distributes the various burdens of wealth production inefficiently and it is unjust. The overall current cost-structure in the manufacturing sector is approximately 70% for labour, 25 % for capital and 5 % for energy. On the other hand, studies in the USA, Japan and Germany have shown that the added value in industry is affected to the same extent by a one percent increase in energy input as by increasing the inputs of capital and labour one percent each. In other words, labour is too expensive when considering its contribution to productivity whereas energy is - relatively speaking - under-priced.

Under such conditions it is entirely rational when jobs are being eliminated, in particular because the expenditures for the social security system depend almost entirely on labour. The labour market becomes de-coupled from growth with the consequence of decreasing tax revenues while social expenditures rise at the same time. It is thus necessary to adjust the optimal input of natural resources for wealth creation. The economically rational mix for the input of labour, capital and material/energy must be shifted toward more work while reducing the input of natural resources.

It is no surprise therefore that a pervasive unemployment problem exists in traditional industrialized countries. In Germany, unemployment has increased continuously since the early 1960ies in a step-like fashion [10]. Officially it hovers now around 10% and emerges as the main reason for the lack of adequate funds for paying pensions in the future as well as adequate public services like education and public health.

> Growth without dematerialization is unsustainable for a long time to come. The rate of dematerialization must be more than twice that of growth measured in GDP.

The findings of the *Future Council* strengthen the arguments of earlier publications **[11] [12] [13] [14]**.

The absolute total yearly material flow (TMF) through most European countries - including the ecological rucksack of all materials - has been more or less steady since the early 90ies in spite of a noticeable trend toward higher resource productivity in terms of GDP/TMF. In Germany for instance, resource productivity increased by 21.8% from 1994 to 2001, while the GDP rose by 11.9%.

I should like to remind the reader that much of the existing environmental legislation has created a situation that is in fact akin to a planned economy with respect of environment protection. It causes non-marked driven costs by the hundreds of billions of

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[10] F. Schmidt-Bleek, "Das MIPS-Konzept – Faktor 10" Knaur, Muenchen, 1998, Page 203

[11] F. Schmidt-Bleek, "Wieviel Umwelt braucht der Mensch – MIPS, das Mass fuer oekologisches Wirtschaften", Birkhaeuser, Basel, 1993 (English under the title "The Fossil Makers" in www.factor10-institute.org), translated into Japanese, Chinese, and Finnish

[12] Recommendations and Statements by the International Factor 10 Club since 1994 (see in www.factor10-institute.org)

[13] F. Schmidt-Bleek, with M. Lettenmeier and C. Nettersheim, "Der Oekologische Rucksack – Wirtschaften fuer eine Zukunft mit Zukunft", Hirzel, Stuttgart, 2004

[14] Yannis Paleocrassas, "Fiscal Reform – Resource Productivity and Employment", Chapter II in F. Schmidt-Bleek et al "The International Factor 10 Club's Report of 1999, Institut fuer Arbeit und Technik, Gelsenkirchen, 1999-10

Euro every year. Moreover, such a legislative approach cannot lead to sustainability because it is basically not precautionary, because only “rich” countries can afford the ensuing costs and it does not reward a decreasing consumption of nature. Altogether it may even increase overall resource use because it requires much investment in hardware, energy for running equipment and for re-cycling as well as for transporting wastes. It would seem worth analysing the resource flows put in motion by environment protection legislation since 1972.

In 2001 President Bush has made it clear that the USA is not willing to follow the path of ordering emission restrictions any longer. He withdrew from the Kyoto Protocol. Unfortunately no action followed to improve the dismal ecological performance of the United States. Increasing the costs of resources before their use would put the cost of environmental protection squarely into the allocation mechanism of the market and it would reward superior ecological performance throughout the value added and consumption chain.

