Presentation
F. Schmidt-Bleak
"Sustainability Made In Germany"

Evolution of Knowledge for Collaborative Sustainability
Putting Resources to Work
F. Schmidt-Bleak

While humans cannot create matter,
They can create value

Tsunesaburo Makiguchi
"The Geography of Human Life", 1903

BY WAY OF INTRODUCTION

The planet earth is still a wonderful place to live. Chances are still realistic for offering sufficient food to all human beings, health, shelter, conveniences and security. Meaningful work could be plentiful. Innovation can underpin a good life for *homo sapiens* far into the future. Win-win solutions have been identified to stop the ecological demise – imbedded in a strengthened market and without telling people what they should enjoy and what not. Industry can and should play a leading role in re-directing our course, not the least for ascertaining its own sustainable future.

But for the time being we continue to move in the wrong direction [1].

Technology moves more materials on the earth's surface than geological forces for activities such as transportation, excavation, mining, plowing, and construction. Catching up with current western standards of material wealth will not be possible for all people on this earth simply because there are not sufficient resources available on our planet earth. We would need at least one additional planet like the one we have.

[1] F. Schmidt-Bleek, Wuppertal Institut Position Paper, "Toward Universal Ecology Disturbance Measures", 1992. F. Schmidt-Bleek, "Wieviel Umwelt braucht der Mensch – MIPS, das Mass fuer oekogischesWirtschaften" Birkhaeuser, 1994, English: "The Fossil Makers", can be downloaded from www.factor10-institute.org, Japanese translation: Springer Tokyo (fourth edition), Chinese and Finnish translations have also been published in book form. F. Schmidt-Bleak, "Der Oekologische Rucksack – Wirtschaften fuer eine Zukunft mit Zukunft" (The ecological rucksack – for an economy with future), Hirzel, 2004, Japanese edition in November 2005.

But even the current use of natural resources has already severely compromised the cost-free life sustaining services of the ecosphere. Among these we count the provision of clean air and water, the climate moderating influence by the Gulf Stream, the balance between surface and ground water on the continents, the curtailing of diseases of plants and animals, the re-generation of soils, the development and survival of species, the productivity of seeds and sperm, and the maintenance of climatic conditions suitable to our ways of life.

Before reminding the reader of some of the more noteworthy current environmental problems, I wish to recall the difference between *feelings* of doom on the one hand and *warnings* on the other as described by Arthur Koestler in his wonderful book *"The Call Girls"* in 1972:

> *„About feelings of gloom and warnings of doom. These two attitudes must not be confused. A warning serves a preventive, a positive purpose. A warning must be life affirming. The geese on the Capitol were not gloomy, Cassandra was. So the geese succeeded with their warning and Cassandra did not".*

Climatic changes are now a reality. Shortages of potable water are on the rise. Deserts are expanding. Rain forests, wetlands and many species yield to human developments. Fossil energy carriers and certain metals are becoming scarce; their increasing price disturbs our economies. While environmental changes are usually slow, chaotic sudden changes are always possible.

Scientists and the insurance industry agree that severity and incidence rates of natural disasters like flooding, taifuns, tornados and hurricanes have increased noticeably during the last few years, at least in part due to climatic changes. In order to indicate the depths of economic and social impacts associated with such events I will briefly recall some of the consequences of Hurricane **Katrina**, one of the hitherto most destructive catastrophes afflicting the USA in modern times.

Katrina affected an area equivalent in size to Great Britain when at the end of August 2005 it struck Louisiana and Mississippi. One week after Katrina, official sources estimated that the final death toll might be several thousand and re-construction costs might eventually amount to 200 billion US $. More than 50 billion $ were appropriated during the first 10 days for emergency measures. Beyond these highly publicized facts, the hurricane's consequences have also been felt in many parts of the commodity market **2**. For instance, damage to coffee stocks in the New Orleans

2 Financial Times, 3rd/4th September 2005

warehouses has sent coffee prices up 10 %. US timber prices rose more tan 17% during the first week after Katrina struck. It is also expected that the hurricane may affect the US grain market considerably because of damage to the New Orleans port installations where more than half of the US exports are being handled. The potential economic impact has caused a fall of the US $ and a rise in metal prices from gold to copper which are often seen as hedge against dollar movements. Copper reached a high of $ 3725 a ton on September 2nd, 2005. Tanker rates for carrying petrol from Europe to the US rose 60 % during this week because of tight fuel supplies in the US.

The most acute economic impact of **Katrina**, however, has been on the energy sector. Prices for oil, petrol products and natural gas have reached record heights, the US benchmark crude oil peaking at $ 70.85 per barrel. According to Deutsche Bank, the petrol costs have now reached about 5 % of the average disposable income in the US, with a considerably higher burden to low-income and fixed income households. Changing habits for purchasing and driving cars may well follow. Unlike consumers, refiners hardly felt the loss in petrol product output because they enjoyed windfall profit margins. The biggest impact on the energy market, however, may well be the fact that natural gas futures rose 20% a week after the storm. Unlike oil and petrol, there are no global emergency stockpiles of gas that could be shared with the US by other countries.

Two weeks after **Katrina**, hurricane **Rita** made landfall at about the same shoreline as **Katrina** did before. New Orleans was flooded again, though noticeably less than two weeks earlier. Millions of people had to be evacuated again.

Past environmental protection actions have not reversed the increasing trend of destroying the vital functions of the eco sphere that underpin all economies. Too many of the past environmental control measures are not anticipatory in nature. Material efficiency improvements are still not given the attention they deserve – even at potentially considerable profits to manufacturers and the national economy [3] [4].

Today, the average European consumes close to 75 tons of non-renewable nature per year, the average Japanese some 40 tons. A typical Vietnamese has less than four tons at his or her disposal. China and India are copying western life-styles

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3 VDI Nachrichten, 9th September 2005

4 Klaus Dosch, "Ressourcenproduktivitaet als Chance – Ein langfristiges Konjunkturprogramm fuer Deutschland" (Resource productivity as a chance – A long term economic program for Germany), Aachener Stiftung Kathy Beys, www.aachener-stiftung.de

successfully at great speed. But where should the developing world turn in the end when even two planets earth would not suffice to supply the natural resources for this kind of development? And what will the response of the traditionally rich countries be, once we get close to the limits? **5**

Sustainability in the making?

"Sustainable enterprise means combining economic success with environmental protection and social responsibility"

J. Hambrecht, CEO, BASF

The current economic mode and world trade prevent sustainability.

This is largely due to their focus on short-lived and resource intensive products as well as their enormous transportation intensity, instead of providing dematerialized services to people. The world economy must be guided in the direction of dematerialized consumption. Only by increasing the resource productivity of energy supplies, goods, processes and services dramatically will we have a chance for economic stability without moving ever further away from a future with future.

Gainful work must be available for all willing and able to work. And those incapable of helping themselves deserve our support and help. A courageous and significant *paradigm shift* is therefore required as regards social equity, our

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5 The reader may notice that I have not touched on the toxic and eco-toxic potential of man-made products. As I have discussed in several books earlier, the original approach to environmental and health protection was necessarily based on differing impact potential of emissions, effluents and wastes, all of which had caused acute health or environmental problems. Specific legal instruments have therefore been promulgated to regulate handling, release, marketing and labeling of hazardous substances. This is n o t possible for resource productivity which has to be improved through changes in the economic framework.
As there are ten thousands of chemically different emissions, emanating from millions of different sources, as there are ten thousands of products of chemical industry on the market, as there are dozens of basically different ways for a substance to interfere with the human body and millions of environmental targets, it would seem quite impossible to ever construct a reasonable model to capture the toxic and eco-toxic potential of all industrial products and services by a few criteria that are simple enough to be computed and used by non-experts for estimating the ecological impact potential of millions of different products and services. In addition, effect-related properties of substances sometimes point in opposite directions. At OECD, experts could agree on the environmental impact potential of only half a dozen suspicious chemical products during three years of debate during the 80ies (The author was responsible for chemicals management and testing procedures at the OECD during the early 80ies as head of the Chemicals Division). See also part "Policies for sustainability" in this communication.

management of natural resources, and the efficiency by which they are used for the benefit of all people. The material and energy efficiency of the wealth production, distribution, and consumption system needs dramatic improvement.

Only within a well functioning market, governed by full cost pricing and by investing unerringly in education, research and innovation can such paradigmatic reforms be successful. Countries and enterprises offering reliable, and superior resource-efficient technologies as well as services can secure themselves a leading position in world trade.

In view of the fact that the German – and the Japanese - economy depend critically upon import of raw material and the export of finished goods, it is crucial that they set sails for this new course without delay and in a spirit of international cooperation.

The challenge is clear: over the next decade Europe will need to create some 20 million new jobs and improve the resource efficiency by *at least* 100 %. Multiple practical experiences tell us that a far-reaching dematerialization is technically feasible without loss of end use satisfaction **6**.

Today, however, there is little incentive for moving aggressively in this direction. While labor is expensive in industrialized countries due to taxation and other overheads, natural resources are internationally still available at relatively low prices. Throwing people out of work or shifting production to countries where work is still available at low cost are therefore realistic responses of enterprises for meeting cost

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6 See, for instance: Harry Lehmann and Thorsten Reetz, 1995, "Zukunftsenergien" (Energy for the future), ISBN 3-7643-5144-6; Mathis Wackernagel and William Rees, 1995 "Our Ecological Footprint", ISBN 1-55092-251-3; Ernst von Weizsaecker et. al. "Faktor 4", 1995, ISBN3-426-26b77-9; Willy Bierter, 1995, "Wege zum oekologischen Wohlstand" (Ways to ecological wealth), 1995, ISBN3-764-5125-X; Claude Fussler: " Driving Eco-Innovation", 1996, ISBN 0-273-62207-2; Fritz Hinterberger et. al., 1996, "Oekologische Wirtschaftspolitik" (Ecological economic policies); World Recouces Institute, 1997, "Material Flows", ISBN 1-56973-209-4; Gary Gardner and Paval Sampat, 1998, "Mind Over Matter", ISBN 1-87807146-7; Ryoichi Yamamoto, 1999, ISBN 478-87084-5 (in Japanese); Paul Hawken et. al.: "Natural Capitalism", 1999, ISBN 0-316-35316-7; Paul Klemmer and Fritz Hinterberger, 1999, "Oekoeffiziente Dienstleistungen" (Eco-efficient services), ISBN 3-7643-6138-7; Tadahiro Mitsuhashi, 2000, "Japan's Green Comeback", ISBN 967-978-745-1; Tadihiro Hashimoto, 2000, ISBN 4-492-39327-7 (in Japanese); Stefan Bringezu, "Ressourcennutzung in Wirtschaftsraeumen" (Resource use in national economies) 2000, ISBN 3-540-66886-1; World Resources Institute et. al., 2001, "The Weight of Nations", ISBN1-56973-439-9; Ryoichi Yamamoto, 2001, ISBN 4-478-87094-2 (in Japanese); Lester R. Brown: "Eco-Economy", 2001, ISBN 0-393-32193-2; Chad Holliday et. al.: "Sustainabilidy through the Market" WBCSD, 2001, ISBN 2-940240-19-1; Stefan Bringezu, 2004, "Erdlandung", ISBN3-7776-1192-1; Lester R. Brown, 2004, "Outgrowing the Earth", ISBN 0-393-32725-6; J. H. Spangenberg, S. Giljum ed, :Special edition "Governance for Sustainable Development", Intern. Journal of Sustainable Development, Vol 8, 2005

pressures, rather than competing with one-another through innovative development of dematerialized technology. This could change dramatically if the roughly 20 % gap between the actual resource use in manufacturing and the real need would be closed and in particular, if the financial overhead burden on labor and income were shifted to natural resources.

