Factor 10 Manifesto

In Brief

”We cannot afford the western kind of environmental protection at this time. We will first establish a market economy and then, when we are as rich as you are, we will take care of the environment”, S. S. Shatalin, chief economic advisor to president Gorbachev said in a conversation with Bio Schmidt-Bleek at the International Institute for Applied Systems Analysis (IIASA) at Laxenburg, Austria in 1989. It became suddenly clear that whatever western countries had hitherto undertaken to protect the environment was not a valid model for reaching ecological sustainability.

This encounter spawned the concepts of Factors 10 and 4, ecological rucksacks, Total Material Flow-TMF or Total Material Requirement -TMR and Material Input Pro unit Service or utility-MIPS. I began searching for a different way to protect the environment, an approach to sustainability that could be integral part of the market and yield profits rather than generate costs.

Violent and life-threatening reactions of the ecosphere to the stresses imposed by human activities are still growing in all parts of the world. Humanity continues to live in an increasingly dangerous and unsustainable environment. Essential environmental services are declining at an alarming pace. More people are exposed to polluted air and have less clean water available than ever before and fertile soil is eroding fast. Fresh water supplies are dwindling, bio-diversity is still rapidly declining, and so are forested areas.

The unprecedented destructive storms in France just before Christmas 1999 have lead to an urgent request of the insurance industry to the government for strengthening policies against climatic changes.

Questions to be answered

There are three key questions that need be answered when embarking on eco-restructuring the world-economy with the goal to move unerringly toward a more sustainable future, both ecologically and economically:

First: *What are the key man-made root-causes for the worsening ecological crisis?*

Second: *What are the limits to which we can stress the carrier system earth with our technologies without seriously and irreversibly damaging life-sustaining environmental services for human survival?*

Third: *What are the characteristics of a win-win strategy that offers effective and precautionary environmental protection as an integral part of a market economy without add-on costs?*

The **answers** are as follows:

First: Environmental damage is caused not only by pollution but also by the processes involved in extracting natural resources. In fact, extracting resources is the more significant cause, not only because all materials taken into an economy end up sooner or later as emissions and wastes, but also because technical displacement of natural resources causes irreversible changes by itself.

Second: Based on observations, the worldwide consumption of natural resources has to be lowered by at least one half on the average before a state of balanced co-evolution between the human economy and the ecosphere can be expected. This implies a reduction in *absolute* levels of resource consumption, be it for fossils, for metals, for sweet water, or for fish, or timber.

Third: Major attributes of a win-win strategy are the increase of the resource productivity of the entire human wealth-producing machine, pushed on by significant fiscal reforms and supported by massive innovation in the areas of production, trade, and consumption. Industrial practices, norms and standards need be reviewed with respect to their impact on resource use. And finally, robust directional indicators must be agreed to.

More in Detail

Wastes

On the average, more than 90 % of the resources harvested and displaced in nature are wasted on the way to producing food, machines, vehicles, and infrastructures. All western systems operate with a lot of wastes. Frequently, the fulfillment of human demands is not at all a question of increasing supplies but rather a question of utilizing available supplies more intelligently.
On the average, close to 100 tons of non-renewable are consumed every year per person to support the current life-style in industrialized countries, in addition to more than 500 tons of sweet water. This is 30 to 50 times more than is available in the poorest countries. Every German occupies 150 square meters of the earth's surface for the production of his or her coffee beans. To build a catalytic converter for a car requires close to 3 tons of non-renewable natural materials, and a PC between 8 and 14 tons.
Not enough raw materials, nor water, nor environmental space are available on this earth to support this kind of consumption for all human beings. More than three planets would be needed if western life-styles and technology were to be adopted by all people on this earth.
And long before the economies run out of resources, humankind will have begun to suffer disastrous ecological consequences from this kind of parasitic behavior. Environmental services cannot be replaced by technology in most cases, at any costs.

Factor 10

As we noted already, reaching sustainability demands an absolute reduction in resource use of at least 50 %. Moreover, equity demands that the rich make sufficient environmental space available for the poor when moving jointly toward ecological sustainability. As less than 20 % of humankind consume in excess of 80 % of the natural resources at this time, the richer countries need to dematerialize their technical basis of wealth – or increase the resource productivity - by *at least a factor 10* on the average (Schmidt-Bleek*, 1993).
Factor 10 is not a mathematical answer to the complex environmental crisis, nor is it an economic model. It is a valid objective. It is a flexible goal that will be refined as experience with changing life styles grows.

Justice

Environmental consumption on the part of the rich, globally and nationally, has an enormous bearing on the possibilities for achieving greater social justice (Sachs*, 1999). One reason for that is the common confusion between cleanliness and sustainability. For 25 years environmental policy has largely focused on cleaning and protecting air, water, and soils. Regulators have concentrated on reducing the flow of harmful substances into nature, and filter technologies have been mounted at the ends of pipes in order to control emissions at the tail end of production and consumption. If the environmental crisis is defined in terms of too much pollution, the issue of justice enters only when the social distribution of harmful impacts is considered – who gets polluted more than others get? But justice acquires a different and more fundamental relevance if the crisis is defined in terms of excessive use of resource use.

