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1.1 THE PROJECT ”KLAGENFURT INNOVATION” (AUSTRIA)

1.1.1 BACKGROUND OF THE INSTITUTION

The *Society Factor 4+ (”Verein Faktor 4+”)* was founded in 1997 in Klagenfurt/Austria. It aims to support and promote knowledge and know-how in the areas of sustainable development, resource productivity and dematerialization, and to communicate the results to experts, industry commerce, and the public at large. It wants to raise public awareness of the significance of the basic services of the ecosphere for maintaining human life on earth as a basic concept in approaching sustainability.

An international scientific advisory board supports the work of the Society Factor 4+. It derives financial support from the Federal Ministries for Environment, Youth and Family, the Federal Ministry for Science and Transport, the Provincial Government of Carinthia and the Provincial Capital of Klagenfurt.

Currently, the main projects of the Society Factor 4+ are the following:

- Training of industry for ecological product development and design;
- Scientific studies on the Factor 10 concept and the MIPS-indicator;
- Organization of the *international congress and trade fair Factor 4+* for sustainable products, technologies and services in co-operation with the Klagenfurt Trade Fair Organization (the 1st Congress and Trade Fair ”Factor 4+” was held from 17.-21. June 1998; the 2nd will be from 13.-15. October 1999).

1.1.2 DESCRIPTION OF THE PROJECT “KLAGENFURT INNOVATION”

This project is based on the new environmental concept of *”Dematerialization”*. Dematerialization describes a comprehensive new vision of environmental protection policies (Schmidt-Bleek, 1993, 1993/2). Industrialized countries should no longer focus their entire attention upon the eco-toxic outputs - emissions, wastes, and polluted water - at the tail end of production and consumption. Rather, the input side of the economies should begin to take center stage. By now it has been shown clearly that 10 times less resources are enough to produce material welfare which can easily rival with the quality and the appeal of present conveniences (Schmidt-Bleek, 1998, 1999; Hawken, 1999).

Dematerialization can be measured in terms of *Material Input Per unit Service (or utility) - MIPS*. With this measure, the way toward sustainability becomes accountable. The inverse of MIPS is the natural *resource productivity - S/MI*, a measure which will become increasingly important as western countries approach a customized service economy.

The *MIPS*- and *Factor 10 concept* can be translated into practical actions. In the project presented here, their usefulness has been demonstrated in the area of innovating, designing, manufacturing, and marketing industrial products.

Supported by funds from ”European Social Funds” and ”Arbeitsmarktservice Kärnten”, the Society Factor 4+ has performed an 18 months training program for small and medium sized enterprises in Carinthia, Austria with the goal to improve the resource productivity of their products and services. The Project was entitled ”Neue Wege einer umweltgerechten Produktgestaltung” (*New ways toward designing Sustainable Products*) in the EU Initiative ADAPT (EU No. A-1997-A-510) and lasted from 1.1.1998 to 30.6.1999. Christopher Manstein (Society Factor 4+, Factor 10 Consulting Network) has co-ordinate the project, Friedrich Schmidt-Bleek (Factor 10 Institute) was charged with the scientific responsibility and Gerhard Weihs (Centric Austria) was chairing the workshop sessions.

This *chapter 1.1* summarizes the background of the project. *Chapter 2.3.1* presents findings and results from applying the MIPS-Concept in practice.

Transnational partners in the project were: The Academy of Crafts and Design Münster/Germany; The Kuopio Academy of Crafts and Design/Finland; CSEA Bonafous Chieri and Polytecnio Torino/Italy; Wuppertal Institute for Climate, Environment and Energy/Germany.

We are grateful for help and collaboration gracefully extended by the following persons: Heinz Mooss (WIFI - Chamber of Commerce - Wien), Hartmut Stiller (Wuppertal Institute), Gert Irgang (Business Transformation and Factor 10 Consulting Network), Willy Bierter (The Product Life and Factor 10 Institute), Peter Maydl, Walter Leiler, Erich Moschiek, Klaus Bürger and Michael Marktl. In particular, we like to thank Ilse Vogl (Society Factor 4+) for her excellent job to organize and render managerial support to this project, as well as Hans-Jörg Pawlik, Director of the Klagenfurt Trade Fair Organization for tirelessly promoting and supporting this project.

1.1.3 TARGET GROUPS AND PARTICIPATING COMPANIES

Target groups of this pilot-project were small and medium sized enterprises from Carinthia, Austria in the building and building-related industry sector, the timber and wood industry, and industry in general. The project was designed especially for technical employees, division and plant manager, environmental officer, architects, product manager, designers, marketing persons, buyers, and sales manager.

One of the surprising successes of this project was the great interest which could be generated in the local industry. Some 80 participants from 50 companies signed up the application forms within a short period of time.