In some European countries “eco-taxes” have been imposed, for instance on gasoline in Germany. So far these taxes or levies are far too timid for either stabilizing the fiscal disarray or stopping the trend toward un-sustainability. The word “eco-tax” is often perceived by the public to hide the real intent: Imposing additional taxes under the pretext of protecting the environment. I am quite certain that no German government will attempt again to impose resource taxes under the label “eco”. When predicting this development in 1995, a very prominent green in Germany got very angry. It seemed as if the word “eco” in conjunction with “taxes” was vital for her self-respect. Perhaps one should call a future tax-shift from labour to natural resources a *“job-creation-tax”.* The public could then observe the results itself.

When shifting taxation to natural resources in Europe, energy carriers, land–use, water, wood, copper, aluminium, silver, gold, sand, gravel and limestone could be attractive choices. Resource taxes can and should be imposed in socially responsible ways. Water- energy- and land-use being subject to routine use monitoring procedures even today, cost exemptions up to certain levels of consumption could be awarded to the needy. In order to avoid surprises, a great deal of focused research is urgently necessary for identifying adequate taxation targets, levels and procedures. If exceptions from payment are necessary for protecting certain parts of the economy from short-term unacceptable consequences, exemptions should be strictly temporary.

The present situation is a vicious circle: The governments’ playing field on which to decide on precautionary expenditures and policies for the future is not only tilted, it becomes progressively smaller. And this situation will prevail until the government changes the relative price signals to the market for labour and natural resources.

Additionally, governments must lower subsidies noticeably, in particular those subsidies that encourage the consumption of natural resources. Since governments purchase some 20% of final goods and services in most countries, giving strong preference to dematerialised goods and services would be a powerful signal to manufacturing and trade for offering dematerialised solutions. Existing standards and norms need be reviewed, too, since hardly any of them were formulated with a view to the resource consumption they generate. This is particularly evident in the building sector, for traffic regulation and for food safety norms.

Only government can correct the currently unsustainable situation legally. It could also smoothen transition by offering training to SME’s for designing dematerialised goods and services. Corrective legal action should be considered in the fiscal, R&D and

educational system, in adjusting norms, standards, purchasing provisions and in other areas. As regards the increase of market prizes for goods and services in exchange for lowering the cost of labour, governments may face protracted international negotiations for defending non-tariff barriers to trade.

However, such reforms could stabilize public finances, create new jobs in a far more sustainable environ, boost innovation, assure long-term success on the world market, and enable government to harness market forces in support of a more rapid transition to an energy and resource efficient service economy.

In my mind, all governments have – sooner or later - little choice but following this path for assuring a future with a future for future generations. Experience tells us that necessary reforms, introduced in a timely manner, can save much money and yield advantages relative to those who did not act in time. I would expect this to be the case for the export of innovative and dematerialised goods, infrastructures and service systems.

Enterprises

The aim of eco-design is to provide
"service-delivery-machines" that consume
as little natural resources
from cradle to cradle as possible
while providing as many units
of extractable value as possible
for the longest possible period of time.

Only few firms are seriously engaged in pursuing truly long term strategies at this time by giving appropriate weight to all sustainability dimensions before making decisions. Usually such firms are global players.

According to an estimate by H. Fischer of ADLittle Berlin in 2001, more than 170 Billion Euro could be saved in Germany on an annual basis by a 25% dematerialization without lowering end use satisfaction. State revenue would increase by some 40 billion Euro annually during the same time period [15]. In addition, 700 000 new jobs could be created through such efforts, provided the resulting savings were not invested in wage increases [16].