Environmental Policies

Even a clean economy can cheerfully continue eroding soils, cutting down forests, degrading bio-diversity and increasing the sea level. What really matters is the sheer volume of material throughput, not so much the pollutants in the output. The environmental performance of most manufacturing firms depends to a much higher degree on the design and the material content of their products and services than on the way in which they are being produced.

Most present environmental policies, however, still focus on the tail end rather than the front-end of the economy. They encourage end-of-the-pipe solutions and treating or re-cycling resources, rather than increasing the productivity with which they are used. Present policies rarely rely on market forces. They are subservient to the bygone myth that a healthy economy needs ever increasing quantities of natural resources. In fact, present environmental policies contribute themselves toward un-sustainability in that they require additional resource consumption for their implementation. As a consequence, they foster a steady increase in environmental protection costs, both on the technical as well as on the administrative side.

Time Frame

”Within one generation, nations can achieve a tenfold increase in the efficiency with which they use natural resources and other materials” (Factor 10 Club). However, determined moves toward sustainability have to begin *now*, as more than two billion people are moving aggressively in copying the western way of life, cementing even further the dangerous trend toward the collapse of environmental services. In addition, it will take at least a decade to set a different economy and a more eco-intelligent technology in motion while avoiding serious disruptions of the economy.
One of the basic – but deeply engrained - fallacies of the present economic system in the west is its fix on short terms because it operates with little concern for the future. This must change. At stake is not only the ecological sustainability, but the economic and social sustainability as well.

MIPS and Rucksacks:

Without appropriate measurements and indicators, management remains directionally hazardous and costly (EEA, 1999). Therefore, technical improvement in resource consumption and changes in consumer behavior must be quantifiable – and measurable against a goal like Factor 10. Otherwise the approach toward sustainability remains what it is largely today: a foggy night-flight without reliable instruments.
It is well known that measurements of environmental performances or quality can be grossly misleading if they are not based on ”cradle to cradle” (Stahel) observations. In view of the huge number of products, services, technical processes, consumers, firms, and traders involved in the global exchange and consumption of goods within and among some 200 countries, indicators must be cost-efficient, easy to understand and to apply, directionally safe, quickly computable, and

internationally acknowledged, if they are to help in guiding billions of daily decisions toward sustainability. Sustainability will be reached on the market, or not at all.
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.
In a like fashion, the input of natural resources per unit utility or service can be used to initially compare the "ecological prices" of functionally equivalent products or like services. Depending upon the importance of the decision at hand, more elaborate considerations may subsequently be necessary, just as is the case once the monetary price comparison has yielded a first but occasionally still insufficient basis for a final decision.
The human economy requires materials and space (surface area) as natural resource inputs from the ecosphere. 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 forms – causes additional stress.

In 1992, I proposed *the material input per unit service – **MI / S or MIPS*** – as a basic measure for the ecological stress potential of products and services. The **M** 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.
The higher MIPS, 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 for basic materials (like steel, plastic, wood, or cement, see: http://www.wupperinst.org), the MI and the **ecological rucksack** of complex products can be computed straightforwardly (Schmidt-Bleek, 1999/1). *The ecological rucksack of a product is defined as its MI minus its own weight*.

MIPS can be improved

The MIPS of products can be lowered – or the resource productivity 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, or the purchase of a smaller car can contribute significantly toward preserving 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 use on the part of the user. Exchanging materials (replacing materials with those carrying lower rucksacks) can of course also lower MI. And S can be increased by re-designing the product altogether (for instance by developing a multifunctional product like the Swiss army knife) (Schmidt-Bleek*, 1993, 1995, 1998).

Rucksack Factor and FIPS

MI-factors for basic materials 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. Most recycled non-renewable materials carry lower rucksacks than virgin materials. But some do not (for instance PVC). MI-factors depend on the source of the material, on conditions of transportation, as well as on the technical processes involved in their production. Thus, MI-factors change over time and must regularly be reviewed and adjusted. For this, approved institutions on the national and international level are needed. The Factor 10 Innovation Network has just received funding from Germany and Austria to build up first such data bank for MI and MIPS.
Similar to MIPS, the specific surface intensity of products, crops, buildings, infrastructures, and services can be computed in terms of **FI / S** or **FIPS** (where F stands for "Flaeche", the German word

for surface area). F can be measured in units of square meters. The actual area to be used for computing FIPS must be scaled on the basis of the extent to which the ecological functions have been diminished. For instance, sealing an area completely with cement represents maximum disturbance. Using soil for agricultural production, on the other hand, diminishes the natural function less (Liedtke, 2000).