A HIGH DEMAND FOR ENGINEERS IN THE FIELD OF RESOURCE MANAGEMENT

A recent survey in Austria indicated a considerable shortage of engineers with backgrounds in resource management and dematerialized product design. The Market institute Linz identified in a market analyses a demand for more than 4,000 engineers within the Austrian industry (Market, 1999). The Society Factor 4+ is therefore promoting a proposal for a new *Academy* on resource management and resource productivity in Klagenfurt, Carinthia, which has been proposed to the Federal Ministry for Science in Vienna some weeks ago.

PARTICIPATING COMPANIES (COMPANIES NAME; BRANCH):

Dobernig&Riedmann, architects · Eisenbahnsiedlungs GesmbH, public house building · Greenonetec, solar technology · Heraklith Gmbh, producer of insulation materials · Magistrat Klagenfurt, public authority · Mörtl, building, property company · Neue Heimat, public house building · Omansiek, architects · Pichler GesmbH, house technology · Ihr Haus, wood construction · Pucher GesmbH/Ihr Haus, architects · Seppele Thermofloc, insulation materials · Sevalite, building materials · Stoiser&Wolschner, concrete materials, environmental technology · BIGU, carpenter · Bistum Gurk, saw mill, carpenter · Brodnig, wood construction, carpenter · Forstner, agricultural engineering · Gemeinde St. Georgen, local authority · Grünes Auge, natural paintings for wood · Guggenberger, carpenter · Herz-Feuerungstechnik, steel construction · Justin&Keckstein, architects · TB-Verfahrenstechnik, environmental engineering · Kapeller, carpenter · Kärntner Umweltschule, technical environmental academy · Puschnig, wood construction · Wech, carpenter, restoration · Sterling, furniture · Krauss, air condition, sanitary · Zarfl, carpenter · AKS – Umweltservice, Environmental services, cleaning · Hermes Schleifmittel, stones, ceramic · Hirsch Armbänder, watch straps · Kanzian Engineering, Consulting · KELAG, Energy supplier · Ortner, climating, air condition · Pago Fruchtsäfte, fruit juice · Pflüger Edelstahl, metal processing and trading · R&D Consulting, engineering, consulting · R&K Risk Management, technical engineering · Ritter, trading · Seebach, metal processing · Solar-Systems, solar technology · Umlauft, textile renting · Universität, university (economics) · Wild Austria, precision engineering · Wurmitzer, steel processing · Winkler, wood design.

1.1.4 ACTIVITIES IN THE PROJECT “KLAGENFURT INNOVATION”

On the didactical level, new approaches were found to be effective. The participating enterprises were teamed up with advisers/consultants and all were supported by scientific experts on pre-arranged occasions. All parties had their specific tasks:

- The *participating enterprises* (resp. their representatives) and the advisors/consultants joined eight common meetings, during which the experts introduced into the concept of MIPS and its implementation in a step-by-step fashion (see below). The enterprises were invited to choose their own example of a reference product for the purpose of improving its ecological properties, in particular its resource efficiency, with the help of guidelines previously established. Further aims were to increase the usefulness of these reference products for the customers while keeping their price competitive. The very encouraging outcomes of the case studies are summarized below (*see Part II, Chapter 2.3.1*).
- The *advisers or consultants* were experienced persons as regards technological matters in consulting enterprises. They received special training by the Austrian Chamber of Commerce on the theoretical and practical aspects of the MIPS-Concept prior the start of the projects described in this report. The consultants accompanied the enterprises throughout the whole project. They had access to specialized information from the experts at any time during the project.
- The tasks of the *scientific experts* were the training of the advisors/consultants and the theoretical input during the workshops. They were also called upon to give special advise during the project when problems arose.

The realization of the training concept required several tools, which had to be prepared especially for this project:

- The *series of workshops* was designed in such a way that the MIPS-Concept became transparent for all participants in a step by step fashion, beginning with a general introduction to the rather novel thinking about environmental problems associated with production and consumption of goods, and the technical, managerial, as well as economic consequences of its application on the firm level. Equally, the participants were familiarized with the needs of intensive and creative dialogs among all decision makers within the company - be that in the area of managing, purchasing, transportation, other logistical matters, design, construction, production, financing or marketing. The MIPS-Concept was demonstrated as an integrating concept for all essential activities within the firm and beyond - from purchasing to customer relations and services after sale.
- To provide a self-learning environment for the participants, a number of existing literature was made available, particularly a *manual* of the Austrian Chamber of Commerce, which was written by Prof. Schmidt-Bleek and which describes the stepwise approach of applying the MIPS-Concept in companies for the purpose of creating new products and services (Schmidt-Bleek, 1999).
- To help the participating enterprises to appreciate their actual situation, and in the selection of reference products, a portfolio of easy-to-understand *checklist* was prepared, including those which are needed to systematically dematerialize the reference products.
- In order to calculate the Material Input values of products, a new *computer program* (MIC – Material Input Calculation) was designed (Manstein, 1999).
- Due to the pilot character of the project, considerable attention was given to the collection and elaboration of *feedback* from the participation enterprises. The participants were motivated to reflect systematically on their handling and thinking by "Play acting" as need arose during the workshops.
- In addition to the present written report "Klagenfurt Innovation" a *video* was produced which explains in a concise manner the major aspects of the MIPS-Concept in English (Schmidt-Bleek/Manstein, 1999). Parts of the training are presented via the *internet* (http://www.faktor4plus.at) and a project *guide* in German - including all necessary materials of the project (checklists etc.) has been prepared (Schmidt-Bleek/Manstein, 1999/2).