In June 2001 a meeting was held in Tokyo, organized by NIKKEI, with the aim of convincing industry to take the lead in guiding the economy to a more sustainable future [17]. Representatives of global enterprises and opinion leaders agreed on a statement that reads in part*: **"**We, the participants, recognize that the present environmental destruction and resource depletion of the earth is undermining our economy and our future**"……** "We agree on the need for fundamental changes in our present economic systems, corporate activities, and lifestyles. Participating business and opinion leaders agree on the need for systemic change. This depends on corporations taking the leading role in changing the present trends, including the encouragement of governments to change the economic framework and incentive structures*." While the Japanese

15 H. Fischer, "Leute rausschmeissen kann jeder", DIE ZEIT, June 2001

16 Economist Prof. B. Meyer, University of Osnabrueck, private communication

17 "The Tokyo Statement", see www.factro10-institute.org

Government decided in 2001 to make Factor 10 [18] part of the strategic national planning, no comparable move has come to my attention from other countries.

In 2001 the Factor 10 Institute together with The Natural Step organization from Sweden, the Zero Emission Forum of the United Nations University in Tokyo, The United Nations Environment Program in Paris, The Dutch Sustainable Technology Program, The Thai Environment Ministry, and subsequently the German "Green Manufacturers Association" (B.A.U.M., Hamburg with some 1000 members), supported by the Aachener Foundation Kathy Beys, undertook an intensive effort to convince industry to shoulder the responsibility of convincing governments to begin restructuring the economy. This effort failed because of Lack of interest in industry. (see "Alliance for Global Eco-Structuring – AGES, Carnoules Appeal under www.factor10-institute.org).

> In our mind, one decisive part of reaching sustainability can be described with "more value on the market for less natural resources" and "solutions instead of products" (Carnoules Appeal 2001).

The Sustainable Asset Management group in Zuerich (SAM) has analysed several hundred stock-exchange-listed companies world-wide with respect to their respective CO^2 emission. Results were plotted against their performance on the stock market. It was found that those with relatively low emissions out-performed others by a considerable margin. The instrument developed by SAM for this comparison has been named the *Dow Jones Sustainability Index-DJSI.* While the results obtained by SAM are an encouraging message because they tend to show an important public awareness for environmental problems, the factual basis of the SAM-analysis would seem far too narrow to allow comparison as regards *sustainability* concerns in the private sector. It is no big surprise for instance that Swiss Re was found to be a top performer because Insurers, banks, as well as real estate agencies are not known to be big emitters of pollutants themselves. Their customers, however, may well be among important polluters and heavy consumers of resources. Since no harmonized criteria for selecting customers exist among insurance companies, banks, and real estate agencies, there is as yet no defensible basis to believe that DJSI can serve as a reliable yardstick for genuinely sustainable performance. Nevertheless, SAM has made an important novel contribution toward approaching sustainability in that it has begun establishing a measurable connection between environmental protection and market performance.

Hundreds of practical examples from industry have been recorded in Europe, Japan and in the USA that demonstrate that dramatically dematerialised technology and service systems can technically be achieved without loss of end-use satisfaction. However, marketing of such solutions remains frequently unsatisfactory because the public has as yet little notion of the interconnection between the resource intensity of gadgets and environmental problems. For instance, one single internet bank transfer typically causes as much non-renewable resource consumption as the production of 4 aluminium beer cans. And German electric current is 6 times more resource intensive than Finnish electricity, which means for instance that while the use of one-way plates,

18 The minimum dematerialization goal postulated by Schmidt-Bleek in 1992

forks and cups may be the ecological solution in Germany but not so in Finland [19]. Furthermore, marketing can be difficult due to the relative small price differences achievable compared to established technologies.

Today, very few people are systematically informed about the key importance of resource productivity. Standard school texts regularly fail to treat resource productivity as an important economic performance parameter And so far the mass media have not focused on this issue in depth, preferring to continue emphasising the effects of selected pollutants on the environment rather than the economic and political causes for the non-sustainability of our present wealth generation system.

One question remains puzzling: Why is it that enterprises operating under market-economic conditions rarely exhaust the potential to save resources – and thus money - during manufacturing and in the design and marketing of their products and services? I have given already one answer: today's cost pressure can best be relieved by throwing people out of work or by moving production to a low-wage country. This may well become an even more troublesome issue after the 10 candidate countries have joint the EU in May 2004.