Today, massive and costly attention is devoted to **terrorism**, sometimes at the expense of preserving the environmental services that underpin all human economies. The natural resources involved in the military "conflict" in **Iraq**, where 0.4% of the human population lives, would have sufficed to build decent shelter for some 15 % of the world population. Continuing to solve human problems in this fashion is probably the most efficient approach to the collapse of the environmental services.

Sustainability and *Corporate Social Responsibility* have become accepted worldwide - in concept. But real progress has been slow in coming, particularly among political leadership and among small and medium sized enterprises (SME's). The 5 companies sponsoring our symposium here can be proud to belong among the industrial leaders in moving toward sustainability. In fact, they even can serve as shining examples for most governments around the globe.

Only one Planet Earth

Having only one planet earth available for the global human economy makes it mandatory to agree on an international harmonized approach to eco-efficient production, trade and consumption. In my opinion, even the USA and other reluctant actors can eventually be interested in cooperating if Europe and Japan were to embark vigorously on sustainable wealth production and launch a hard-hitting global information campaign on the shortcomings of the current economic frame work as regards our common future and what we need to do in order to gain it.

In order to gain sustainability, the world needs generally acceptable yardsticks for the ecological *per capita* impact of national economies on the macro level, for the organization-specific performance, and for individual goods and services. Next to a few traditional indices, the *life-cycle-wide* material input per unit output (per unit service, utility or value), and the total annual material flow through an economy – TMF/capita - are such measures **7**.

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7 See www.factor10-institute.org

Other than what some experts still seem to believe, such yardsticks do not have to be scientifically *"as complete and refined as possible"*. They have to be simple, reliable, cost-efficient, directionally true as well as internationally acceptable and applicable. Neither GDP nor market prices of goods are based on scientifically *"complete"* considerations. And yet they apparently serve rather well for making economic decision – everywhere. At the same time it is trivial and unfortunate - but bears repeating - that GDP is not helpful for guiding the economy into a sustainable mode, nor do current market prices *"speak the ecological truth"* (E. U. von Weizsaecker).

If all ecological damage potentials could be internalized into market prices, we could largely forgo life-cycle-wide environmental analyses and ecological criteria for the environmental quality of substances, goods and services. Science cannot, however, foretell, assess and quantify all the potential impacts of goods and services on the ecosphere and therefore it is not possible to make meaningful monetary damage assessments either.

This is one of the reasons why I proposed the **Factor 10/MIPS Concept** in 1992 (see below), in conjunction with a radical shift of taxes from income to natural resources.

Hope?

Five years ago, on 22nd May 2000 a meeting took place here in Tokyo, organized by the distinguished keynote speaker of today, Professor Tadihiro Mitsuhashi [8]. At that meeting representatives of global enterprises and international 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… Restructuring the global economy to make it socially, ecologically and economically sustainable, presents the greatest investment opportunity in human history*".

Today we are again assembled in Tokyo for an important meeting with industrial leaders. We were invited by 5 well-known global German enterprises to discuss progress toward sustainability and to understand better what still needs to be done. I am impressed by the progress that has been achieved during the past 5 years among global industrial players. Their serious efforts to monitor and improve manufacturing

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

performance and in particular the ecological quality of goods is outstanding. And I feel that there is readiness to continue this course and move toward globally harmonized approaches in measuring progress.

I am most grateful for the opportunity to share some of my thoughts with such a distinguished audience.

On the Extent of Industry's Responsibilities

A multitude of legally binding performance and quality standards, labelling and packaging requirements, as well as manufacturing- and marketing regulations exist for goods and services. Quite a few have been internationally harmonised within the EU, by OECD, ECE, ISO, ILO and others.

Here I would like to focus on *volontary* actions by business that relate to the three dimensions of sustainability: economic, social and environmental.

In my view, **C*orporate social responsibility*** extents to *all* facilities operated by a company, irrespective of geograhical location. Protecting the health and safety of employees has long been a tradition in European and Japanese industry. More recently it has also become routine in larger enterprises to support continued training of co-workers in order to improve business and self-fullfillment. Serious consideration of proposals for innovation as well as fair hearings of complaints by co-workers, regular payment of fair salaries, justifiable and reasonable co-ownwership options and participation in corporate gains, and protection from arbitrary notice should be considered integral features of c*orporate social responsibility*. Labour by uneducated children and unequal gender treatment counteract sustainable performance. It also behooves companies to exercise influence on their business partners for ascertaining that *corporate social responsibility* is practised everywhere.

Companies should bring to the attention of proper authorities all circumstances that inhibits exercising *corporate social responsibility* and they should make proposals for change in tune with the goal to reach global sustainability. For instance, child poverty has risen during the past 10 years in Germany and should be eliminated.

It is the responsibility of **government** to optimize framework conditions for reaching social equity and sustainability on a national and international level. In particular it is the responsibility of government to establish frame-work conditions that make child-bearing attractive for carreer women in their 20ies and early 30ies.

Companies are responsibility for the *environmental performance* of their business sites and for the *life-cycle-wide* ***ecological impact potential*** **of all substances, goods and services** they place on the market, even beyond legal requirements. In addition to providing voluntary information on substances, goods, services and plant performance, all applicable legal requirements of the home country should be adhered to in all other countries where a company does business.

Industry should accept the responsibility to bring to the attention of authorities circumstances that inhibits exercising its ***corporate environmental responsibility*** and offer proposals for change. For instance, if world **market prices** or **subsidies** for resources are such that saving natural resources in product design is not sufficiently attractive, industry may wish to stimulate and participate in developing **fiscal reforms** that can support the **dematerialization** of goods and services, while **reducing the cost of labor** at the same time. Equally, existing **standards** and **norms** that are counterproductive to approaching sustainability should be pointed out to authorities. In this context it is also worth remembering that *excessive* technical risk reduction and convenience support systems frequently cause considerable additional input of natural resources.

Even with optimal resource productivity for goods and services on the firm level, the sum total consumption of natural resources can surpas the sustainable natural capacity of the planet earth. Consequently, governments and international organizations need to monitor yearly **Total Material Flows** (TMF) and take appropriate actions for preventing or reversing *„overshoots“* on the macro-level. This problem resembles the global appropriation attempt by the ***„Kyoto Protocol“*** for emissions that cause climatic change. For solving such profound problems, too, industry may wish to provoke and participate in a timely international.

Since, as we have noticed, there is an absolute limit of sustainable resource consumption on our planet, and in view of the dominant neo-classical base assumption in our current economy, namely that more consumption leads to more (apparently considered to be necessary) growth and hence to more employment, I believe that this calls for theoretical considerations on the need for growth and its nature. Wouter van Dieren edited a treaty for the Club of Rome in 1995 in which current economic models and measures were discussed as they related to sustainability. It is observed that true wellbeing in industrialized countries declined since the

late 70ies, inspite of steady advances in **GDP** [9]. Where not long ago a single breadwinner per family was enough in Germany, two incomes are necessary now for adequate living standards of a family with two children. Perhaps this is one of the reasons why we notice today a lively debate on understanding and measuring *„happiness“* of human beings.

I consider it entirely possible that the future optimisation of economic activities will be very different from what it is today [10].

There is another issue involved here. In saturated markets, industry sees little value to innovate long-lived goods that could save natural resources. Today, the typical approach is to replace existing goods as quickly as possible with new ones. Repairs and maintenance are extraordinarily expensive [11]. Of course, industry without adequate profit and cash flow is not sustainable. There would seem need for serious dialogue, however, what new market strategies can better support economic, social and ecological sustainability than the ones we have today. For instance, new leasing and financing concepts, and the provision of affordable and conveniently available services for consumers might be prominent features oftomorrows' economy.

Note: an air planes can be operated for some 250 million km on the average, cars only 250 thousand km or a little more.

Next

I will attempt to summarize my proposals that could get us perhaps closer to preserving the environmental services and simultaneously reduce the unemployment, utilizing the power of the market. The two major features are these: *Use natural resources far more eco-efficiently than we do today and simultaneously lower the cost of labor decisively.* In fact, both turn out to be the two sides of the same coin.

Subsequently I will attempt to outline as best as I understand the outstanding progress toward sustainability achieved

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9 W. van Dieren ed.: “Taking Nature into Account” , Copernicus, 1995

10 See, for instance Neue Zuericher Zeitung 28th April 2002 Nr. 7-22 (article by B. S. Frey); see also a series of articles in Financial Times Deutschland, 15th; 17th, 20th; 22nd; 24th Feb 2005; and 1st March 2005 by S. Dullien, T. Fricke, C. Priemeister, C. Karweil. The well known conservative British economist Richard Layard has recently written a book on happiness (German “Die glueckliche Gesellschaft”, (“The Happy Society”), Campus 2005. The Sustainable European Research Institute (SERI) in Vienna, Austria, undertakes research in this area (fritz.hinterberger@seri.at)

11 Recently, close to Toulon, we were given a written estimate of 256 euro by a shop specializing in “repairing all gismos” for repairing a steam iron worth less than 100 euro.

already by German global industrial players. I am certain that the representatives of the enterprises assembled here can and will complete the picture presented by me – and correct it, if necessary.

PROPOSALS FOR CHANGE

Full-Cost Pricing and New Jobs

Many governments, corporations, and voters continue to assume that a healthy economy is one that uses increasing amounts of energy, materials, and land in order to produce more goods, more jobs, and more income. This assumption is a holdover from the mass economy of a dying age, an age in which growth was marked by a steady expansion in the production of energy, the depletion of resources, and the degradation of the environment. Although passé, this assumption still dominates public policies in finance, energy, agriculture, forestry and other sectors, slowing and sometimes stopping and even reversing the transition to a new, efficient and more sustainable economy. Existing taxation and subsidy systems, designed to support these outdated policies, are still in operation today **12**.