The milestones of activities are listed below in chronological order:

- *January - May 1998:* Developing the training concept and inviting participants
- *February 1998*: "Kick-off" conference and "train the trainer"
- *May 1998*: 1st workshop (divided in 3 groups of branches) on: Dematerialization, the MIPS-concept, finding a reference-product and calculating the ecological rucksack of a reference-product
- *Since May 1998*: Starting Project work in companies supported with consulting by trainers within each participating company
- *October 1998*: 2nd workshop (divided in 3 groups of branches) on: Improving the utility (service) of reference products and to find new technical solutions (i.e. "lean products")
- *November 1998*: 3rd workshop (common workshop with all participants) on: Transferring the MIPS- and Dematerialization concept into business
- *March 1999*: 4th workshop (common workshop with all participants) on: Business transformation and new marketing strategies
- *June 1999*: Final conference on project results in the companies

1.1.5 CONCEPT OF ECOLOGY AND DESIGN – THE REASON FOR A FRESH START IN ENVIRONMENTAL PROTECTION

“New questions begin to appear,
for example how large is the consumption of nature
per kg product from cradle to grave?”

Prof. Klaus Steilmann
(Major enterpreneur)

During the 20th century, the industrialized countries accelerated their hunt for and consumption of natural resources, which they had begun in earnest after the invention of James Watt's wonderful machine some 100 years earlier. The earth's geological and biological fruits are being plowed, dug up, harvested, left behind in the landscape, harnessed, refined, burnt, turned into buildings, infrastructures, vehicles and other goods. They are being "consumed" and discarded with no constraint but the availability of capital, labor, and know-how. These altogether frantic and frequently thoughtless activities continue to be encouraged and favored by subsidies and taxation policies, as well as accounting practices such as GDP.

THE “THROUGHPUT ECONOMIES”

On the average, up to 90 % of the biomass harvested as well as more than 90 % of the natural abiotic (non-renewable) materials disturbed by machines in their natural settings are wasted on the way to making products available to the end-user. From this perspective, humankind has hardly any supply problems. Surprisingly, we seem to be serious when calling this dismal situation "high tech", "high chem", and "eco- something" or other.

The "throughput economies" of the west have become the world-wide standard of success. Already, man-induced material flows easily rival in quantity those put in motion by geological forces on the continents. The per capita resource consumption has clearly outpaced the population increases and continues to do so. Some 80 tons of non-renewable materials are removed yearly from natural settings to satisfy the present per capita needs of Americans and Europeans. If all people lived like that, a complete layer of 5 mm denatured non-renewable material could be put on the continents every year, or a continuous layer of half a meter in depth in 100 years. If the car density (cars per person) of the United States was ever to be reached in China, some 20 % of her arable land would have to be devoted to roads and parking spaces in order to accommodate the new mobility. If the Chinese ever insisted on a similar *per capita* beer consumption as the Austrians are proud of today, more than the present world production of barley would disappear in eastern stomachs in liquid form. If six billion people were to copy successfully the life style of the "advanced" industrial nations, three new planets earth would be needed. It seems self-evident, that timely changes in this resource consumption for life styles are needed, if humankind does not wish to suffer terminal convulsions in the non-too-distant future.

Classical environmental protection remains a costly and rather insufficient answer to the ecological crisis. It typically works at the end-of-the-pipe and implies additional costs in money and resources. This still allows businesses and politicians to argue conveniently that economies need to prosper in the first place in order to afford environmental protection at all, implying „property is a necessary condition for environmental protection“.

As long as "to prosper" means to maintain per capita consumption rates of resources similar to the ones prevailing in highly industrialized countries to date, the pollution control strategy remains profoundly unecological as well as uneconomic. Nevertheless, protecting health and the environment from particularly dangerous substances remains a necessity.

It is therefore not accidental, that classical pollution control measures failed to be internationally harmonized at a meaningful level - as demonstrated again by the meager success during the United Nations meetings in Kyoto, 1997, and Buenos Aires, 1998 devoted to curbing the emission of CO_2 and some other gases relevant to climatic changes. Even the United States have pronounced that they cannot afford their share to protect the essential services of the ecosphere. The environmental order and command legislation in technically advanced countries is obviously not market driven. It has spawned a secondary economy which cleans up the "real" economy and its technology. Whether or not it functions well thus depends to a very large extent upon the prosperity of nations and can consequently not at all be expected to be adopted in the majority of countries around the world.

Small wonder, therefore, that twenty five years of costly pollution control efforts have not prevented environmental deterioration from increasing on a global scale. Only that now toxic industrial emissions and effluents are found more in the poorer countries, while they used to be characteristic of the "the North" twenty-five years ago.