Beyond this, however, standard book-keeping in industry does not normally include reporting the flow of natural resources in weight units. And since prices of raw materials, goods and services almost never reflect their respective resource intensity (their "ecological rucksack" [20]), manufacturers, traders and institutions rarely have any knowledge of the true resource turnover they generate. Most cannot therefore assess their saving potential for natural resources.

Fairness demands mentioning that some companies, in particular global players such as Cannon, have begun reporting yearly changes in social and economic matters as well as in resource flows under their control.

Resource Use

Production Sector

I have already mentioned that the average resource intensity of western industrial products today is about 30 kg of natural resources input per kg product. I have also pointed out that for ICT the figure are typically 10 to 20 times higher. These results are obtained when counting the resource input from "cradle to finished product" and refer to *non-renewable* natural resources only. The overall consumption of *water* tends to be in the hundreds of kg/kg product.

Since no services are rendered anymore in modern societies without the support of a multitude of manufactured goods and interconnected infrastructures, the resource

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[19] F. Schmidt-Bleek, with M. Lettenmeier and C. Nettersheim, "Der Oekologische Rucksack – Wirtschaften fuer eine Zukunft mit Zukunft", Hirzel, Stuttgart, 2004

[20] F. Schmidt-Bl;eek, "Das MIPS Konzept – Faktor 10", Muenchen, 1998

consumption of services can be very high also. Withdrawing cash from an automatic bank teller for instance, while saving labour, is an altogether extremely resource intensive affair. It is a typical case of replacing labour by natural resource investment for the sake of profit maximization. And it is obvious that flying to a far-away land for vacation causes very high resource consumption as well.

A number of training methods have been worked out for industry, in particular for SME's, small and medium enterprises, to reduce resource consumption [21]. Help is also available in this respect from such institutions as the Efficiency Agency and the Energy Agency of Northrhine-Westfalia, the Wuppertal Institute in Germany, the University of Graz in Austria and the International Factor 10 Innovation Network (see www.factor10-institute.org). A new publication of the Wuppertal Institute details the calculation of the resource intensity of goods and services [22]. Information on rucksack factors for raw materials are available from www.aachen-foundation.de.

One recurring observation when computing the overall resource intensity of products is that it is their design and their specific resource consumption during use that far outweigh the resource consumption during manufacturing. This contrasts considerably with the focus of much existing environmental regulation. It also puts into question the enormous efforts made and costs incurred when reducing industrial emissions and increasing re-cycling rates (e.g. the "green point") rather than lowering the resource input at the front end of the economic cycle.

Population and Consumption

There are at least three major reasons why the consumption of natural resources is still rising steeply on our planet, moving us further and further away from sustainable conditions.

First, the global population is still increasing. Best estimates indicate that 30 to 40 % more people will be alive and live longer by the end of the present century than at its beginning.

Second, the economically emerging countries are still far less resource intensive on a *per capita* basis than the average OECD country (factor 5 to 30). Simultaneously many show very high economic growth rates. Western life style, beamed into most households world-wide by relentless advertisement on TV, is the desired future of a large majority of people, particularly in very poor countries. Anybody who has observed the change in density of mopeds during the last few years in countries like Vietnam or Indonesia can testify to a very fast materialization of life styles.

Thirdly, the trend toward living as "singles" in traditionally industrialized countries is pervasive. In cities like Cologne or Stockholm, households of "singles" are said to have reached more than 50 %. Estimates indicate that the resource consumption of singles in Europe exceed that of freshly born children in African countries typically by a factor of 50 to 100.

It is considerations such as these, together with the need to dematerialise the global economy by at least a factor 2 even at present overall resource consumption that has

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21 See, for instance publications by the Austrian Chamber of Commerce (Wirtschaftskammer/WIFI) No 270 and 303.