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, the burning of brown coal (lignite) for heating purposes 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. It also calls for the removal of surface from its natural functions, and it requires resource-intensive transportation equipment – in addition to generating CO2, SO2, NOX and dust on the output side that have to be filtered out technically to the extent possible with considerable input of natural resources.
Solar heat plants and windmills on the other hand are relatively dematerialized technologies and provide electricity almost 50 times less resource intensive than brown coal fired power plants. Moreover, they can still be improved considerably with respect to their ecological rucksacks. The production of photovoltaic cells consumes enormous quantities of natural materials and the MIPS of electric cars are far higher than that of traditional vehicles of comparable capacity. The ”aluminum car” by Audi has a considerably higher ecological rucksack than its traditional steel brother, and only if it lasted for some 600 000 kilometers would its smaller weight become an ecological asset (Schmidt-Bleek*, 1998). The non-renewable MI for each kWh for the German electricity mix is 4.7 kg, whereas the European mix measures 2.0 kg, and the Austrian mix only 0.8 kg.
Dematerializing an economy by Factor 10 will lead to an energy reduction of roughly a factor 5 overall. Achieving Factor 10 therefore means the end of the fossil age as well as the end of the debate about nuclear power.

That Which Factor 10 Cannot

The Factor 10 Concept does *not* deal with eco-toxicity or with human-toxicity issues directly. Environmental policies dealing with hazardous substances can therefor *not* be guided by MIPS, at least not alone. The use of agricultural chemicals, for instance, could be cut down in many cases manifold, if laws would require much more efficient application technologies.
It should be recalled that the severity of the inadvertent impact of materials on human beings or the environment depends not just upon their specific toxicity, but also upon their concentration, their *quantity* at the place of impact. For instance, it is entirely possible to kill a person by the intake of several liters of distilled water, and a lawn can be sniffed out if sufficient sand is spread over it. There are many millions of very hungry people on this earth who are driven from their land by moving sand dunes.
Any drastic dematerialization of an economy will lower the exposure potential to natural as well as synthetic materials in the technosphere. This, of course, can easily be counterbalanced (”boomeranged”) by the introduction of new hazardous substances. However, many countries have legal protection instruments for controlling the use of toxic substances and others are part of Prior Informed Consent, PIC, agreements which may protect them from unwelcome imports (OECD, UNEP).
The European Environment Agency is currently engaged in developing ”hazardous chemical intensity indicators” (EEA, 1999).

It should be understood that ecological sustainability can not be reached by toxic substances control policies alone, whatever their cost - for theoretical and practical reasons. However, this should not detract from the fact that such policies are very important for the protection of human health and sensitive parts of the environment.

Another area where Factor 10 policies offer only indirect protection is the loss of bio-diversity. But here, too, quantities play a significant role. For example, the ever increasing clearance of natural habitats, the ever more intensive preparation, chemization, and use of soil for crop production, and the fast growing areas for human infrastructures and urban development exert important influences upon the disappearance of species.

TMF/TMR

Statements about relative efficiency on the product, household or firm level remain of little relevance as long as they are not linked to absolute volumes on the macro level: There is no logical connection between statements of relative efficiency and absolute scale, but it is in the end the absolute scale of resource consumption that matters. It is for this reason that the efficiency perspective, 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, or TMR, the total Material Requirement (including their rucksacks) of nations or regions on a regular basis (Bringezu, 1993, WRI, 1997, ISD, 1999).
Showing that TMF divided by GNP decreases over time is no proof for an ecologically adequate increase in resource productivity because TMF may still be increasing.

Rebound-Effects

These are effects that counteract reductions of resource use, waste avoidance, and emission decreases that were achieved on the level of individual production and consumption. They are probably the most serious threat to progress on the way to reaching sustainability.
Rebound effects can arise from technical efficiency gains that stimulate new expansion. Thus, energy savings by improved car engines were frequently ”eaten up” by bigger cars, faster driving or more mileage. Other examples include the increasing use of fax machines and paper. Of course, the sheer material growth of an economy can also counteract efficiency gains obtained on the level of individual technologies. For example, the electricity consumption has steadily increased for many decades even though the efficiency of power plants increased by a factor of more than two during the same time period.
If the composition of TMF with respect to the various economic sectors is known, rebound effects in these sectors can be detected, and counteracted by appropriate measures.

Psychology, Technology, Education and Training

Radio and television programs, newspapers, curricula from prep schools to universities, and a flood of books are still focusing on the traditional view of environmental problems and their solutions: There are many sinners in this world, particularly among the greedy industrialists, who poison the environment in order to safe money. We need to stop using and eating certain things, we should pay more respect to ”mother nature”, we need more ”environment technology”, stricter laws, so the story goes, to attain a different behavior, and prevent further soiling of the environment. And we need more police to bring the culprits to justice. Housewives spend many hundred million of unpaid (and untaxed) working hours to sort out wastes, seriously believing that these are important contributions toward sustainability. In reality they clean up (without profit and assurance of environmental improvement) what the production sector placed on the market (with profit).