Moreover, the wealth of the industrialized countries is based to a considerable degree upon man-induced material flows in the “Third World”, as for instance in the form of natural timber, overburdens from mining mineral resources, and the use of water resources for the production of agricultural products and aluminum. To satisfy Germany’s thirst for orange juice, four times as much land would have to be devoted to orange production as is now being occupied by fruit trees in Germany.

NEW THINGS TO BE CONSIDERED

Irreversible disturbances of ecological equilibria are caused directly by technical interference with environmental resources or processes, irrespective of how much material wealth is produced with the masses translocated from their natural settings, and irrespective of how much and what kind of emissions or wastes are produced. Hence the availability of the critical life-supporting services of the ecosphere - such as clean air, drinking water, and climatic stability - are undermined by our very resource consumption.

The impact of all this disruption is increasing, and is beginning to be reflected in economic terms. For example, there is an increase in the number and severity of natural catastrophes such as storms, floods and droughts, to which the insurance market is responding by sharply raising premiums. Central America will take many years to recover from the devastating hurricane Mitch in early November, 1998. The United States has lost some 50 % of its topsoil by erosion, virtually all of it during this century. In the Ruhr valley in Germany, some 70 000 hectares of land have subsided due to former deepmining of coal, with the consequence that waters have to be pumped around the clock forever to keep this area from flooding. Millions of people could otherwise lose their homes.

The massive material translocations - as well as the emissions of toxic materials and greenhouse gases - are exceeding the capacity of the ecosphere to absorb them and they are shifting ecological balances.

Environmental policies must henceforth be directed toward the input side of the economy. When considering resource flows through technically advanced societies in a "material added" fashion it turns out that the sector which manufactures goods for the end-use markets contributes relatively little to our environmental problems. Policy attention must rather be focused primarily upon the material intensity of goods - from cradle to grave. Purchasing practices by industry and end users therefore should become rapidly important targets for environmental protection policies. The economic as well as ecological goal must be the dematerialization of our technical world. If we wish to move toward sustainability we have to radically improve the resource productivity of our economies.

GOALS FOR TOMORROW – CURBING MATERIAL FLOWS

A radical reduction of the material throughput in "advanced countries" is imperative during the coming decades, while end use satisfaction as it exists today in industrialized countries must be maintained - or even improved. In this sense, the industrialized nations are the real "development countries" (Schmidt-Bleek, 1993, 1993/2, 1998).

In order to reliably achieve the necessary dematerialization, decision makers in politics and business, but also the consumers, need directionally safe, understandable, and internationally compatible information about the relative resource intensity of goods on the market, because one can hardly manage that which cannot be measured and compared.

And national accounts must lay open the consumption of natural materials - including their ecological rucksacks - that are invested on a yearly basis in order to create wealth and provide security to people (World Resource Institute, 1997).

But this is not enough. While the improvement of the technical eco-efficiency is imperative for the realization of a sustainable economy, even the most extreme dematerialization of material artifacts alone will not suffice *à la longue*. Rebound (boomerang-) effects must be avoided: As history shows, technical advances in investing less resources per unit wealth have traditionally been "eaten up" by increasing consumption (Bonniot/Manstein, 1998). A change in the traditional development of consumption patterns is urgently called for: a revision of use - offering new forms of satisfaction, well being, and prosperity.

INVENTING THE RIGHT TECHNOLOGY

Under the impression of alarmingly high pollution levels that were reached in the 1960's, and in particular their consequences for public health, the industrialized countries launched a first wave of response to the environmental degradation: Pollution control standards were defined for ambient air and water quality, and later for emissions (Schmidt-Bleek, 1999). Diluting the emissions was the least costly way to go.

When this approach no longer seemed to suffice, end-of-the-pipe solutions came about in the seventies. Still today, catalytic converters in cars are considered ecological devices. During the eighties, recycling became the new wave. Not only was the flux of waste to be lowered in this fashion, but the need of natural resources was to be reduced also. Inspite of all efforts so far, only about 1 % of all non-renewable natural material fluxes are recycled - at staggering costs.

In the early nineties "Integrated Technologies" and "Cleaner Production Methods" began to appear, avoiding known pollutants through altered processes and consuming less energy. But the basic quality and superiority of existing technologies and products were still not questioned in earnest. Consequently, technological dinosaurs are still being "ecologized" with "cleansing machines" at the tail end of the old ones, driving up the costs as well as the consumption of resources per unit wealth generated. The present-day automobile (that in fact is basically an almost 100 year old technology) is a perfect example. Instead of responding to the question, how the statistically well known inner-city transportation of people by automobiles could be dematerialized by eco-intelligent solutions, the dinosaurs are still fitted with expensive catalytic converters, whose longtime functioning nobody can guarantee. Close to three tons of non-renewable materials must be taken from nature in order to build such a "cleansing" device. Is that "good environmental technology"? Or are devices of this nature rather preventing the development of technical systems with which profits can be made while simultaneously offering precautionary environmental protection?