22 M. Ritthof et. al., "Calculating MIPS – Resource productivity of products and services", Wuppertal Special N0. 27.

lead me to postulate the “Factor 10” as a minimum requirement for approaching ecological sustainability in 1992 **23**.

Seven
Strategic Goals
For Reaching Sustainability

I consider the following 7 goals of strategic importance for reaching sustainability:

- Defending and respecting the needs and dignity of *all* people
- Increasing the well-being of *all* human beings
- Assuring justice and free speech for all
- Encouraging self-responsibility and entrepreneurship
- Maximizing resource productivity (land, material, energy)
- Avoiding all wastes, not only over-use of nature
- Minimizing the handling and emission of dangerous substances

Competences For Tomorrow

The following key-competences should be taught as early as possible to children in all countries so that people can effectively contribute toward approaching sustainability:

Social Competence
The capacity to respect the dignity and needs of all live on earth
Competence to learn
The ability to perform independent studies and evaluate results by one-self
Systems competence
The capacity to discern and take into consideration interdependencies, time sequences and limitations when creating new options
Innovation competence
The ability to convert experience and knowledge into novel solutions within existing conditions
Communication competence
The ability to present and communicate even complex interconnections in generally understandable terms – even in a foreign language
The ability to participate actively in constructive dialogues
Economic competence
The ability to increase wealth through market forces, respecting ecological, economic and social needs
Decision competence

23 F. Schmidt-Bleek.: "Eco-Restructuring The Economies Of The Former COMECON Countries", Fresenius Environm. Bull.1, 1992 and many subsequent oublications and books.

The ability to give fair consideration to ecological, social, cultural and economic consequence before reaching a decision

Productivity competence

The ability to meet needs and develop capacities with the least possible waste and the ability to generate utility in the most cost effective fashion with the least amount of natural resources, capital and labour

Measuring Sustainability

What cannot be measured, cannot be managed
OECD, 1998

At the beginning of this article I noted that it has become international consensus that sustainable solutions require the simultaneous and even-handed consideration of ecological, social as well as economic expectations and needs.

In other words, unless a suitable mix of inter-connectible indicators is applied to guide policies in accordance with the above-mentioned strategic goals, approaching sustainability will continue to be a rather elusive undertaking. And in view of the fact that all human commerce depends and happens on one planet, such sets of indices should be internationally acknowledged and – to the extent possible – they should be internationally harmonised.

Here follow my suggestions for the properties of useful indicators:

Requirements for indicators
- They should be few in numbers to be useful in decision making - They should be compatible with striving for a sustainable economy - They should reflect *key targets* for social, ecological and economic development - They should apply to the needs of all people and be valid for all products and services - They must be measurable or calculable - They should be based on «cradle to the grave» (life-cycle-wide) analyses - Their application should be cost-effective and yield reproducible, timely and directionally safe answers - They should be applicable to all levels: locally, regionally and globally

Indicators For Preserving The Services of the Ecosphere (Environment)

The enormous dislodging and use of natural resources, comprising natural materials and land, has been widely accepted as a *root cause* for human-induced *environmental*

changes [24]. The material input per unit extractable value or service, MIPS, and the land-use per unit extractable value or service, FIPS, are consequently used as basic indicators for a first life-cycle-wide evaluation of the ecological impact potential of goods and services. On the macro level, the indicator TMF the total yearly material flow, has already been introduced into the German and European statistics **25**.

Raw materials are assigned a "rucksack factor" (or MI-factor) that is the total amount of natural material displaced in kg to produce one kg of raw material. "Rucksack factors" are intensity factors and could be looked upon as a new kind of material property that should be taken into account when constructing goods. Typical "rucksack factors" in terms of non-renewable natural material are: Bamboo 1.01, Plastics 3-8, iron 7, steel 8 - 20, aluminium 85, copper 500, and gold 500 000. Many can be found in the internet under **www.wupperinst.org/projekte/mipsonline**.