”Environmental Technology” is still commonly understood to mean equipment that purifies water and soil and that retains or cleans up dangerous emissions, effluents, and wastes of industry, farms, households, vehicles, and waste dumps. ”Zero-energy houses” compete on the market without regard to their MIPS values. Existing buildings are still demolished for the sake of building ”environmentally sound” structures in their place with subsidies. And cotton is still looked upon as a fine ecological material, even though up to 45000 kg of sweet water are used (in Russia and in the USA) for irrigation to produce 1 kg of it. Chemical fibers, on the other hand, with far lower rucksacks, are supposed to be environmentally destructive. Most Greens in Germany are deeply convinced that the ”Transrapid” (Meglev) is an unecological transportation system whereas published calculations show it to be much better as regards MIPS than the existing rail-bound transportation system ICE.
While some of the cleanup activities will still be necessary for a transitional period into the future, none of them will ever lead to sustainability. A re-orientation is desperately needed, and it has to begin soon. Some pro-active firms have started to move in the direction of dematerialization, with profits to the bottom line (Fussler*, 1996, Hawken*, 1999).
But in order to move forward fast enough to avoid life-threatening backlashes of the ecosphere we need new stimuli like ”low-MIPS” government purchasing policies and new R&D programs, information campaigns, training and education programs, we need prizes for winning performers, and tax breaks for proactive producers, traders, builders, institutions, and consumers – in addition to a radical fiscal reform.

Population

With respect to natural resources, human beings can act as consumers only. Technology cannot generate most natural resources or services - at any price. The larger the world population becomes, the fewer natural resources are available for an individual in our finite world. Because of this, the present trend of the world population forces continuous upward adjustments of Factor 10. Ecologically even more significant than increasing world population, however, is the trend toward ”singles”, particularly in industrialized countries. This is so because each ”single”, tends to exhibit a basic demand in material investments which could also satisfy a family with children: bathroom, toilet, washing machine, micro-wave oven, vacuum cleaner, power drill, car, etc. On the average, the appearance of a new ”single” in Germany for example is equivalent to at least 50 newborn babies in Namibia in terms of resource consumption.

Innovation and Design

For reaching Factor 10, massive technological and social innovation as well as re-direction of consumption is unavoidable.
The basic requirement for eco-design *is to generate as much units of service or utility (and fun) as possible out of the smallest possible quantity of natural resources (including rucksacks) for the longest possible time period.*
Thus, a painting by Picasso could be called a very ecological product. Yamamotosan has recently provided a wonderful example of sustainable architecture (Yamamoto, 1999). The Hohryuji Temple in Japan was built about 1300 years ago, major parts having being constructed with cypress wood that in itself is more than 2000 years old. The ecological rucksack of wood is understandably very low. Hohryuji has survived many earthquakes. The structural durability derives in part from the temple’s flexible structure in which the central pillar hangs free from the roof so that it can counteract the forces of earthquakes. And the pavilion of Japan at the EXPO 2000, designed by Shigeru Ban of Tokyo, is a structure built of recycled carton.

The principal focus of innovation must shift from generating ever-new products - in particular those for saving labor - to the provision of dematerialized technical and managerial answers to social needs and wants.
Here is a practical question: How and how much could the resource productivity of automotive city driving be improved (per passenger-km) under condition that all present needs are comfortably met? Unfortunately no detailed studies have as yet been performed. However, a rough calculation shows the potential for a Factor 25 when presently available materials and technologies are employed. The "Smart" of Mercedes is on its way to meet this future. Unfortunately it is regularly criticized and ridiculed by journalists because it does not conform to their perceptions.
Statements about productivity increases of parts of a product – for instance a Factor 4 increase for the carburetor of a car – have little relevance as long as they are not related to the dematerialization of the whole "service delivery machine", in this case the automobile.
Reaching Factor 10 is not bound by any particular technology. Dematerialized products are high quality products by definition since they need to be long-lived and robust, they must be easy to operate, to maintain, to up-date, and to repair. The design of eco-intelligent products, as well as the appropriate information of consumers – e.g. by labels - requires the knowledge of MI-factors for basic materials.
Many experiences in companies have shown that Factor 10 design requires the creative dialogue among many actors throughout the supply chain, and in particular also the participation of consumers for creating new and adequate solutions. These conditions can be met much more easily by local and regional enterprises than by global players.
In praxis and in theory, products need henceforth be considered as "service delivery machines" whose possession is far less important than their convenient and cost-efficient accessibility for use.
Practical examples for Factor 10 (and much more than Factor 10) abound (Fussler, 1995, Hawken, 1999, Yamamoto, 1999/2). Practical approaches to creating dematerialized technical and social solutions have been developed. And guidelines for their design and construction have been published (Schmidt-Bleek, 1995, 1999).