The goal is to achieve a balance among the productive factors labor, capital and energy/resources that can support sustainable development. For this reason the productive factors should be taxed in accordance with their real contribution to value creation. But the present tax and levy systems frequently point in the wrong direction. They distribute burdens in-efficiently and unfair**.**

On the average, the current cost structure in the production sector looks roughly like this: 70 % for labor, 25 % for capital and 5 % for energy **13**. A rather different picture emerges when the question is raised: How is the distribution of contributions to the bottom line? Empirical studies in the USA, Japan and Germany have shown that a one percent change in energy expenditures has as great an effect on value creation as a one percent change in the total amount spent on human resources and capital investments. In other words: Human resources cost more than they should relative to their contribution to output, whereas energy makes a relatively

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12 Statement to Governments and Industry leaders by the International Factor 10 Club, 1997, see www.factor10-institute.org

13 Here, energy units were the basis of computation. However, each unit of energy (even solar energy) consumes a certain amount of natural material for making it available – from cradle to the point of applying the energy (Material input per unit energy output). For example, the material weight (mass) in tons of non-renewable material input per Megawatt-hour output in Germany ranges from 11 to less than 0.1 ton, depending on the electricity generation technology. See also the discussion on energy in the text below.

large contribution to output and is relatively inexpensive [14].

Under these circumstances cost downsizing inevitably leads to job cutbacks, primarily because the health of today's social insurance system is mainly determined by the size of the work force, which is shrinking as the economy grows. The result: a smaller tax base and reduced social insurance revenues. This vicious circle is becoming ever narrower for a country like Germany in terms of social insurance and sustainability expenditures. Only the federal government has the power to extricate Germany from it.

Extricating will require a re-adjustment of ***fiscal policies***. The financial burden on income must be shifted to natural resources to ensure that resources are spent optimally. Human, capital, and natural resources can and must be developed in such a way that more jobs are created while energy and material consumption are reduced. Efficient management of the fiscal system's various mechanisms would significantly contribute to the achievement of this goal. Industry and labor unions could and should play a significant role in developing policies designed to overcome the barriers to sustainability.

Extricating also implies that governments lower ***subsidies*** noticeably, in particular those subsidies that encourage the consumption of natural resources [15]. Since ***governments procure some 20%*** of final goods and services in industrialized countries, giving strong preference to goods and services with high resource productivity would be a powerful signal to manufacturing and trade for offering dematerialized solutions.

Extricating requires finally that ***standards and norms*** be reviewed, 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 transport and logistic systems, for food safety and packaging norms. Some design and construction **habits** may also warrant review. For instance, right angles in pipes for gases and liquids require considerably higher pumping pressures than diagonal or rounded arrangements. Material needs that result from computing static requirements for construction should not be surreptitiously surpassed in order to "increase safety". Private habits can also increase resource consumption. Stand-by functions in electric equipment for instance can increase electricity consumption in homes by 40 %. Training,

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14 Report of the "Future Council" of North-Rhine Westphalia (in English), 2004, www.agenda21.nrw.de

15 Norman Myers and Jennifer Kent: "Perverse Subsidies", 1998, ISBN 1-895536-09-x

information and education could make a significant difference here.

Increasing productivity has been a basic strategy in industry since the early days of industrialization. Between 1960 and 1990 labor productivity in Germany increased by approximately 3.8 % annually [16]. The Total yearly Material Flow (TMF) in Germany increased by about 1.6 % annually during the same time period, whereas the GNP increased by 3.1 %. Apparently, a noticeable decoupling of the German economy from the use of natural resources took place: A strategically very important development in view of the fact that Germany depends critically upon importing natural resources (as is true for Japan also). It should be noted, however, that the *absolute use of natural resources* still *increased* in Germany during this period of time. This points to the fact that **ratio indicators** must be carefully chosen in order to avoid misleading conclusions.

In recent years, increasing *labor* productivity has received considerable attention in the mass media because it is frequently associated with increasing un-employment. On the other hand, increases in *resource* productivity take place more quietly, perhaps because its implications as regards reaching economic and ecological sustainability are not as yet sufficiently understood by politicians, the media and the public.

In 2002, the United Nations Environment Program (UNEP) published a report that argues: Dematerializing goods, services, and production must achieve more eco-efficient consumption**.** A new report of the European Environment Agency (EEA) shows once more that the consumption of European households has not only risen in monetary terms but also in volume, eradicating previous progress that had been achieved in material efficiency ("*Rebound*" or "*Boomerang"* effect). The EU Commission is currently defining its resource use strategy [17]. In Japan, METI [18] is actively pursuing a resource conserving strategy ("RRR = Reduce-Reuse-Recycle" policy) [19], which has its scientific roots in the *"ZERO Emission"* research program of the United Nations University in Tokyo since the early 90ies.

From hundreds of consulting experiences with European manufacturers it is known that on the average approximately

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16 F. Hinterberger, H. Renn: " Arbeit, Wirtschaft, Umwelt" ("Labor, Economy, Environment"), Wuppertal Paper 89, 1999

17 www.europa.eu.int/comm/environment/natres/index.htm

18 Ministry for the Economy, Trade and Industry in Japan

19 www.meti.go.jp/english/policy/index_environment.html

20 % of the input costs for energy and material could be saved without compromising end use satisfaction of their outputs [20]. In some small and medium size enterprises much higher potentials for increasing resource productivities have been observed.

One puzzling question emerges: Why is it that enterprises are *not* minimizing their energy and material inputs to the extent feasible? Why are they forfeiting the possible savings associated with avoiding waste and excessive resource use for products?

As we noted already, cost pressure is commonly relieved by releasing labor rather than kilowatt-hours or cement. One reason may well be the very slow diffusion of the economic implications of potential resource savings. Resource saving is an issue that has been demanded traditionally by environmentalists "*for the sake of nature*" and for "*preserving raw materials for future generations*" rather than for economic reasons. Small firms tend to shy away from experimenting with alternative processes, alternate materials and new product design. Norms and standards frequently reduce options for resource savings, for instance in the food packaging and building industry. Bookkeeping in companies rarely concerns itself with material flows in terms of kilograms or tons per annum. We have met only a very few manufacturers who could give us information about the *cradle to work gate* inputs of materials ("*the material added*") for one of their products. Obviously the concept of the *ecological rucksack* [21] is not widely known. And since prices do not reflect the resource intensity of materials in kg/kg, pre-products and services used by enterprises as inputs, management usually has little knowledge of the resource flows they generate, except water and energy used during manufacturing. Most cannot therefore assess the magnitude of saving natural resources under their control either.

During the past 15 years, E. U. von Weizsaecker, Schmidt-Bleek, F. Hinterberger [22] – among others – and more recently the World Business Council of Sustainable

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20 See reports on the "Effizienzpreis" by the Efficiency Agency NRW, www.efanrw.de; and the Aachen Foundation on its "R.I.O. Innovationspreis", www.aachener-stiftung.de; F. Schmidt-Bleek, C. Manstein,: "Klagenfurt Innovation", 1999, ISBN 3 9007 43 74 6; F. Schmidt-Bleek ed.:"Der Oekologische Rucksack – Wirtschaften fuer eine Zukunft mit Zukunft" (The ecological rucksack – running the future economy with a future"), Hirzel 2004;

21 Ecological rucksack = the total cradle to sale input of material (including energy) into a product. Measured in kg, minus its own weight (mass) in kg. A concept that Schmidt-Bleek introduced in 1992. See for instance "Der Oekologische Rucksack – Wirtschaften fuer eine Zukunft mit Zukunft" (The ecological rucksack – for an economy with future), Hirzel, 2004 (Japanese edition appears in November 2005)

22 See www.seri.at

Development [23] and Spangenberg [24] have suggested to shift fiscal overheads from labor to natural resources in order to make labor more affordable and create incentives for improving resource productivity through competitive innovation.

Against this background, Professor Bernd Meyer and his coworkers at the University in Osnabrueck [25] have undertaken a number of simulation studies to answer the question, whether deliberate policies for increasing the resource productivity in Germany might also have beneficial effects upon the consolidation of state budgets, the competitiveness of German industry and employment.

Financed by the private Aachen Foundation Kathy Beys [26], Meyer applied his model INFORGE in combination with the model PANTA RHEI [27] to investigate the potential effects of two policy instruments: *First*, an appropriate information and advisory campaign aiming at the reduction of current resource inputs in the manufacturing sector without compromising end-use satisfaction **("Aachen Scenario").** And *second*, imposing a **material input tax (MIT**), shifting the financial burden from labor to natural resources. The *Aachen Scenario* was timed from 2006 to 2016 and the tax option from 2011 to 2020. The tax option excluded energy carriers and water and assumed a linear tax increase of 1 to 10 Euros per ton with a corresponding reduction in labor taxation (16 Billion Euro in 2016, ca 10 % of labor taxes in 2001 [28]).

The results indicate a better than 1 % increase in GDP per annum, a continuous improvement of the state budget by up to 80 billion Euro in 2016 [29], savings of ca. 160 billion euro for enterprises, the creation of more than 1 million new jobs with a considerable shift to the service sector, and a dematerialization of some 18 %. The potential economic

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23 WBCSD. C. O. Holliday, jr et. al.: "Walking the Talk", Greenleaf Publishing, 2002

24 J. Spangenberg, Ed: "Vision 2020: Arbeit, Umwelt, Gerechtigkeit – Strategien fuer ein Zukunftsfaehiges Deutschland" (Vision 2020: Work, Environment, Justice – Strategies for a sustainable Germany), Munich 2003

25 www.gws-os.de

26 www.aachener-stiftung.de

27 INFORGE is based on the past development of the 59 economic sectors and their inter-relationships (www.gws-os.de/Research/Modelle/inforge/inforge.htm). PANTA RHEI was developed to analyze environmental issues with INFORGE. It handles the energy inputs and the CO_2 emissions in 121 manufacturing sectors and private households and it considers material and raw material inputs.

28 This shift of overheads from labor to resources is probably not enough to yield the changes in resource productivity envisioned by von Weizsaecker, Schmidt-Bleek and others .

29 The yearly budget of the Federal Government of Germany is about 250 billion euro.

improvements indicated by Meyer's study far outweigh the projections of any other reform proposal presently being considered in Germany.

Meyer also investigated the question, which of the 59 statistical sectors of the German economy would contribute most toward an overall reduction in resource use when a small lowering of resource inputs into each sector is simulated. The 59 sectors represent a network with some 3 500 separate resource links between them. Surprisingly, ca. 50 percent of all possible resource savings can be achieved along only 16 of these inter-links and 40 links can contribute close to 100 % of the total possible resource input savings. Many sectors currently attracting particular "green" (and legal) attention (as for instance the recycling of electro-wastes) do not show up among the top 40 links. These findings offer first significant selection criteria for low-cost/high efficiency policies aiming at increasing the resource productivity of the national economy in Germany.