Instead of focusing more or less exclusively upon cleaning up our technologies and reducing the loss of heat we need to increase dramatically the rate of innovating a completely new world of dematerialized "service delivery machines" which give comfort and security to people at a greatly reduced rate of natural resource inputs. The products and services of the future will disturb and consume less natural resources. They will require instead a considerable higher input of know-how, know-when, know-where, and know-who. They will be part of a customized economy which focuses on the availability and accessibility of services rather than on the possession of goods.

FACTOR 10

In 1992, Schmidt-Bleek proposed to halve the global natural material disturbed yearly by technology in order to move decisively toward sustainability (Schmidt-Bleek, 1993, 1993/2). It should be noted that this is an absolute target for lowering the yearly totality of natural resources disturbed in their original settings. Therefore, showing the material input per unit of GDP as a measure for dematerialization can be very misleading because even while the GDP outpaces the consumption of natural resources, the resource input may still increase.

Since western style wealth, generated at present for less than 20 % people of the world, consumes in excess of 80% of the natural resources disturbed and harvested globally, the "rich of this world" will have to invent ways to generate their wealth with some 10 % (or a factor of 10 less) of their present consumption in order to let the "poorer" nations claim their fair share of resources - and the worldwide total flow of natural resources could still be halved.

In the future, western style processes, products, buildings, infrastructures, and services would therefore need to be de-materialized by an average factor of 10 (compared to present conditions) in order to move reliably toward sustainability. With increasing world population - or increasing numbers of people living as singles in any society - the factor 10 would have to grow, too.

Increasing the resource productivity by a factor of 10 or more is strategically important since it implies that system solutions must be sought, and in many cases entirely new technical approaches be developed in order to provide services with high quality in a more sustainable future. In most instances, neither "good housekeeping" nor mere "ecological adjustment" or "cleaning" of present-day technologies - and most certainly not any end-of-the-pipe solutions - will suffice to reach a tenfold increase in resource productivity.

Increasing the Eco-efficiency by a factor of 10 or more in industrialized countries is essential for regaining the ecological stability. Less than a Factor 10 will not suffice to make enough environmental space available for the development of more than 150 countries within the confines of the sustainability goal of halving the yearly global translocation of natural resources.

Factor 10 is not an economic goal, it constitutes physical guard rails for western economies to grow within. It indicates how much industrialized countries have to increase their resource productivity in order to approach sustainability.

Austria wrote the factor 10 goal into her Environment Plan already in 1995. In 1994, UNEP-IE and the Business Council of Sustainable Development suggested a factor 20 as a goal for sustainability. In 1997, the European environment ministers supported factors 4 to 10 as a strategic goal.

Dozens of consultations in medium and small sized enterprises in central Europe have produced convincing evidence that factors of 3 to 8 increase in resource productivity for products can be routinely achieved within a company by making better choices of materials (that is by giving preference to materials with smaller ecological rucksacks than had been previously embodied in their products), and utilizing a wide variety of options for reducing waste, packaging and transportation intensities. To increase the dematerialization further, the utility of the products can be raised in many cases, their longevity improved, as well as cascading uses and recycling options foreseen when designing new products (Schmidt-Bleek, 1999; Schmidt-Bleek/Manstein, 1999/2).

MAKING SUSTAINABILITY ACCOUNTABLE: MIPS

As outlined in Agenda 21 of the UNCED in Rio de Janeiro in 1992, there is a need for indicators of sustainability. Some national and international bodies as well as scientific institutions have since begun work on this subject (Adriaanse, 1993). The European Environment Agency in Copenhagen has recently moved proactively in this area (EEA, 1998), based, in part, on the work of the Factor 10 Club (Faktor 10 Club, 1995).

When attempting to develop measures for describing the ecological stress potential of goods and services, of individuals, firms, enterprises, regions, countries and the world economy as a whole, such measures should meet the following conditions:

CONDITIONS FOR INDICATORS OF SUSTAINABILITY

1. They must be simple, yet reflecting essential environmental stress factors. They must be scientifically defensible, albeit not scientifically complete.
2. They should be based on characteristics that are common to all processes, goods and services.
3. The selected characteristics should be measurable or calculable, irrespective of geographic locations.
4. Obtaining results with these measures should be cost-effective and timely.
5. The measures should permit the transparent and reproducible estimation of environmental stress potentials of all conceivable plans, processes, goods and services from cradle to grave.
6. Their use should always yield directionally safe answers.
7. They should have a bridge to economic models and thinking.
8. They should be acceptable and usable on all levels: locally, regionally and globally.

In 1992, Schmidt-Bleek proposed the *Material (including energy) Input Per unit of Service* (utility or function) - the *MIPS* - as a robust initial measure for estimating the (life-cycle-wide) ecological stress potential of goods and services. MIPS meets the conditions outlines above. With MIPS, the concept of sustainability - to the extent that it governed primarily by resource consumption - can be operationalized on the micro-economic level when applied in conjunction with the goal of dematerializing industrialized countries by a Factor 10 or more .