Markets, Fiscal Reform, And Employment

Current market prices of natural resources are probably too modest to stimulate developments all the way to Factor 10 and more. In many instances, the prices of resources are even subsidized in various ways. In contrast, labor costs are high in most industrialized countries and they are frequently the reason why firms shed labor and replace it with resource-intensive equipment. To a considerable extent, the high cost of labor (not salaries) is the consequence of deliberate policies– and not at all the inevitable consequences of market forces. In the EU, in excess of 80 % of all taxes are income-related (Paleocrassas 1999). Massive subsidies (for example some 300 billion Marks per year in Germany) and privileges for special interest groups perturb the market still further, often stimulating resource consumption, and so do many existing technical norms and standards.
Chances and timing of reaching Factor 10 depends to a considerable degree upon increasing the relative prices of natural resources at the front end of the production chain. Prices of basic materials and energy have a strong influence on design, construction, trade, and the maintenance of products and of course also on consumer choices and behavior. Market forces will drive these changes, once the prices of natural resources begin to rise. The higher the prices, the more will competition among producers push innovation toward dematerialized products and services. History has shown the way: The increase of labor cost through social and tax policies, if unintentionally, has spawned tremendous technical progress beginning in the late 18th century.
And saving taxes will be the down right pleasure of shopping for low-MIPS (low-cost) services and products.
It is a commonplace that the present tax base of many industrialized countries is inappropriate for financing necessary public tasks in the medium term. Major fiscal reforms are overdue for many

reasons other than environmental protection. It is therefore rather perverse when politicians imply that resource taxes are synonymous with ”eco-taxes”.
Shifting sources of public revenue from labor to resources would very likely create jobs by making labor cheaper (not salaries lower). Shifting from a throughput economy to one where longevity of products becomes the standard of success would offer additional hopes for increasing the need for labor because maintaining, updating, and repairing products, buildings, and infrastructures is considerably more labor intensive than manufacturing new ones (Bierter, 1997).
As experiences have shown in Germany and elsewhere, small and timid step by step moves in the direction of resource taxation can be a frustrating experience, easily seized upon by populist actors to slow down the process of moving toward sustainability of both, the tax base, and the environment. *As is true in so many areas of life when paradigmatic changes are imminent: only bold designs and their execution will be successful, even if only part of the original goals can be reached in the first effort*.

World Trade and Foreign Aid

Most products and services traded on the world market today are ”high-MIPS” in nature. For this reason, every expansion of the world volume of consumption, for example by means of liberalizing trade or subsidizing transports, is ecologically counterproductive. This applies to industrial goods as much as to agricultural products. Consequently, any further liberalization of the world markets at this time prevents reaching ecological sustainability, whatever benefits may otherwise be reaped.

Similarly, the infrastructures, buildings, products, food, and services provided to developing countries today within the context of foreign aid must be viewed as ecological time bombs. Not only are they resource intensive by themselves, they also stimulate local developments of un-ecological food, products, and services in the receiving countries, occasionally displacing much more sustainable practices of yesteryear. Moreover, as pointed out already, the worlds` natural resources – including the surface area of the earth – and the ecological consequences of their excessive use do not permit the western way of life for 6 billion or more people. For instance, if China ever reached the per capita car density of the United States (with similar models), some 20 % of her arable land would have to be turned into roads and parking lots. Clearly, China and other emerging countries may be better served with novel solution to her transportation and mobility needs.
These thoughts imply that foreign aid policies and exports to developing countries must change as soon as possible. For instance, the buildup of electricity supply systems (and energy supply systems in general) in large parts of the world may have to be redesigned. The decentralized (regional) capture of solar energy and the widespread use of low voltage DC current would not require the kind of large grids and power plants that exist in industrialized countries.
The reader may be reminded, however, that the nations of the ”Third World” are most likely only prepared to cooperate in efforts toward dematerialization if the west begins this development and demonstrates that a high standard of living can be achieved in a dematerialized world.
It seems very likely that those countries that embark upon the unavoidable change of present export and foreign aid policies early will benefit most. There is strong evidence that Japan will be among the winners.

Economic Growth in a Customized Services Economy

Traditional economic growth by way of expanding the throughput of natural resources will be severely limited in the future. So long as services are produced with the help of ”high-MIPS” technologies, expanding the service sector will be similarly restricted. Factor 10 on the other hand offers the chance to progressively replace the input of natural resources into products with knowledge and know-how without lowering end-use satisfaction. For instance, new synthetic materials – already

close to reality today – can lead to vastly dematerialized bridges, structures, and earth-bound transportation systems, imitating the extraordinary qualities of spider webs.
Different from natural resources, human knowledge and know how are available in virtually unlimited quantities. Following the path of Factor 10 therefor offers new options for economic growth. Not only could technical artifacts be dematerialized significantly, but by increasing the capacity utilization of existing products, vehicles, buildings and infrastructures (e.g. with the help of information technology) additional gains in utility per unit input of natural resources can be generated.
While the present economies of the west can be characterized as high flux throughput systems, the hallmark of future wealth and profit producing economies can and will likely be: Providing high quality and customized services, fulfilling the needs of individuals at far lesser costs to nature than is presently the case.
Thus, Factor 10 should turn out to be the major thrust for the creation of ***a sustainable and customized service economy ("nachhaltige und dienstleistungsorientierte Masswirtschaft")*** (Lehner/Schmidt-Bleek, 1999)**.**
The future economic measure for the value of products and services should be the Costs per unit Service or utility (**COPS**), **MIPS** being its ecological counterpart.