Preliminary results of the *Aachen Scenario* were published in 2004 **30**. A publication summarizing the overall study by Meyer and coworkers has recently been presented by Klaus Dosch and can be downloaded from the web site of the Aachener Stiftung Kathy Beys **31**.

> *The surprisingly beneficial macro-economic effects indicated by Meyer's study would seem to warrant a high political and industrial level of attention.*

It seems important that additional studies must follow in order to prepare a solid basis for private and public policy actions. In my view expanded studies should include a considerably larger percentage shift of taxes from labor to resources. In addition, water should be considered as a taxable resource. Water consumption in Germany amounts to some 500 tons (m^3) per person-year (approx. 40 billion tons annually) and is largely under national and local control. Further, I believe that a differential taxation approach may be called for along the lines of ecological rucksack factors within the 40 top resource exchange links indicated above.

At first glance, the findings of Meyer's study are somewhat disappointing with respect to the resulting dematerialization

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30 Hartmut Fischer, Karl Lichtblau, Bernd Meyer and Janina Scheelhaase, "Wachstum und Beschaeftigungsimpulse rentabler Materialeinsparungen" (Consequences of realizing profitable material savings on growth and employment), Wirtschaftsdienst, Issue 4, April 2004.

31 K. Dosch" Ressourcenproduktivitaet als Chance – Ein langfristiges Konjunkturprogramm fuer Deutschland" ("Resource productivity a chance – a long-term economic program for Chermany"), 2005 www.achener-stiftung.de

when compared to ***"Factor 10"*** (see below*).* There are several possible reasons for this finding. *One* is, that the induced acceleration of growth results in a *"boomerang"* or *"rebound"* effect that *"eats up progress"* in resource saving. This effect has been observed in many sectors before, for instance when the efficiency improvements in coal-fired power plants were overcompensated by growing electricity demand. Another example is the growing overall gasoline consumption in spite of increasing fuel efficiency of car engines. A *second* reason is that the forward *"predictions"* which the model simulates are rooted in the social and economic experiences of the past. No simulation model can foresee surprises. For example, no simulation model could have predicted the fall of the Berlin wall in 1989. Since average prices of energy carriers and raw materials were rather constant during the past 30 years – in spite of sharp price fluctuations – the model has a certain *"built-in inertia*" when simulating the consequences of pre-selected future price hikes for raw materials. A *third* reason is that the model obviously cannot deal with innovations to come, charismatic statesmen elected in the future, major *"natural"* disasters, epidemic spread of deadly diseases and psychological factors such as changes in consumption habits.

It is not inconceivable that growing experience with the benefits of dematerialization among manufacturers and consumers during the time when the *"Aachen Scenario"* is applied stimulates more intensive innovation, a new era of competition among companies and the creation of new repair and maintenance jobs. A *fourth* reason is the cautious shift of only 10 % of labor taxation to resources investigated so far. And *finally*, the impending shortages of fossil energy carriers and other natural resources, in particular due to the fast development of emerging economies with some 2.5 billion people and increasing numbers of *"natural disasters"* like Katrina in 2005, might give an additional push in the direction of increasing resource productivity.

Beyond shifting taxes and other overheads, applying a number of other instruments, sometimes called the **"Carnoules Potentials",** could accelerate dematerialization**.** They include: Changing publicly and privately financed **research priorities**; Introducing the subject of resource productivity and its implications for sustainability in **education** on all levels; Offering **training** to staff of SME's in life-cycle-wide computation of material and energy efficiency of goods and services and provide the necessary base information (like rucksack factors for raw materials and rucksack information on standard products like e-motors or windows (see below under MIF and Rucksacks); Introduce regular **mass media accounts** of progress toward sustainability, including trends

in Total Material Flows (TMF), and particularly impressive examples of new products and systems solution for increasing resource productivity; Offering substantial **prizes** for resource efficient solutions (e. g. The Efficiency Agency of North Rhine Westphalia and the Aachen Foundation [32]. Recently, the federal ministry of economics in Berlin has also introduced prizes for increasing material efficiency); Requiring **labeling** of goods and services on the basis of "*product specific core ratio indicators"* like MIPS (see below)**;** Adjusting and eliminating **norms and standards** that induce high resource consumption; Reducing sharply **subsidies** that stimulate high resource consumption; Considering incentives for **trading stocks and bonds** of companies with superior material and energy efficiency performance (processes and products); Imposing **taxes** on the right to extract minerals, water and bio-products from nature; Providing incentives for **leasing** arrangements; Providing incentives for marketing products with **long life times** and little **maintenance** needs (guarantee provisions); Introducing **public procurement policies** that favor products and services with high resource productivity.

Policies for Sustainability

Policies for approaching sustainability require a systemically balanced and simultaneous consideration of their potential impacts on all dimensions of sustainability: Social, ecological and economic. This applies to all sectors of society. On occasion, additional consideration may also be relevant, like preserving the cultural heritage and adjusting institutional arrangements.

As indicated before, approaching sustainability requires that protecting the environment and maintaining a healthy economy 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 has already incurred the damage costs of unsustainable development [33].

This cannot be achieved adequately with the environmental policies of today. They were *not* designed to protect the ecosphere in a *systemic* way while minimizing costs to and disturbance of the economy. Not many are *precautionary* in nature or market based, they do not systematically encourage sustainability-oriented innovation, and they offer hardly any long-term perspective or investment security for business.

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32 www.efanrw.de and www.achener-stiftung.de

33 See also statements and reports of the International Factor 10 Club, www.factor10-institute.org

At the beginning, environmental protection legislation was overwhelmingly a necessary response to health threats reaching human beings through air, water, food and feed. Governments had little choice in the early 70ies but to react to the observation of a sequence of specific life-threatening events, typically by limiting or forbidding certain activities and reducing the emission or effluence of dangerous substances. This approach was essentially akin to a lengthy fire fighting exercise, accompanied by a growing number of monitoring schemes and an ever-increasing army of bureaucrats who had to administer legal provisions and level fines on industry for non-compliance.This approach has created a situation that is in some aspects similar to a planned economy. It causes non-marked driven expenditures by hundreds of billions of euro every year in the EU with increasing tendency.

In spite of the shortcomings of these policies, protecting man and the environment against toxics will remain important far into the future.

However, today's *"end-of-the-pipe"* oriented legal approach to protecting the environment cannot lead to sustainability because it does *not* reward saving of natural resources and only "rich" countries can afford the ensuing costs (notice that even the USA claim not to be in a position to absorb the costs associated with the *Kyoto Protocol*). Altogether this approach can even increase overall resource use because it requires much investment in hardware and energy for running equipment and for re-cycling as well as for transporting wastes. The German *"Green Point"* scheme for recycling packaging material may serve as an example.

Still today, the environmental performance of manufacturing plants continues to be the main focus of policy attention in the business sector rather than the resource intensity (the *ecological rucksack*) of their products: When computing the contribution of manufacturing activities to the overall resource intensity of products and services, it turns out that plant performance is often only responsible for a few percentage points of the total mass and energy flow when compared to the goods and services they place on the market. This situation applies in particular to companies producing large yearly numbers of goods with high material complexity, containing in particular special kinds of steel and non-ferrous metals **34**, such as cars, batteries and ICT equipment.

These are some of the reasons that led the author of this communication to develop a paradigmatically different

34 Equivalent to saying " goods with heavy ecological rucksacks" (see below).

approach to protecting the vital ecological services [35]. *"Rather than continuing just to focus on nanograms of suspicious substances we should begin to worry about the megatons of nature we put in motion for wealth production".* Every technical translocation of water and material in nature is bound to change ecological balances and the evolution of the ecosphere. The more natural resources are put into the *"wealth production machine"*, the more comes out of it in the form of emissions, effluents and wastes. And virtually all material waste outputs from the economy are physically and/or chemically altered when compared to the original state of the natural material inputs into the economy.

Environmental protection policies that cost tens of millions of non-productive (and largely untaxed) working hours per year in order to ascertain the return of bottles and cans after use do not seem very systems oriented when at the same time a single money transfer by internet is as resource intensive as producing 4 aluminum beer cans [36].

In the future, heads of state and government may want to consider placing the responsibility for approaching sustainability into the ministry for economics and labor, because a healthy and sustainable economy is unthinkable without protecting the services of the environment on a systems level. Dealing with specific insults or threats to man and the environment through the environmental media may be left to an institution well qualified for this task.

DEFINING AND MEASURING PROGRESS

Sustainability will be reached on the market.
Or not at all.

All economic activities and all *social policies* have impacts upon the **ecosphere**, and hence upon the **ecological sustainability**.

> *Sustainable development is an open-ended process that must be adapted to ever changing circumstances and insights. Nevertheless, legitimate governance must have at any time a transparent and reliable way of accounting for its goals and contribution toward sustainable development.*

[35] As indicated before, the author of this communication was responsible for developing the environmental aspects of the German Chemicals Act, as well as its application in Germany and later for the worldwide harmonization of chemicals management as Head of the Chemicals Division at the OECD. He is therefore quite familiar with the evolution of environmental protection legislation and its cost to industry and the administration.

[36] F. Schmidt-Bleak, ed.: "Der oekologische Rucksack", Hirzel 2004

Without measurement, management is not possible (OECD 1998).

Goals

In order to approach sustainability, realistic and quantifiable **strategic goals** have to be set for its **three principal dimensions: economic, social** and **ecological,** together with a time frame and practical indicators. The goals must be interlinked and they may not contradict or exclude each other. For instance: Policies aiming at sustainable health, social security, or employment are futile if they do not also take the ecological consequences into account. Sustainable economic growth without radical increases in resource productivty is not possible. Social benefits for all is neither social nor sustainable when overwhelmingly financed by taxing labor and income. And attempting to preserve a sustainably viable ecosphere without utilizing the power of the market is akin to attempting sustainable growth in an economy that is planned by bureaucrats.

G*eneral strategic goals* *for sustainability* are applicable to all segments of society. Important among these strategic goals are:

- Happiness, wellbeing, dignity and work for all
- Free speech, justice and freedom of violence for all
- Long-term stability of the eco-social market economy
- Optimal conditions for innovation
- Acceptance of self-reliance and personal responsibility
- Protection of the environment from specific destructive impacts
- Optimal resource productivity (material, space,)
- Optimal use of renewable resources
- Maximum waste-avoidance
- Minimal use and release of hazardous substances

Transparency, relevance und long-term reliability of government and commercial activities must be measured against these goals. Their success should be judged on the basis of these goals and be reflected in regular **performance reports**.

Depending upon the responsibilities and activities of the various sectors of society, additional and more specific goals are usually defined and monitored with the help of ***„organisation specific indicators*“.** Because sustainability

is indivisable, however, they must be consistent with general goals such as outlined above.