The Aachen Foundation Kathy Beys has agreed in November 2003 to collect all available MI-factors in the future and put them on its web site. With MI-factors, the composite rucksacks of complex products can be computed, so long as the compositions of the product - as well as the quantities of wastes during its production - are known. Having the rucksacks of goods in hand, the rucksacks of services generated with these goods can also be calculated.

Virtually all prices quoted for goods on the market are *"prices at the point of sale"*. Such prices rarely allow end-users to asses the real value of goods since the overall costs per unit extractable value (such as for driving a car for 1 km or for cleaning 5 kg of cloth with a washing machine) cannot be deduced. I have therefore suggested to replace the present pricing system with COPS, the *Cost Per unit Service* **26**. The price of services such as using a taxi or obtaining a haircut are traditionally given in COPS. For me it is difficult to imagine a functioning service economy without stating the prices for goods *and* services in terms of COPS.

Other indicators for the protection of the ecosphere are included in the attached table.

Indicators
For Social Cohesion

During the deliberations of the above-mentioned *"Future Council",* some social goals were identified. They include the availability of all-day *"family centres"* where sick and working parents would find help, including the care for children starting with 3 years of age. Basic skills in reading and handling numbers would be taught as well as the foundation of at least one foreign language. A related target is increasing the birth rate of women from 1.3 to 1.9 in Germany. In order to improve the *"life-time economy"* of young people, high school should be finished at 17 and university education by the age of 23

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[24] The use of energy as such is environmentally of little consequence. It is the overall material intensity of the energy at the point of use - and the material consequences of its use - that count most.

[25] F. Schmidt-Bleek introduced these measures in 1992 and has since published many books and papers on their use and computation. Among his former co-workers at the Wuppertal Institut, Stefan Bringezu, Fritz Hinterberger, Christa Liedtke, Joachim Spangenberg and Hartmut Stiller (and and their co-workers) have published many treaties in this area since 1993.

[26] F. Schmidt-Bleek, "Wieviel Umwelt braucht der Mensch – MIPS, das Mass fuer oekologisches Wirtschaften", Birkhaeuser, Basel, 1993

(present figures are considerably higher). The performance of Social services would be shifted on a voluntary basis to those who have left active employment.

Other indicators for social cohesion are included in the attached table.

Indicators
For A Stable Economy

Most economic experts, politicians and the public media seem to be content to continue using GDP (or GNP) as an all-embracing *measure for economic growth* and they frequently seem to imply that it also is a measure for the welfare of people. However, this index cannot possibly measure the quality of life of people since it does not give information of average income, social justice conditions, the breakdown of environmental services, cultural achievements, institutional appropriateness, democratic conditions and other factors contributing to human survival on this planet,.

> In my view, the continued failure to seriously consider factors other than increasing money flows and optimising financial gains is at the heart of the non-sustainability of present human activities. GNP and GDP are measures that are open-ended, that is, no limits of the presently resource-intensive growth are considered. From a scientific point of view this is not a justifiable assumption because the planet earth is a limited system and the only natural resource base we have. This is why Factor 10 demands replacing resource use by innovation *("Replace the use of mass and space with brain").*
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> However, since satisfying most all human needs requires at least *some* resource input (material, energy, space), Factor 10 is essentially a mechanism for gaining time in finding truly sustainable conditions for human survival. Increasing world population and growing individual resource consumption (singles!) shorten the time available for necessary change.

There have been noticeable efforts to expand GDP to include social and ecological requirements **27**. However, it seems to me that the interdependences and interactions of various non-linear complex systems cannot adequately be captured by a single indicator.

Instead, small sets of "*key (or headline) indicators"* could be agreed to for the three dimensions of sustainability, together with a set of coherent "*interlinkage indicators"*.

The following table contains such sets without claim to completeness or best choices.