Initiatives for Operational Progress toward Sustainability

Some recent initiatives have developed practical tools for moving toward sustainability: Jola Welfens at the Wuppertal Institute has shown with her project "MIPS For Kids" how easily 8 year olds can understand the concept of the ecological rucksack and use it, for instance when shopping (Huber, 1999). The ZERO Emission Initiative of the United Nations University in Tokyo (Pauli, 1998), the Natural Step Program of Karl-Henrik Robért in Sweden (Nattrass, 1999), The Cleaner Production Initiative of the Industry and Environment Office of the United Nations Environment Program in Paris, the Projects of Claude Fussler* and Manfred Wirth* at Dow Europe, Switzerland (Fussler*, 1996), Leo Jansen's* Sustainable Technology Program in the Netherlands (Weaver, 2000), and activities of the Factor 10 Innovation Network (Schmidt-Bleek*, 1999/2) – among others – are aiding and training industry, communities, NGO's, consumers and many others to take systematic steps in the direction of sustainability. The Factor 10/MIPS-concept is not only compatible with the concept of eco-efficiency of the World Business Council of Sustainable Development (WBCSD), it suggests a "landing place" for it and provides the initial yardstick for assessing the eco-efficiency of products, services, and performance in an operational fashion.
Intrigued by Weizsaeckers* writings, the Director of Klagenfurt Fair in Corinthia, Austria has organized an exhibition of dematerialized products for the first time anywhere in 1998 (Weizsaecker*, 1995). Upon the initiative of Ryiochi Yamamoto* and M. Mitsuhashi (Nikkei), the Japan Environment Management Association for Industry and Nihon Keizai Shimbun (Nikkei) have since organized the Exhibition "Eco-Products 1999" in Tokyo that focused on dematerialized products. Close to 300 firms participated in this venture. It will be repeated in 2000.

Political Initiatives for Factor 10

In 1987 the Brundtland Commission has concluded that humanity has the ability to meet its needs without compromising the ability of future generations to meet their own. In the wake of the United Nations Conference on Environment and Development in Rio de Janeiro in 1992 most governments committed themselves to undertake steps toward sustainability.
When reviewing progress toward sustainability in 1997, the United Nations General Assembly Special Session (UNGASS) at New York noted: "...attention should be given to studies that propose to improve the efficiency of resource use, including consideration of a tenfold improvement in resource productivity in industrialized countries in the long term and a possible factor-four increase in

industrialized countries in the next two or three decades. Further research is required to study the feasibility of these goals and the practical measures needed for their implementation. Industrialized countries will have a special responsibility and must take the lead in this respect". UNGASS was pointing in particular to the "1997 Carnoules Statement to Government and Business Leaders" of the internationally noted Factor 10 Club (Factor 10 Club).
The environment ministers of the OECD Member countries pronounced at Paris in their News Release of April 3, 1998:" Ministers agree... to promote an international policy approach which encourages coherence among economic, environmental and societal policies by: (inter alia) promoting .... Innovative approaches, such as eco-efficiency, aiming to achieve substantial improvements in resource productivity, for example a factor of 4 and eventually of 10; [a]
The Chairperson of the Informal Meeting of the EU Environment Ministers and Environment Ministers of Candidate Countries of Central and Eastern Europe and of Cyprus (July 1999), Ms Satu Hassi of Finland, summarized the discussions as follows:
“.... Targets with timetables should be set, where appropriate, for improving eco-efficiency in the different sectors and the development monitored with appropriate indicators. In this context, the factor 4 and factor 10 concepts for eco-efficiency were mentioned. Internalization of environmental costs, the appropriate use of economic instruments and the abolition of non-sustainable subsidies will provide a powerful tool for achieving more eco-efficient production and consumption patterns. Economic instruments can enhance the competitiveness of industries or the economic base in general. On the contrary, genuine win-win situations can be created where both the environment and the economy can benefit..."