Organisation specific indicators used in industry apply to certain units or sites of activity. Results usually allow valuable insights into the overall performance of producers so-long as *performance goals* were set in advance and the reports issued regularly.

Indicators

Assessing progress toward sustainability is a **holistic and systemic approach** that encompasses all aspects of sustainability. Indicators must be capable of estimating the contribution of policies, activities, goods and services toward sustainability while allowing to estimate the distance of the current situation from envisioned targets. Indicators must be *science-based, directionally safe, internationally harmonious, sufficiently simple so as to be widely understood and used and they must also allow fast and low-cost application*.

At the level of decision makers, as few ***core indicators*** as possible should be applied that display the current state of affairs and past progress in a comprehensive and integral manner. Six to seven indicators are broadly considered to be the maximum number for this purpose, backed up by a set of indicators bound by a comprehensive and mutually supportive framework.

The *life-cycle-wide* ***environmental disturbance potential*** of ***individual*** **products and services** placed on the market determine the sum total of the ecological performance of the human economy to a large extent.

As it is *not* possible to elucidate *all* environmentally relevant properties of even a single product or service, representative ***core properties*** of particular ecological significance have to be selected and captured in product specific **ecological core indicators.** They must be based on *cradle-to-grave* considerations in order to avoid wrong consclusions. For instance, it is not sufficient to take the mass (weight) of material inputs into a manufacturing process as a basis for computing the material efficiency of a product without considering the specific resource consumption for making each individual raw material available for manufacturing activities. That is to say, every material has ist own specific *„material added history*“ from *cradle to use* in a manufacturing process. Lignite from an open pit for instance causes 10 to 20 times more displacement of nature than hard coal from an underground mine on a ton per ton basis. We shall discuss

socalled *„MI-factors"(MIFs)* or *„Rucksack-factors of raw materials"* below.

In view of the fact that the ecological quality of all goods and all services must be assessed relative to the same source of resources and the same sink for wastes, namely the one planet earth, the ***core indicators*** chosen for goods and services ***must apply to all*** **products and *all* services** in order to allow meaningful ecological evaluation and comparison, independent of geographical or political boundaries. For different products and services that serve functionally equivalent purposes, identical core indicators allow moreover a direct comparison. For instance, the ecological quality of cars from different manufacturers can be directly compared on the basis of *cradle to grave* material input per passenger kilometer.

In my opinion, the presently common comparison among vehicles that rests largely on fuel consumption falls short of serious ecological analyses. Perhaps one should keep in mind that there could well be a „Rolls Royce" effect involved, meaning that a larger and more solidly built car with relativel high fuel consumption, with a much longer life-time, requireing less maintenance and repair needs, may well surpass the environmental quality of a small electrically propelled cars with relatively a short half life (note that copper has an MI-factor of 500 kg/kg). Only a life-cycle-wide analysis can tell the truth.

„Ratio indicators" allow comparing the performance of one company with another. Ratio indicators display overall **input per unit output or time, or output per unit input**. **HEIDELBERG,** for instance, reports [37] the *percentage* of female and handicaped co-workers employed; the energy (MWh/a) and water (m^3) consumption as well as waste produced (tons) *per* million euro turnover; energy and water consumption *per* ton of output; and the ratio of waste (tons) *per* million euro trurnover and *per* unit output (tons). These are informations that allow meaningful ecological comparison to other manufacturers, even those that produce other products.

„Product or service specific indicators" give the most telling picture of the eco-intelligent performance of a company because they allow comparison of individual products with individual other goods. For instance, it may well be of interest for a consumer to compare the ecological impact potential of a bicycle to that of a body building machine or a sauna.

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[37] HEIDELBERG, Nachhaltigkeitsbericht (Sustainability Report) 2003/2004

Scientists now agree that for the *life-cycle-wide* environmental disturbance potential of ***all products*****,** their specific *life-cycle-wide* consumption of natural resources (water, material, energy, surface area in m^3, tons, MWh **38**, m^2) per unit service **39** serves as a reliable initial ***„product specific core ratio indicator“*** on the input side of economic activities. When using output indicators (effect indicators), care must be taken that they are equally meaningful for ***all products*** being compared and that no double counting occurs when using input- and output indicators for the analysis of the same product.

For many producers of traditional goods (like shoes, mousetraps or houses), the concept, significance and definition of ***„product specific core ratio indicators“*** are confusing because "*everybody knows what our products are good for"*. However, without clarifying the purpose (or bundle of purposes) of a product in terms satisfying a customer's specific need (the **S** in **MIPS**), the comparison of its *"ecological price"* with that of other solutions for meeting the same need are rather impossible. Only by defining the purpose of an automobile in such terms as *"transporting 1,5 persons on the average for 1km"* can its environmental quality be compared with that of another car, a motorbike, a city bus or a train [40]. Only by defining the purpose of a printing machine in terms such as *"providing such and such kind of information to people"* can it be compared with other printing machines, or using television or e-mail instead or any future technical solution for the same purpose **41.**

Of course it is appropriate to also report developments in industry beyond those covered by *core indicators*, for instance on specific products, wastes, emissions or effluents that are particularly significant for a production site or subject to legal controls.

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[38] Considering energy inputs, see below

[39] There are various denominators in use. In the MIPS/Factor 10 concept we usually set unit "service" equal to unit "utility","value" or "pleasure". Other terms include "demand based benefit", "defined customer benefit" (BASF), and usability (TUV Rheinland).

[40] F. Schmidt-Bleek, ed.: |"Der oekologische Rucksack" (The ecological rucksack), Hirzel 2004, to appear in Japanese in November 2005

[41] For a detailed discussion of different kinds of services, see F. Schmidt-Bleek, "The MIPS Koncept", Droemer, 1998, page 167.

A systematic set of principal objectives and indicators for has recently been set out [42] for the three principal dimensions of sustainability (economic, social and environment).

MIPS

The common way for the initial assessment of the value of a product or a service is to compare the input (the price) to the output (the pleasure, service, utility) one can derive from putting the product to work or by acquiring a service. Consumers use products to obtain service. Products are therefore sometimes referred to as *"service delivery machine"* in order to highlight the fact that the *use of products* justifies their existence in most cases.

In a like fashion, the input of natural resources per unit utility or service can be used to initially compare the *"ecological price"* of products and services. Depending upon the importance of the decision at hand, more elaborate considerations may subsequently be called for, just as is the case once the monetary price comparison has yielded a first but occasionally still insufficient basis for a final decision.

All goods and services require materials, energy and space (surface area) as natural resource inputs from the ecosphere. Both, the displacement of material from its natural places, and the removal of soil from the ecological functions, inevitably spawn changes of the natural system. The return of the material streams from the technosphere to the environment – usually in physically and chemically altered form – causes additional stress.

In 1992, I proposed *the material input per unit service* – ***MI / S or MIPS*** – as a core ratio measure for the general ecological stress potential of products and services [43]. The **MI** is the sum total of all natural material inputs (Life-Cycle-Analysis – LCA), including those displaced and used for making the necessary energy available. **S**, the service or utility desired, must obviously be defined in each case. Contrary to M, S is not measurable in physical terms.

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42 „ Governance for sustainable development in Europe: What is at stake for further research?", K.N. Farrell et. al., Internat. Journal Sustainable Developm, Vol8 1/2 2005. This presentation is based on a meeting at the Factor 10 Institute in 2003.

43 F. Schmidt-Bleek, Wuppertal Institut Position Paper, "Toward Universal Ecology Disturbance Measures", 1992, subsequently detailed in a book printed in 1993 ("Wieviel Umwelt braucht der Mensch", Birkhaeuser, 1994)

Equally, I proposed **FI / S**, **FIPS** [44] as an indicator related to the surface coverage per unit output. A surface area related indicator is important for all **biotic products.** For instance, the coffee consumed per year by the average German requires 150 m^2 for production.

The higher MIPS or FIPS, the higher are the *"ecological costs per unit utility"*.

The **MI** associated with a given **S** can then be assessed in weight units. With the help of MI-factors, **MIFs** (see below) for basic materials (like steel, plastic, wood, or cement), the MI and the ecological rucksack, as well as MIPS of complex products can be computed straightforwardly [45]**.**

For instance, **DaimlerChrysler's Class A** [46]. Taking the rough material composition indicated in Daimler Chrysler's *"360 Degrees Environmental Report 2005"*, one can arrive at a total weight (mass) of about 20 tons for the car (applying IMFs for computing the Rucksack), and some 2.5 tons for tires, cleaning and repair parts, including IMF's for a certain longevity. With my own Class A I have a consumption of about 5-liters/100 km Diesel fuel. This corresponds to 15 tons fuel, includingTMIs, for an assumed life time of 250 000 km. The total material consumption is therefore about 150g/km, of which ca. *60 grams or **40 % is due to fuel*** consumption. Water has not been considered in this computation. The **SMART** should show a considerably better g/km performance than 150, whereas dual drive vehicles may have a considerably higher than 150 g/km figure because copper has an MIF of 500 kg/kg.

It may be obvious, but it bears repeating, that determining impact potentials of chemical products and mixtures placed on the market by producers, formulators and importers require special consideration for their **toxic**, **eco-toxic** and other danger potentials. All original 24 OECD Member states promulgated substances control acts, starting more than 20 years ago and many other countries have since followed. The OECD has harmonized test guidelines for determining toxic and eco-toxic potentials as well as good laboratory procedures (GLP) for performing such tests. These test guidelines are now standard in the EU and in most other chemical producing countries. The OECD has also agreed on

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44 In FIPS, F stands for the German word Flaeche

45 Michael Ritthoff et. al.,: "Calculating MIPS – Resource Productivity of Products and Services", Wuppertal Institut, 2002.

46 The numbers given here are only approximate because the detailed material composition is not known to me. The consumption of tires, cleaning material and repair parts are presumed from the experience with my own Class A vehicle.

information procedures to be followed when chemicals are exported (guidelines for prior informed consent (PIC)).

For composing the danger potential of materials, **BASF** uses the parameters *"very toxic", "toxic", "harmful", "corrosive",* and *"irritant"* as part of its overall **Eco-Efficiency-Analysis** for materials. These properties constitute a conscious selection by BASF from among many additional toxic property information specified under the European Chemical Control legislation. They relate primarily to human health and to a lesser degree to the sustainability of the ecosphere. All can be determined by standardized testing procedures and require specified labeling of materials.

COPS

In order to make market prices of goods more transparent for consumers, I have proposed to use COPS, the costs per unit service [47]. That would mean for instance that a car dealer informs customers about the average approximate *costs per km* for using the car, including purchasing price, interest payments (if any), insurance, taxes, tires, gasoline, oil, regular check-ups etc, assuming a certain life time (which could be the same as the guarantee time).