27 Wouter van Bieren, Ed., "Taking Nature into Account", Copernicus, 1995

Possible Headline and Interlinkage Indicators
For Approaching Sustainability

Headline Indicators

Headline Indicators
Ecosphere

Resource Productivity	TMF [28] in tons/year (including rucksacks)
	Total Yearly Energy Use (in Tons/GDP) **[29]**
	MIPS for a basked of products
	MIPS for a basked of services
	MIPS for national energy mix
Total waste [30]	kg/person-year
Land use	yearly increase/decrease of commercially used area in km^2/km^2 total area
Natural Habitat	% un-used Land left in areas no smaller than 10 km2 (according to protection targets, e.g. IUCN IV)
Emission of green house gases	Total tons of CO2 equivalent/year
Change in Biodiversity [31]	
Introduction of GMO's [32]	

Headline Indicators
Social Cohesion

Total Population (females/males)	
Population Density	Inhabitants per km2
% of inhabitants with less than 60% of the median-equivalised income	
Health insurance	
Yearly for total population over 18	
Long term unemployment rate	
Percent of "3-17-23", see text	
Master Degrees in Science and Engineering	In % of population
Expenditure for R&D	In % of public budget
Patents	Number per year

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[28] Annual Total Material Flow (incl. rucksacks)

[29] Energy use stated in energy units is of little help as the environmental impact potential of solar energy and electricity depends strongly on their respective material intensity (MIPS)

[30] The waste from all exit points of human activities should be considered throughout the value added chain, starting with mine spoils and ending with disposal sites of household waste

[31] Biodiversity is without a doubt a very important environmental target issue. However, in spite of a great deal of scientific effort, no useful indicator has been developed as yet (and it would seem likely to stay that way for a number of reasons). TMF, land uses and land fragmentation can be taken as "stand-ins".

[32] GMO = Genetically modified Organisms

Headline Indicators
Economic System

GDP in PPS [33]
Inflation rate [34]
Net national debt
Price/food basket [35]
Price/service basket
Total yearly subsidies

Interlinkage Indicators

Ecological/Social Dimension

TMF [36] [37] for basket of products
TMF/food basket
TMF/for transport system (Persons and freight)
TMF/for health care
TMF/Area sealed

Ecological/economic

TMF for all statistical sectors
TMF/GDP
Tax and levies on capital, savings, labour, natural resources
Subsidies for natural resources

Social/Economic

Income distribution in IQR [38]
Debt/inhabitant of residency town
Public and total expenditures for education/person
Age pyramid

33 Purchasing Power Standard

34 Yearly change in "Harmonized Index of Consumer Price"

35 Same selection as under ecological indicators

36 TMF = Total Material Requirement with ecological rucksacks

37 Oekologischer Rucksack = Overall input of natural resources for the production of a good in kg minus the weight of the good itself in kg.

38 Income Qintile Ratio

Outlook

Neither social nor economic or environmental pressures are as yet sufficient to force political leaders – and the vast majority of business leaders as well - to take the risk of replacing “business as usual” with changing their priorities in the direction of preserving our planet earth as a good place to live for generations to come.

Current concern with international terrorism and globalisation deflect the debate. Wars for securing resources and power (e.g. the Falkland "Conflict" and the US ”counter terror” invasion of Iraq and of Russia in the Caucasus region) are far more costly than setting the development of resource-saving developments in motion. The material input into the war in Iraq alone would have sufficed to build housing for 1 billion people. If as much money would be spent today on generating economically sensible sustainability options and feeding the hungry as is being spent for arms and on exploring the chances for men to live on another planet, we would not need worrying too much about losing the viability of the only planet we will ever have.

And yet there is hope. When I compare the number of people who participate today constructively in the debate on sustainability with the few in the early 90ies and when I compare the level of care in enterprises then and now, I feel encouraged. I wish that scientists would concentrate more on systemic solutions for our dilemmas and use their influence for convincing politicians to act more for the benefit of future generations. This applies particularly to my colleagues trained in economic matters and who have the privilege to advise governments, politicians and international organisations.

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