MIPS is computed in mass input per total units of service delivered by the (service delivering) product over its entire useful life span. Resource extraction, manufacturing, transport, packaging, operating, re-use, re-cycling, and re-manufacturing are accounted for, and so is the final waste disposal. As such MIPS is akin - in terms of total material inputs (or "environmental costs" or "natural subsidies") - to the costs per unit service *("COPS")*, the actual price of a haircut for instance or the price for a flight ticket. Recently, the price of a new car was offered in terms of COPS during an advertising campaign in Germany for the first time. According to this source, the Smart cost about 30 Pfennige (ca 15 Cents) per driven km.

The value for *”S”* is the total number of units of service delivered by the product during its life time. (in the MIPS-concept, products are *"service delivers machines"*). This number is usually considerably larger than that is implied by the guarantee on products.

The MIPS - which could be called the eco-intensity of a product or service **-** is the inverse of *S / MI*, the measure of *resource productivity*. Both include the material inputs from cradle to grave. Both account for the energy inputs in terms of material fluxes associated with these energy inputs in addition to the natural material inputs. For electricity or solar heat inputs, the system wide material intensity per unit energy input is taken as MI value.

When measuring the resource productivity S/MI, "Service" corresponds to "utility" and must first be defined before its specific natural resource consumption can be determined. For example: what is the system wide MI for cleaning 5 kg of cloth? Or: what is the MI for one person-kilometer in an automobile?

The resource productivity can be improved by either lowering MI for a given S, or by increasing S with a fixed quantity of resources. Both changes can be achieved through technological as well as managerial personal changes/innovations. For example, by increasing the longevity of goods, or by leasing rather than selling a product, and by sharing buildings, infrastructures, vehicles or machines can the total number of service units be improved dramatically, without a corresponding increase in the total input of natural raw materials.

If one assesses the environmental impact potential of technology only on the basis of energy consumption, serious errors can result. For instance, when assessing the MIPS of identical quantities of electricity delivered to the grid on a system-wide basis, German brown coal turns out to be ca. 50 times as material (plus energy) intensive as wind powered or natural gas burning systems, and some 8 times as material (plus energy) intensive as those using hard coal or photo voltaic cells.

Another example is the aluminum car of a major European producer. Whereas the energy-only calculation shows that this car becomes more "ecological" than its steel cousin after some 120 000 km due to its reduced weight, more then 600 000 km must be driven before the lighter car begins to show its better resource productivity on a per kilometer basis (Schmidt-Bleek, 1998; Manstein,1996).

MIPS could be considered to be the entry point (or "base set") for a step-system approach in Eco-balancing products and services, based on *LCA´s* (Schmidt-Bleek, 1993/2).

In the future, the total ecological quality of goods and services could probably best be represented three terms that would all have to cover the total life span of products and services, namely:

THREE FORMS FOR ECOLOGICAL QUALITY

MIPS for their material and energy consumption

FIPS for their land use (F is the first letter in “Fläche”, the German word for area)

and

TOPS for their eco-toxic potential,

all with respect to their ability to satisfy specific human needs.

ECOLOGICAL RUCKSACKS

The sum total of natural materials utilized (in kg) to make one kg of technical base (raw or starting) materials available (e.g. wood, iron, aluminum, copper, cement) is called the *"rucksack factor"* of base materials (Schmidt-Bleek, 1998).

The ecological rucksack of products is defined as the total quantity (in kg) of natural resources (MI) that is disturbed in its natural setting in order to generate a product - counted from the cradle to the point when the product is ready for use - minus the weight (in kg) of the product itself (Schmidt-Bleek, 1993).

We defined five different types of rucksacks in order to describe the overall natural resource intensity of products. They correspond to the 5 environmental spheres that have been traditionally distinguished in environmental sciences and policies: water, air, soil, renewable biomass, and non-renewable (abiotic) materials. The factor 10 goal for dematerialization is applicable to all (Schmidt-Bleek, 1998/2).

For industrial products, the rucksacks of water typically exceeds that of non-renewable material inputs by a factor of 10 or more. An even higher ratio applies to approximately fo the amount of mechanical soil movements (largely by plugging) in the production of food stuff when compared to the biotic (renewable) outputs. In the case of agricultural and forestry products, the erosion in tons associated with the production of 1 ton of product can also be taken as a measure of material (soil) flow intensity. These numbers range from approximately 0.1 to 5 tons erosion per tone of product (Schmidt-Bleek, 1998).

On the average, industrial products carry abiotic rucksacks that are about 30 times their own weight. This means that only about 5 % of the non-renewable natural material disturbed in the ecosphere typically end up in a technically useful form. In the case of a PC, the ecological (abiotic) rucksack weighs at least 200 kg per kg of product. This number calls seriously into question the expectation that modern communication can *eo ipso* contribute to a noticeable dematerialization of life styles.