For my own **Class A Mercedes** I come to the conclusion that I pay ca **28 euro cents/km** or ca **300 euro per months**, assuming a life time of 250 000 km for the car and 12 500 km/year use. The assumed costs include insurance, fuel (assuming 1.4 euro/liter average), tires and maintenance-repairs. In France, I pay no yearly taxes for the vehicle. **COPS** for my Class A Mercedes is therefore **ca 30 c/km.**

COPS-meters and MIPS-meters could be offered as a standard integrated item for all goods that have a relatively high consumption of water, energy etc during use. In this case purchasing, using and maintaining the good would probably have to be operated by means of an individual credit card like device that would also serves as a key for starting their operation.

MI-Factors - MIFs

In order to fulfill the requirement for "cradle to grave" analysis, I have defined *MI-factors, **MIFs** ("Rucksack-factors"),* for basic materials such as cement, steel, aluminum, PVC, and gold. MI-factors sum up the total material (and energy) input from *cradle to manufacture of products* and as such facilitate the fast computation of the total input of natural material into

[47] F. Schmidt-Bleek,: "Wieviel Umwelt braucht der Mensch", Birkhaeuser 1994

finished products, provided the material composition and the total weight (mass) of the finished product are known. MIFs are defined as the total amount of material and energy input in kg/kg for making the basic material available to the manufacturer. MIFs are intensity factors.

MIFs range from 1.2 for round wood, 5 for a typical plastic, 85 for aluminum, 500 for copper all the way to 540 000 for gold [48]. Most recycled materials carry lower rucksack factors than virgin materials, but some do not (for instance PVC). MI-factors depend on the source of the material, on conditions of transportation and storage, as well as on the technical processes involved in their production. Thus, MI-factors depend upon geological conditions at the location of extraction, technical processes, mode and distance of transportation etc. and should therefore be reviewed and adjusted from time to time. For this purpose, approved institutions on the national and international level would seem useful [49].

BASF uses *"reserve factors"* of raw materials as weighing factors for the various material inputs when producing a good [50]. These factors predict how long a particular raw material will presumably still be producible with today's economical methods, assuming that consumption remains constant. *Reserve factors* are not related to the ecological impact potential associated with the technical translocation and extraction of raw materials from their natural locations.

Many scientists and economists believe that it is technically induced *flows* of materials that are relevant for economic activities and their ecological consequences rather than the magnitude of "reserves" that rest in their natural location. Nevertheless, a discussion of this point with BASF's experts should be most interesting.

The Ecological Rucksack

The ecological rucksack of a product is defined as its MI - from cradle to first use - minus its own weight (mass).

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48 www.mips-online.de, www.wupper-institut.de; www.wupperinst.org; www.factor-x.info.de

49 The International Factor 10 Innovation Network has proposed the establishment of such an institution: PROREGIS. See www.factor10-institute.org. More recently, Arthur D. Little, Fraunhofer-Institut fuer System- und Innovationsforschung and the Wuppertal Institut: "Studie zur Konzeption eines Programms fuer die Steigerung der Materialeffizienz in der mittelstaendischen Industrie" (Study on a program for the increase of material efficiency in SMEs"), Wuppertal Institut, 2005

50 Peter Saling et. al., "Eco-efficiency Analysis by BASF: The Method", Internat. Journal of Life Cycle Analysis, 2002 (Online First)

The ecological rucksack of a service is correspondingly defined as the sum of all portions of the rucksacks of the goods utilized (utensils, machines, ICT, vehicles, buildings etc) for making the service available, plus the MI and the space necessary while the service is being consumed.

The ecological rucksacks of goods has been illustrated in a little story by *Eija Koski* of the Finnish Association of Nature Protection:

Mirjas' heavy morning
Mirja wakes up and puts her 12.5 kg wrist watch on;
Than she slips into her 30 kg Jeans;
Eagerly she brews her daily morning pleasure with her 52 kg heavy coffee machine;
And sipps it from her 1,5 kg beaker.
After having put on her 3,5 kg heavy jogging shoes
She drives her 400 kg heavy bike to the office.
Having arrived, she turns on her 11 ton computer
And answers her first telephone call with her 25 kg heavy telephone.
The working day of Mieja has begun
But this time with all the ecological rucksacks.

A number of companies and communities in Europe and Japan calculate and use ecological rucksack data for improving the resource productivity of their businesses. In Japan, Panasonic in Osaka has a fine program for this purpose **51**. In Sweden the town Haellefors has decided to construct new businesses and buildings along the line of Factor 10/MIPS and MIFs, including a large design center, the Swedish Formens Hus **52**.

Energy

The consumption of energy in itself is ecologically of little significance in almost all cases. The ecologically decisive factor in putting energy to work is its MIPS, the consumption of natural material per unit energy made available at the place of energy need. For example, using brown coal (lignite) as a heat source is a particularly significant threat to the natural evolution of the ecosphere because every ton requires the displacement of more than 10 tons of overburden and water on the average. In most cases it also calls for the removal of surface from its natural functions, and it requires resource-intensive transportation equipment.

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51 **Aoe.taeko@jp.panasonic.com**

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Solar and geo-thermal plants and windmills on the other hand are relatively dematerialized technologies and work with zero-cost natural input. Windmills provide electricity almost 50 times less material intensive than brown coal fired power plants. Moreover, they can still be improved with respect to their ecological rucksacks. The production of photovoltaic cells consumes considerable quantities of natural materials **53** and the MIPS of battery driven cars can be considerably higher than that of traditional vehicles of comparable capacity, in particular because of the high MI-factor of copper (500 kg/kg) and the use of batteries. In 1996, the *"aluminum car"* by Audi had a considerably higher ecological rucksack than its traditional steel brother, and only if driven for some 600 000 kilometers would its smaller weight become an ecological asset because of reduced fuel consumption **54**. The non-renewable MI for each kWh for the German electricity mix is about 4.7 kg, whereas the European mix measures close to 2 kg, and the MI of the Austrian and Finnish mix "weighs" less than 1 kg **55.**

The non-renewable MI/Mwh of **nuclear power plants**, counted from cradle to electricity on the grid, is close to that of hard coal fired power plants, not counting the technical investment in nuclear waste storage and treatment. This contrasts with the fact that the CO_2 emission of **nukes** is much more favorable per unit output than that of fossil fired power plants.

Measuring energy in mass terms has the advantage that mass and energy can be measured with the same physical units. Measuring energy in mass terms also captures the widely differing energy contents in fossil energy carriers per unit weight. Knowing the cradle to grave input of specific energy carriers for the life cycle of a good allows computation of CO_2 and other energy-generation- and use-related outputs.

Dematerializing the economy by Factor 10 will lead to an energy need reduction of up to a **factor 5** overall. Achieving Factor 10 therefore would mean a reduction in CO_2 emissions far beyond the demands of the Kyoto Protocol (8 % by 2020 for Germany), and most likely also the end of the unproductive and doctrine shrouded debate about nuclear power.

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53 Christopher Manstein has calculated the material intensity of all common types of electricity generation. The results can be found in F. Schmidt-Bleek,:"Das MIPS-Konzept", Droemer 1998

54 F. Schmidt-Bleek, "Das MIPS-Konzept – Faktor 10", Droemer, 1998

55 F. Schmidt-Bleek Ed., "Der Oekologische Rucksack, Wirtschaft fuer eine Zukunft mit Zukunft" (The Ecological Rucksack), Hirzel, 2004

In MIPS-computations, all energy inputs are in weight units. For solar and geothermal energy and electricity inputs into the economy, MIPS are computed on the basis of the MI of the technology applied in kg.

Design for Tomorrow [56]

"*True wealth is the use of things,*
not their possession
Aristotle

Eco-efficient products are based on defined customer demands and benefits. That means that eco-design starts with the definition of a desired service (pleasure, utility) or a bundle of services expected from the use of a product (the *«service delivery machine»)* **57 58 59 60.** The eco-efficiency analysis developed by **BSAF** also begins with the definition, here called the *«customer benefit»* **61***.*

Eco-efficient products are competitively priced goods that yield maximum possible utility/service – in terms of individual customers preferences – for the longest possible time, with a minimum of natural materials, energy, land-use, and dispersion of toxic substances – from cradle to grave.

The resource productivity (**S/MI**) of a product can be increased by social choices as well as by technical improvements. For instance, moving into a smaller apartment when the children have left, sharing things within a family and among friends (e.g. a lawn mower or power drill), using a towel several days instead of only one in a hotel, or the purchase of a smaller car can contribute significantly toward lowering the flow of natural resources. Improving the longevity of a machine can be achieved by either a technical change (e.g. modular design) or by better maintenance and longer

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56 Designing "eco-efficient", "eco-intelligent", "environment friendly" or "environment compatible" products and services

57 F. Schmidt-Bleek, Ursula. Tischner, " Produktentwicklung – Nutzen gestalten – Natur schonen", (Product development, designing utility, saving nature"), Austrian Chamber of Commerce, Wien, 1995

58 Walter Stahel, et. al., "Ökointelligente Produkte, Dienstleistungen und Arbeit", ("Eco-intelligent products, services and labor"), Birkhäuser, Basel, Boston, Berlin, 1997

59 F. Schmidt-Bleek, "Ökodesign – Vom Produkt zur Dienstleistungs-erfüllungsmaschine", ("Ecodesign – from product to service delivery machine"), Austrian Chamber of Commerce, Wien, 1999

60 Ch. Manstein et. al., "Klagenfurt Innovation", Klagenfurt,, ISBN 3 900743 74 6, 1999. Report on a training program for 50 SMEs for the Design of sustainable products, services, and management (also available in Japanese).

61 Peter Saling et. al., "Eco-efficiency Analysis by BASF: The Method", Internat. Journal of Life Cycle Analysis, 2002 (Online First), page 3

use on the part of the consumer. Replacing materials in products with those with lower MIFs can of course also lower MI and MIPS of products. And the number of extractable S can be increased by re-designing the product, for instance by developing a multifunctional product like the Swiss army knife or creating lotus-like surfaces, eliminating traditional cleaning altogether.

The hallmarks for products of the future can be summarized as follows:

- The number of service units obtainable from a product (the "service delivery machine") must be as large as possible.
- The life-cycle material input into processes, goods and services must be as low as possible.
- The life-cycle energy input into processes, goods and services must be as low as possible.
- The land use (surface coverage) per unit service must be as small as possible, from cradle to grave.
- The dispersion of toxins must be minimal.

Increasing the resource productivity of goods can be achieved in different ways:

- They can be leased or borrowed rather than owned;
- They can be made to last longer, require less maintenance and repair and consume less input of natural resources while performing their assigned tasks;
- They may be constructed in a modular way so as to allow easy up-dating, re-manufacturing, and better re-cycling;
- They can be designed to yield different types of utility with only slightly increased rucksacks (multi-functionality **62**);
- They can be dematerialized by replacing materials with high rucksack factors by those materials with smaller MIFs. In fact, this is usually the fastest and most cost-efficient way to obtain good results;

62 Increasing multi-functionality has its limits: Often, customers do not need and cannot make use of the multi-functionality that is routinely built into mass products like washing machines or computers. In this case the excess functions can increase MIPS without purpose and can make the product more subject to repair and shorter longevity than would be otherwise the case.