Outlook

Sustainability requires that environment and economic development be made mutually supportive at the front end of the cycle when the goals and policies are being set, not at the tail end after society has already incurred the damage costs of unsustainable development.
Dematerialization creates synergies for changing values of society, particularly in western countries. Indeed, the Factor 10 concept offers in itself a valuable stimulus and basis to advance structural change toward a more innovative and service-focussed economy and provoke sustainable consumer choices. Thus, Factor 10 emerges as a key component to guide development in the new Millennium.
I do not suggest that all the answers be known. The question of limits to national sovereignty is one example in view of human rights abuses in many countries, and in view of the fact that there is only one common planet earth. Another concern could be the growing mismatch between the power of global firms as well as global financial players and their democratic control. What new international accords or organizational structures are required to make a level playing field? By whom and how can global risks of instability be controlled that originate from armed conflicts, insufficient food, insufficient health and shelter, as well as from the misuse of children in many parts of the world?
Making this planet a more sustainable and secure place for future generations of people requires that the main areas of disarray in the economic and social systems must be addressed in addition to - and simultaneously with - the ecological crisis (Steilmann, 2000).
Despite the prevailing uncertainties I remain convinced that if the process of dematerialization does not begin soon, both the social fabric of our societies and the global ecosystem are seriously at risk in the medium term. Furthermore, by starting now, we would have the option of achieving a transition slowly by evolution rather than being forced to change suddenly through revolution.

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Friedrich Bio Schmidt-Bleek

Formerly Vice President, Wuppertal Institut

Founder President of the Factor 10 Club

President, Factor 10 Institute

La Rabassière
F – 83 660 CARNOULES PROVENCE
Fax: + 33 4 94 33 24 58
E-mail: biofsb@aol.com

Literature

(Bierter, 1997), Willy Bierter et. al., ”Oekointelligente Produkte, Dienstleistungen und Arbeit” Basel, Boston, Berlin, 1997
(Bringezu, 1993) Stefan Bringezu, "Towards increasing resource productivity: How to measure the total material consumption of regional or national economies?", Fresenius Environmental Bulletin, Vol.2, No 8, August 1993 (in a pecial issue of the Fresenius Env. Bull. for Factor 10, containing a number of articles by coworkers of my coworkers).
(EEA, 1999), European Environment Agency/Factor 10 Institute, ”Making Sustainability Accountable: Eco-Efficiencv, Resource Productivity And Innovation”, EEA Topic Report 11/1999
(EEA, 1999/2) European Environment Agency, ”Note on the proposed chemicals ”headline” indicator-background paper (Updated Nov. 10th 1999)
(Fussler, 1996), Claude Fussler, ”Driving Eco Innovation”, Pitman, London, 1996
(Factor 10 Club), Declarations 1994 and 1995, Statement to Leaders in Government and Business, 1997, Reports, 1999; Factor 10 Institute, F-83660 Carnoules, France
(Goerlach, undatiert, wahrscheinlich 1998), B. Goerlach et.al., “Von Wien nach Helsinki”, Studie im Auftrag des oesterreichischen Bundesministerium für Umwelt, Jugend und Familie (BMUJF)
(Hawken, 1999), Paul Hawken, E.Lovins. H. Lovins, ”Natural Capitalism”, New York, 1999
Internet: (http://www.wupperinst.org), Collection Of Ecological Rucksack Factors For Basic Materials And Rucksacks For Some Some Products
Hinterberger, 1996), F. Hinterberger et.al., ”Oekologische Wirtschaftspolitik”, Basel, Boston, Berlin, 1996
(Huber, 1999), Andreas Huber, ”Erziehung zur Nachhaltigkeit”, Psychologie Heute, November 1999
(ISD, 1999), Institute for Sustainable Development, Warsaw, Poland, ”Sustainable Development by Dematerialization in Production and Consumption”, Report 1999
(Lehner/Schmidt-Bleek, 1999), F. Lehner, F. Schmidt-Bleek, ”Die Wachstumsmaschine – der oekonomische Charm der Oekologie”, Droemer, Muenchen, 1999.
(Liedtke, 2000), Christa Liedtke, ”Das FIPS-Konzept”, Wuppertal Papers
(Muendl, 1999), Andreas Muendl et. al. “Sustainable Development by Dematerialization in Prodution and Consumption – Strategy For The New Environmental Policy In Poland”, Institute for Sustainable Development, Warsaw, September 1999.
(Nattrass, 1999), Brian Nattrass, Mary Altomare, ”The Natural Step For Business”, New Society Publishers, Gabriola Island, Canada, 1999
(Paleocrassas 1999), Yannis Paleocrassas, ”Factor 10 And Fiscal Reform”, Report Of The Factor 10 Club, 1999. The Factor 10 Institute, F-83660 Carnoules
(Pauli, 1998), Gunter Pauli, ”UpSizing”, Greenleaf, London, 1998