For base materials (such as iron, plastic or copper), the MI values (rucksack factors) represent a new kind of material property. These factors allow the comparison of technical starting materials as regards their resource intensities and thus allow the computation of the rucksack of products, so long as the material compositions of these products are known.

At the Wuppertal Institute in Germany, MI values (rucksack factors) were assessed for a large variety of materials that make up industrial products (Schmidt-Bleek, 1998/2). For the time being, they should be considered as preliminary average figures. They allow the design of dematerialized products. Christopher Manstein has developed a practical software package "MIC – Material Input Calculation" that permits important conclusions to be drawn very fast when comparing the resource intensity of products (Manstein, 1999).

Typical approximate MI values (rucksack factors for non-renewable resources) of *base materials* are as follows: sand = 1.2 kg/kg, glass = 2 kg/kg, plastics = 5 to 11 kg/kg, steel = 7 kg/kg, paper = 15 kg/kg, aluminum = 85 kg/kg, copper = 500 kg/kg, Platinum = 500 000 kg/kg.

More detailed Rucksack factors are available on the internet homepage of the Wuppertal Institute: http://www.wupperinst.org/projekte/mipsonline.

In this report we attach a English list of rucksack factors of the most important basic materials.

RUCKSACK-FACTORS OR MI-VALUES

As mentioned before the Rucksack-Factors or Material-Input-Values in the MIPS-concept are defined for fife different categories: water, air, soil, renewable biomass, and non-renewable (abiotic) materials.

For practical reasons we are using in the training project "Klagenfurt Innovation" just one category with "MATERIALS".

A MI-value of 85 kg/kg, in the case of aluminum for instance, means that the sum of material resources to produce this kilogram of Aluminum was 85 kg, without any water and air!

WHY MIGHT ENTREPRENEURS CARE ABOUT FACTOR 10 AND MIPS?

To reach sustainable conditions, the physical dematerialization of the economies is unavoidable. Beyond this general goal on the global scale, could one expect any advantages for individual entrepreneurs?

In contrast to present end-of-the-pipe prescriptions in environmental legislation, the paradigmatic change as foreseen by the MIPS and Factor 10 Concept gives *entrepreneurs* enormous flexibility and freedom to seek best possible dematerialized technical solutions for satisfying customer demands on a competitive basis. No longer would a "protective shield" around existing "service delivery machines" be the focus of attention but rather their power to create low-priced end-use-satisfaction with fun and few resources.

Resource prices will increase in the future because the global demand rises sharply. What counts probably more is that governments in industrial societies may well be forced to begin financing their business by taxing resources rather than labor (Paleocrassas, 1999; Lehner, 1999). This will give entrepreneurs the chance to expand their work force and avoid high priced purchases by concentrating on *"low-MIPS"* innovations, both for improving their production methods and their products.

Legal instruments designed to increase the relative scarcity of resources can obviously not be cast in the traditional form of environmental legislation. They would have to take the form of tradable permits, taxation (e.g. through a natural resource added tax), restricting monopolies, and the shifting/abolishing of subsidies. They would be economic instruments, supported by order and command legislation. A great number of present standards and norms would have to be reviewed with the goal to deregulate the situation in order to allow dematerialization. (Note: technical safety regulations always cost extra resources!). This applies particularly in the building sector. In Germany, millions of aluminum ladders are still installed on roofs to ascertain safe movement for chimney sweepers who no longer sweep chimneys from the top of houses.

As "Charterway" of Mercedes among many actual examples proves, leasing one's own products - selling services instead - can be a very profitable business. Leasing rather than selling products improves the resource productivity dramatically. Not only can the *capacity utilization* be increased by several factors. Leasing rather than selling is also a powerful incentive to improve the modular design of "service delivery machines" (products) and increase their longevity. Leasing rather than selling can also shield the entrepreneur from the financial consequences of sharp variations on the market. Leasing rather than selling often leads to a closer relationship between entrepreneurs and end-users, improving customized services as a benefit to the consumer on the one side, and a better protection of the entrepreneur from competition on the other side.