•The most challenging and far-reaching approach, however, is this: Define first the utility demanded - or a bundle of related needs - and then create a new type of service delivery machine – or a systems solution - that can reliably deliver this utility with the highest possible resource productivity (with the smallest possible MIPS) - life-cycle-wide.

Note that there is *no technology fix* involved when generating dematerialized services. Any technical route toward delivering a unit of a certain utility with less resource inputs than previously necessary is to be favored, provided, it conforms to legally imposed specifications in terms of toxicity and eco-toxicity.

TMF

From a global sustainability point of view, statements about the relative eco-efficiency of an individual product, a household or an enterprise are of limited value because they almost never allow the extrapolation to the total resource use on the regional, national or global level. There is no logical connection between statements of relative efficiency and that on an absolute scale. But in the end it is the absolute scale of resource consumption that matters for reaching sustainability.

It is for this reason that the eco-efficiency of products and services, if it is to become meaningful, must be imbedded in a broader resource productivity perspective. This can be accomplished by measuring TMF, the total material flow, (including the rucksacks) of nations, regions like the EU, or worldwide on a regular basis **63**. Monitoring TMF is essential for detecting rebound effects.

Why Factor 10?

Many experts now agree that approaching sustainability requires reducing the resource input into the global economy by at least 50 % on the average. *Social justice* requires that the 20 % of the world population who now enjoy the fruits of about 80 % of the technical resource flows make environmental space available for the rest of humanity. This implies that the rich of this world will either curtail the conveniences and security they enjoy now, or that they find

63 Stefan Bringezu, ; "Erdlandung" ("Earth landing"), Hirzel 2004; World Resources Institute: "The Weight of Nations", 2001, S. Bringezu: "Ressourcennutzung in Wirtschaftsräumen. Stoffstromanalysen für eine nachhaltige Raumentwicklung" ("Resource use in economies, material flow analyses for sustainable Development"), Heidelberg 2000. The European statistical office in Luxembourg, EUROSTAT, now publishes TMF information regularly

ways to use some ten times less resources for benefits equal or better than those of today. Today, there is plenty of evidence that technology can be dematerialized sufficiently without compromising end use satisfaction. We should also remind the reader that labor productivity has been increased far more than a factor of 10 since the beginning of the industriaol revolution.

Quoting John Maynard Keynes freely one might say that not only money but also natural resources form the bridge between today an the future. This implies that Germany has a chance for future with future if and when a sufficient number of enterpreneurs will generate as much wealth as possible with the least possible amount of natural resources because they believe that sustainability will only come about when investments in resource productivity will be profitable. As we have seen, some resource savings are profitable already. But we also noticed that for clearing the way to a promising future, governments will have to change some rules.

ACHIEVEMENTS BY 5 GERMAN ENTERPRISES

The following comments reflect much information that was kindly provided to me by the 5 companies sponsoring today's meeting. I will attempt to summarize progress toward sustainability achieved by these global players and suggest some further steps that could be taken. I am certain that the representatives of the enterprises assembled here in Tokyo will complete and – if appropriate - improve the picture presented by me.

Improving the eco-efficiency of industrial products is at the same time the foundation for offering increasingly eco-friendly services because in the industrialized world, no service can any longer be provided without the help of goods and infrastructures.

When compared to a few years ago, progress of big German enterprises in approaching sustainability is nothing less than astounding. Their achievements have deservedly won recognition and awards by many professional organizations, foundations and governments.

Perhaps the most pervasive improvement in Germany is the growing cross industrial collaboration in moving toward sustainability. All companies sponsoring the forum today have multiple co-operation schemes, supporting each other in their deliberate strives to move toward sustainability and influencing thousands of business associates far beyond traditional supplier-customer relations.

Judging from the information given to me, there is growing interest among the 5 sponsoring companies to work hand in hand with governments as well as international organizations in moving toward policies that can smoothen the way to sustainability. For example, **HEIDELBERG** says: *"We need challenging legal regulations creating essential improvements – without causing too much bureaucracy*". This is precisely what I was referring to earlier in this communication.

From my point of view this is important for at least two reasons. On the one hand, industry needs certain economic, fiscal and social framework conditions in order to optimize its own contributions toward sustainability.

Secondly, progress by ***authorities*** in adapting their internal procedures for moving toward sustainability has hitherto been lacking in strength. Industry could share its experience with governments, for instance in reporting progress, in cross-cutting decision making procedures, in focusing on procurement of eco-efficient products and services, in re-shaping *"customer"* relations of administrative units, in matters of education and in adjusting research priorities.

One forum where systemic needs and systemic plans for change could be discussed in Germany is **Ecosense.** *Ecosense* has been established by German enterprises and organizations engaged in global activities as a forum for dialogue between commerce, politics and society. It already participates in the political discourse as an opinion leader, seeking to actively shape issues. According to its statutes, **Ecosense** is particularly interested in framework conditions that can support a sustainable future. Several issues were touched upon in this presentation that make timely government activities for smoothening the way to sustainability urgent. **Ecosense** could therefore be the place for intensifying industry's concerted pro-active efforts in sharing its broad experiences with government. **DaimlerChrysler** and **BASF** mention ongoing cooperation within **Ecosense** in this regard**.**

While there is apparently still a considerable potential for saving natural resources in small and medium sized enterprises, large German companies continue to install epoch-making technologies that lower resource use and waste generation during manufacturing. Altogether, German industry is **leading in waste-water-free** manufacturing

processes. **Rainwater** is frequently used to replace loss of water during operations [64].

In Germany, it seems now commonly accepted that:

- Sustainability will be won on the market – or not at all.
- The availability of *"life-cycle-wide"* information is vital when judging the environmental impact potential of products, processes and services. This includes chemicals.
- When attempting to improve the eco-efficiency of industrial products, the design, the material composition and transportation intensity is frequently more important than manufacturing performance;
- The environmental impact potential of goods and services depends in a fundamental manner upon their resource productivity.

Since 1997, the **Global Reporting Initiative**, **GRI** attempts to answer this question: How can one obtain a clear picture of the human and ecological impact of business, so that Civil Society, consumers and governments can make informed decisions about purchases of goods and services, investments, and partnerships [65]? The initiative grew out of concerns that the ability of the general public and governments to influence decisions of business is eroding steadily due to globalization. The **GRI Guidelines** are open to improvements and their application is voluntary.

GRI has proposed a large number of indicators for systematically assessing and presenting the influence of business on the economic, social and environmental dimension of sustainability. **GRI's** tableau captures the state of the art well.

DaimlerChrysler [66] displays in its *"Sustainability Profile 2005"* the relation between the items covered in its report and the **GRI Index**. This is a very useful exercise and could be adopted also by other companies. This alone would contribute a great deal toward harmonizing industry's voluntary transparency for consumers and governments. Giving

64 The Efficiency Agency of Northrhine Westfalia is currently composing a brochure that details waste-water free manufacturing processes in many industrial branches.

65 www.globalreporting.org

66 WWW.DAIMLERCHRYSLER.COM/SUSTAINABILITY

numerical *"ratio information"* more prominence would be very helpful. The addition of ***"product specific core ratio indicators"***, as well as ***"core performance ratio indicators"*** to yearly reports would improve the quality of **DaimlerChrysler's** *"Sustainability Profile"* considerably.

The number of **GRI** criteria for all dimensions of sustainability is large. Therefore this listing does not seem very suitable for **executive decision-making**. It does *not* allow effective and efficient initial determination of site specific performances and product specific qualities as regards their ecological impact potential.

DaimlerChrysler believes that cross industrial activities should focus on developing globally harmonized environmental evaluation schemes that are transparent and easy to understand in order to allow comprehensive comparison of environmental impacts of products and services world-wide. I will touch on this point when discussing **TUV-Rheinland's** role below.

DaimlerCrysler pays profound attention to alternative energy source development, global warming issues and sustainable mobility, complete product recycling and waste water treatment. **DaimlerChrysler** also states that it works toward *"zero hazardous emissions"* from industry and households.

For the time being, the **longevity** of products has been less than prominent as an important product property on the agenda of most manufacturers. Longevity has an important positive impact on the ecological quality of products because the "*investment*" of natural resources (**MI,**) in long-lived products yields more units of service (**S**), for a longer period of time, thus lowering **MIPS. HEIDELBERG** is the one company among the 5 that specifically mentions *durability* and *resistance against corrosion* during use of its machines as environment related criteria. This does not seem to be surprising in view of the fact that their products typically have a lifetime of over 30 years.

HEIDELBERG is among the world leaders in manufacturing high tech/high performance printing machines. **HEIDELBERG** is also regarded as an internationally leader in innovating high performance cutting **(HPC)** technology for cube-shaped components needed for constructing complex machines. **HPC** is 3 to 30 times faster than conventional cutting, drilling and milling techniques, it produces smoother surfaces, improves the life-time of tools, increases the rate of metal removal by a factor of 10, and it achieves a factor 25 000 in reducing the quantity of cooling liquids (traditionally around 5000 liters of emulsion per process hour). **HEIDELBERG** has intensive

cross-company cooperation with dozens of business associates in applying and improving **HPC** technology. Among them are **BOSCH** and **DaimlerChrysler.**

In its *"Sustainability Reports"* [67], **HEIDELBERG** mentions material inputs and outputs, some material savings, electric energy savings of up to 75 %, and VOC emission reduction of 50% energy needs, as well as environmentally friendly cleaning of their machines during their use phase.

HEIDELBERG uses the following "*internal criteria"*: *energy consumption* ("if relevant"), "forbidden" substances in *material inputs*, *waste generation*, emission of *VOC*, *ink* and *varnish mist*, *powder dust and ammonia*, emission of *noise*. Systematic life-cycle-wide analyses are *not* performed for its products. One single LCA revealed that the preponderance of environmental impacts is due to the *use* of its machines.

While **HEIDELBERG** assumes that recycling of its products is no major ecological concern on account of its longevity, take-back and re-manufacturing of its machines play an important role in many parts of the world.

HEIDELBERG conducts audits of all new suppliers and monitors the performance of all suppliers regularly. Customers are informed by way of a series of brochures called *"Printing and the Environment".* Business associates and the public can also visit a newly created *"Environmental Information Center"* where key environmental aspects of using **HEIDELBERG's** printing machines are being demonstrated. **HEIDELBERG** has made the experience that hardly any of the print buyers ask for information on sustainability. 80 % of these companies are SME's with less than 20 employees.