(Sachs, 1999), Wolgang Sachs, ”Planet Dialectics”,London, New York, 1999.
(Schmidt-Bleek, 1993), ”Wieviel Umwelt Braucht Der Mensch? MIPS, Das Mass Fuer Oekologisches Wirtschaften”, Basel, Boston, Berlin, 1993.
(Schmidt-Bleek, 1995), F. Schmidt-Bleek, U. Tischner, ” Produktentwicklung”, Wirtschaftskammer Oesterreich, Wien, 1995
(Schmidt-Bleek, 1998), F. Schmdt-Bleek, ”Das MIPS-Konzept – Faktor 10”, Droemer Muenchen, 1998
(Schmidt-Bleek, 1999/1), F. Schmidt-Bleek And Coworkers, ”MAIA, Einfuerung In Die Material-Intensitaetsanalyse Nach Dem MIPS-Konzept”, Basel, Boston, Berlin, 1999
(Schmidt-Bleek, 1999/2), F. Schmidt-Bleek, Ch. Manstein, ”Klagenfurt Innovation”, Klagenfurt, 1999/2, ISBN 3 900743 74 6, Report On An Eco-Design Training Program For 50 Small And Medium Sized Enterprises.
(Paleocrassas 1999), Yannis Paleocrassas, ”Factor 10 And Fiscal Reform”, Report Of The Factor 10 Club, Factor 10 Institute, La Rabassière, F-83 660 Carnoules
(Steilmann, 2000), The Steilmann Commission, ”The Wealth Of The People – A Framework For An Intelligent Economy”, Oxford University Press, late 2000
(Yamamoto, 1999), Ryoichi Yamamoto, ”Manifesto For Ecodesign” Tokyo University, February, 1999
(Weaver, 2000), Paul Weaver et. al., ”The Sustainable Technology Development”, Greenleaf, London, 2000
(Weaver, 2000/2), Paul Weaver, F. Schmidt-Bleek eds.,”Factor 10 – Manifesto For A Sustainable Planet”, Greenleaf, London, 2000
(Weizsaecker, 1995), Ernst U. von Weizsaecker et.al., ”Faktor 4”, Droemer, Muenchen, 1995
(WRI, 1997), World Resources Institute, Washington, D. C. (and other institutes), ”Resource Flows; The material Basis of Industrial Economies”, 1997

Clarification of someTerms

Areal Input per Unit Utility or Service, Flächeninput pro Einheit Nutzen - FIPS
A robust and directionally safe indicator for the comparison of functionally equivalent products with respect to their surface coverage. A quantitative measure for the ”use of natural surface” per unit utility or service. The ecological surface price for utility

Dematerialization
Absolute or relative diminution in use of nature per unit utility or service

Factor 10
The goal to dematerialize the economies of the industrialized countries tenfold on the average within 30 to 50 years, starting 1995. The goal to increase their resource productivity tenfold on the average during this time period.

Material Input - MI
Micro-economic indicator. It includes all natural materials that are moved by technical means from their natural places in order to manufacture and use a product or produce a service. MI includes all natural materials which are needed to make the necessary energy available. MI is measured in tons or kg

Material Input per Unit Utility - MIPS
A robust and directionally safe indicator for the comparison of functionally equivalent products with respect to their material eco-intensity. A quantitative measure for the use of natural materials per unit utility or service. The material price for utility

Eco-intensity
An indicator for the ”consumption of nature” (Material, Energy, Surface) per unit of output. Any decrease in eco-intensity means progress toward sustainability

Eco-intelligent Products
Nontoxic utensils, objects, foodstuffs, machines, vehicles, buildings, infrastructures etc. that produce a maximum number of high quality service units at competitive prices with a minimum of natural materials and space

Eco-intelligent Service
Meeting of a defined and socially acceptable demand – or a bundle of demands – at a competitive price by means of eco-intelligent products (”service delivery machines”) and a minimum input of natural resources

Eco-intelligent Processes
Technical procedures that function at competitive prices by utilizing eco-intelligent products and a minimum input of natural resources with a minimum output of waste and toxic substances

Eco-intelligent Production
Organizational and technical processes for the production of goods and services at competitive prices that utilize eco-intelligent products and a minimum input of natural resources with a minimum output of waste and toxic substances

Eco-intelligent Consumption
The utilization of eco-intelligent products and services. With regard to a whole country, the total consumption of natural resources may not surpass one tenth of the total that was used in 1995

Eco-intelligent Economy = Customized Economy = Sustainable Economy
From an ecological point of view, a sustainable economy is a market economy
that makes a maximum of high quality customized services available to all people within the guard rails of at least a Factor 10.

Eco-intelligent Service Economy
In a service economy that operates according to the MIPS- and Factor 10 concepts, mainly eco-intelligent services are being traded, paid for in COPS (costs per unit service). In most cases, customers procure such services directly. In cases where this is not advantages, the customer acquires the appropriate eco-intelligent product that are priced according of the guaranteed number of service units available from that product.

Ecological Rucksack of a Product
The total amount of natural material input (MI) for manufacturing a product minus the weight of the product itself. Ecological rucksacks are counted separately for abiotic (non-renewable) and biotic materials, moved soil, water and air.

Total Material Flow – TMF, or Total Material Requirement - TMR
Macro-economic indicator for measuring (tons/year) the yearly quantity of natural material – including their rucksacks - needed for sustaining an economy within defined geographical or political boundaries. Currently, the worldwide consumption would seem to be roughly double the sustainable quantity

Ecologically sustainable Economy
Service-oriented customized economy that operates with at least a factor 10 less natural material resources that were consumed in an industrialized economy in 1995