HEIDELBERG's sustainability report lacks quantitative information. It is not possible to compare the environmental performance of their production sites with other companies. Product specific input and output data are not provided. It would seem useful if **HEIDELBERG** could take **DaimlerChryslers** *"Sustainability Profile 2005"* as an example to follow as a first step and eventually follow **BASF's** lead in producing *"eco-efficiency portfolios"* (see below).

BOSCH calls its principal report on ecological, social, and economic performance during 2003/2004 the *"Global Responsibility Environmental Report"* [68]. **BOSCH's** Automotive Systems Corporation published a separate report

67 www.heidelberg.com

68 www.boschenvironmet.com

entitled: "Social & Environmental Report 2004" [69]. The worldwide **BOSCH Group** has elected the following environmental **core data** when considering its overall ecological performance: Energy and water consumption, total waste generation and CO_2 emission (compare the *"Hexagon-display"* of **BASF** below, but note that the core indicators of the **BOSCH Group** apply to the overall manufacturing performance of **BOSCH global** and *not* to individual products). From 2002 to 2003 the **BOSCH** figures for all 4 core items increased by 38 %, 23 %, 26 % and 103 % respectively. **BOSCH** attributes this to including the Buderus AG for the first time in its 2003 report.

Before including Buderus AG, the four core environmental figures seem to have decreased steadily for the **BOSCH Group** since the early 90ies. The **BOSCH Automotive Systems Corporation** reports additionally on site-specific yearly input materials (solvent, chlorinated HC, steel, aluminum, and some controlled substances) and output/transfer of certain controlled materials.

The *"Principles of Environmental Protection"* of the **BOSCH Group** apply to all its production sites, and apply equally to all its associates, service providers, and suppliers. Bosch states that it strives to minimize overall *material and fuel consumption*, optimizing logistics, moving toward "**ZERO WASTE**" [70], increasing the use of *"environmentally-friendly"* materials as well as *the "environmental performance" of products by* assuring *easy product disassembly,* maximum *re-manufacturing potential and recyclability.*

Of course the absolute increase in total yearly flows quoted above cannot be interpreted to show that **BOSCH's** site-specific environmental manufacturing performance has worsened. Nor can the data quoted be interpreted to mean that **BOSCH's** products have decreased in eco-efficiency. Unfortunately, however, the data provided in the report of the **BOSCH Group** do not exclude either possibility.

It would seem that following **DaimlerChryslers** lead in reporting along the **GRI Guidelines** could noticeably improve **BOSCH's** transparency, credibility and comparability as regards moving toward sustainable manufacturing and products. Beyond this, the addition of ***"product specific core ratio indicators"***, as well as ***"core performance ratio***

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[69] Fax No: +81 493 21 6340

[70] Compare to the "ZERO EMISSION" Program in Japan, centered at the United Nation University at Tokyo since 1991!

indicators" to yearly reports could give **BOSCH's** public sustainability image a significant boost.

BASF is one of the world's leading manufacturers of chemical products. This means that **BASF** has responsibility for an extraordinarily wide variety of products, derived from over 10 000 different raw materials from approximately 5000 suppliers. Every single chemical *can* be a dangerous product, even if close "relatives" are well known to be (relatively) harmless.

For this reason, *all* chemical products have been put under legal control in the OECD countries, including labeling provisions, more than twenty years now. Even *before* marketing of *new* chemicals can occur, a considerable number of test and other data have to be supplied to authorities in the EU (the so-called *"base set"* of the *"step sequence plan"* [71]), yielding information about toxicity, physical properties and environmental behavior. More sophisticated information must be supplied under specified conditions at a later stage.

From the very beginning, the focus of chemical producers was naturally on the individual product as regards human health and environmental impact potentials. Thus, the concept of ***„product specific core indicators"*** is a routine matter for **BASF's** scientists.

Because the design of a chemical product begins traditionally with the question of how to meet a customer's need (or serve a specific purpose, or solve a certain problem) *„product specific core ratio indicators"* are not new to chemical companies either. In the case of indigo, for examples, **BASF** chose as a practical *"unit of service"* (the **S** in **MIPS**) "*dying 1000 pairs of jeans*".

Being an energy-intensive industry sector, chemical industry has continuously intensified its attention to optimizing the use of energy input during production. Since profits of chemical industry are rather sensitive to the *"yield"* of synthetic procedures, optimizing material and energy inputs as well as minimizing waste are daily routine tasks for chemical engineers.

Knowing not only its products, but also the emissions into the air and water well from a chemical point of view, *"cleaner production"* as well as emission and waste control can be managed rather straight forwardly by chemical companies.

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71 The "step sequence plan" for notifying new chemicals in the EU was actually invented at the dining table of the author

BASF is therefore particularly well placed among the 5 companies sponsoring this meeting for developing a systematic procedure for establishing ***eco-efficiency portfolios*** for manufacturing performance and industrial products in general. **BASF** began its work in this area in 1996 [72]. *Raw material and energy consumption, emissions into air and water and disposals, toxicity, hazard potential,* and *land use* have been chosen as core indicators. They are analyzed and results displayed in a hexogram [73]. In this fashion, the *status quo* and improvements over time can be visualized in a simple fashion and as such support executive decision-making. Such displays are very helpful also for identifying areas for which improvements seem particularly urgent or easy to achieve. Various manufacturing options for a particular product can be compared with one-another, as can be the ecological impact potentials of the good produced by different manufacturing routes.

BASF compiles also data on costs for the various alternative production routes for the same chemical and the costs to the customer for applying the product for one and the same specific use or service (the **S** in **COPS).** Plotting the costs of production/use on the x-axis and the environmental impact for various production/product options on the y-axis, yields ***eco-efficiency portfolios*** for the various options for delivering the same utility or service. This display is an excellent tool for management decisions. Therefore, **BASF** employs this approach to determine which products and processes it will pursue in the future.

The purchasing department of **BASF** has the responsibility to check out suppliers and transporters locally as regards the quality and safety of supplies and transportation. In accordance with the *United Nations Global Compact Initiative,* **BASF** insists that all suppliers do *not* employ **children** or use forced or bonded laborers. Its procurement provisions also specify that suppliers must comply with the *International Labor Organizations' (ILO) employment standards*.

For the public and its business associates, **BASF** maintains a *"Sustainability Service Center"* in Ludwigshafen, Germany

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[72] Peter Saling et al., "Eco-efficiency Analysis by BASF: The Method", Internat. Journal of Life Cycle Analysis (Online First), 2002

[73] This approach was pioneered for chemicals by Dow Europe in Switzerland, starting in 1994. See: Claude Fussler, "Driving Eco-Innovation", Pitman, 1996. In 1998 Schmidt-Bleak suggested a similar hexagon display as an aid for the design of eco-intelligent products in his book "Das MIPS Konzept , Weniger Naturverbrauch - mehr Lebensqualitaet durch Faktor 10" (page 110), Droemer. Christa Liedtke and her co-workers of the Wuppertal Institut have published similar approaches since 1998 (Christa.Liedtke@wupperinst.de .)

and the company pro-actively supports SME's in modernizing production procedures and assessing the co-efficiency of their products.

On a global and cross-industrial level, the **TUV Rheinland Group** monitors and documents ***as a neutral party*** the safety and quality of new and existing products, systems and services, supporting and securing state of the art innovation toward harmony between man and the ecosphere. Both, legal frameworks and voluntary commitments form the basis for **TUV Rheinland's** work. For example: The *"Green Purchasing Network"* in Japan has profited from **TUV Rheinland Group's** experience in applying ISO's 14001 standard, as have systematic supply chain investigations for hazardous substances in materials for electronic products and vehicles in many countries.

Again I should like to stress the overriding importance of applying an *internationally harmonized* approach to assessing ecological impact potentials of manufacturing performance and products – on a life-cycle-wide basis. All human activities, all human wealth and happiness depend upon the resource base and the environmental services of the one planet earth we got. And all outputs from manufacturing and consumption have their impacts upon the very same one planet earth.
If harmonization is not achieved, sustainability cannot be reached.

Based on the experience in the EU for managing chemical substances as regards their potential dangerous effects on humans and the environment, it may be useful to consider developing a **step system** for assessing and displaying both, the **eco-efficiency of manufacturing performance** and the **ecological impact potential of products and services.**

The 5 companies sponsoring today's meeting may wish to *first* intensify sharing among them and pool their rich experiences in reporting on sustainable developments, and how to assess them in a transparent, reproducible manner. They may *secondly* undertake a joint activity with the aim to develop and agree on a **harmonized approach** for assessing eco-efficiency, perhaps on the basis of **a systematic step systems approach**.

The exercise could start with answering this question: What is the *basic physical cause, or causes, that is responsible for our failure* to develop an economy that produces goods and services in harmony with the natural system? And the second question is this: Among all the possible basic causes one may

think of, which of them apply to ***all*** products and ***all*** services? The answers should lead to the *"base set"* of core indicators, followed by a well-systematized collection of additional criteria/indicators that can be assembled from various sources. For the sake of supporting effective management decision, the aim should always be to keep the whole catalogue of indicators on all levels of analyses *as small as possible*.

Reporting by virtue of an internationally harmonized ***"base set"*** will increase transparency and comparability of industry and its products as regards sustainability impact potential on a global level. This would be a decisive step in supporting worldwide efforts for reaching sustainability.

I have the impression that the **TUV Rheinland Group** is well positioned to lead an effort of working out common assessment procedures in close co-operation with the 5 sponsoring companies - and perhaps some other knowledgeable parties, including major Japanese firms. I would suggest that **BASF**'s approach serve as a starting point for assessing the ecological impact potentials of **manufacturing performance** as well as **products,** to be followed by establishing **eco-efficiency portfolios.**

Of course it is the responsibility and privilege of well-established bodies like the OECD or the Commission in Bruxelles to harmonize assessment procedures for goods in international trade. In my experience, however, development and harmonization of practical instruments starts with the determined effort of a few highly trained experts with lots of practical experience, with sufficient time, money and freedom from pressure by interested parties. Some of the companies sponsoring this symposium have practical experience in dealing with international governmental organizations.

It was a great honor and rare pleasure having been invited to share some thoughts with you today. I wish you every possible success in making this world a safer place and giving it a better chance to be a wonderful place for future generations.

I will close my contribution by quoting a poetic description of planet earth and the shortsighted use of it by us for material wealth production:

> *Unspoiled, undamaged, ruled by her own natural law and subject only to her own will - and the great void whence she sprang - the great Mother Earth took pleasure in creating and sustaining life in all its prolific diversity. But*

pillaged by a plundering dominion, raped of her resources, despoiled by unchecked pollution, and befouled by excess and corruption, her fecund ability to create and sustain could be undone. Though rendered sterile by destructive subjugation, her great productive fertility exhausted, the final irony would still be hers

Jean Auel, “Plains of Passage”

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