List of materials: MI-Factors of basic materials

Metals (kg/kg)		Granite, -slabs (polished)	1,9	Methanol	0,88
Aluminium, primary	85	Hardboard	2,9	Sodium hydroxide, 50%	6,1
Aluminium, secondary	3,5	Chalky sandstone	1,3	Naphtha*	2,9
Lead	16	Coalfibre (PAN)	61	Pentane	2
Raw iron	5,6	Perlit-foam	2	Phenol	3,2
Iron with zinc (small parts)**	9	PUR-hardfoam	7,3	Polyester resin	5,4
Ferronickel (33% Ni)	47	Foamglass	6,7	Polyethylene, PE	5,4
Chromium (53% Cr)	16	Plywood board	2	Propylene	3,9
Gold (540.000)	5,4E+5	Stone wool	4	PVC	8
Copper, primary	500	Stoneware,	2,9	Nitrogen, liquid*	2,3
Copper, secondary	10	XPS-foam	11,3	Sulphuric acid, 100%	0,5
Brass	350	Cement, iron & steel works	2,2	Nitric acid, 100%	1,05
Molybdenum	100	Cement, Portland-	3,2	Hydrochloric acid, 37%	3
Nickel	141	Brick, roof-	2,1	Starch	1,1
Platinum (320.000)	3,2E+5	Brick, porous	2	Water glass, 35%	1,2
Silver	7500	Brick, full-	2,1		
Steel, Oxygen-	7			**Electricity/Heat***	
Steel, Electro-	3,4	**Wood (kg/kg)****		Mini-BHKW (kg/kWh & MJ)*	0,16
Steel, V2A (18%Cr, 9% Ni)	21	Spruce: round wood	1,9		
Steel, V4A (17%Cr, 12% Ni)	24	Spruce: boards, beams, slats	2,2	**Energy Source (kg/kg)**	
Titanium	1000	Spruce: floor, shuttering	2,8	Petrol (H_u 42,8)*	2,9
Zinc	23	Spruce: windows, doors, etc.	3,5	Brown coal, D (H_u 8,8)*	10
				Vapour (3,1 MJ/kg)*	0,4
Mineral Materials (kg/kg)				Natural gas (H_u 41/kg)*	1,3
Aluminium Oxide (Al_2O_3)	7,4	**Others (kg/kg)**		Raw oil, (H_u 42,6)*	2,3
Borax	5,8	Aramid fibre	37	Light oil heating (H_u 42,8)*	2,5
Boron acid	7,6	Cotton	22	Heavy oil heating (H_u 40,7)*	2,6
CaO (burned limestone)	3,2	Container glass (0% recycled)	3	Refinery gas*	2,6
Colemanit	8,4	Container glass (88%recycled)	0,9	Hard coal, D (H_u 29,4)*	2,6
Diabas, broken	1,4	Colour, red lead	8	Hard coal, Import (H_u 27,5)*	5,8
Diamonds (5.300.000)	5,3E+6	Colour, wall-	2,2	Hard coal coke (H_u 29)	4,2
Fluorspar	2,9	Glass fibre (E-glass)	6,2		
Gypsum	1,8	Rubber	5	**Electricity (kg/kWh)**	
Graphite (synthetic)	20	Indiarubber	4	Europemix (UCPTE)*	2,0
Potassium salt	5,7	Cellulose*	12	Germany, public net*	4,7
Limestone	2,5	Linoleum	2	Austria, public net*	0,8
Kaolin	3,1	Acrylic paint	2,7	OECD-countries	1,55
Gravel	1,2	Latex	6	Brown coal (600MW)*	0,89
Loam	1,5	Leather	2	Hard coal (745 MW)*	11
Magnesium (miner.)	10	Paper	15	Natural gas(620 MW)*	0,23
Quartz sand (Glass sand)	1,4	Card	3	Heavy oil (400 MW)*	0,65
Sand	1,2	Polyesterfibre	3,6	Wind power (33 kW)*	0,07
Soda	4,5	Porcelain	10	Wind power (300 kW)*	0,06
Salt (NaCl)	1,2	Viscose	7,5	Photovoltaic, multi. (300 kW)*	1,8
				Hydroelectricity (Austria)*	0,21
Building Materials (kg/kg)		**Chemical Materials (kg/kg)**			
Insulation recycled paper	1,7	Acetone	3,2	**Transports (kg/tkm)**	
Concrete, B25	1,3	Ammoniac (NH3)	3,6	Rail transport	0,9
Concrete, pore- (500 kg/m^3)	2,3	Chlorine (Cl2)	6,1	Goods traffic	1
Bitumen*	2,6	Epoxy resin	13,7	Ocean shipping	0,006
EPS-foam	11	Ethylbenzol	4,5	Inland water ways	0,35
Fibre-board, medium-thick	2	Ethylene	3,9		
Glass wool	4,7	Formaldehyde	1,11	**Disposal (kg/kg refuse)***	
Flat glass	3	Carbamide	3,5	Domestic refuse dump	1,1

Source: Wuppertal Institute (and: *C. Manstein; **estimation Irgang/Manstein)

When entrepreneurs achieve decreasing dependence on natural resources through eco-intelligent innovations, they will:

ADVANTAGES FOR ENTREPRENEURS

- be interested in convincing governments to replace present environmental order and demand legislation with economic instruments, stimulating innovation and productive competition;
- give support to and derive income from eco-efficient innovations paving the way to a knowledge driven service economy;
- motivate the innovative spirit of their co-workers and improve their cooperation;
- experience new opportunities for "gaining the future";
- renew the emphasis on local and regional achievements and opportunities, resulting in more independence of "globalization";
- create job opportunities;
- create new chances for small and medium sized companies;
- get the benefit of cost reduction as they save resources, even at low resource prices;
- gain sustainable long term competitiveness;
- shift from capital intensity bred inertia to the agility of service providers with higher return to equity:
- hedge against resource bottlenecks and price instability;
- create new markets, first-movers making the greatest and most long-lived gains not only in market share but also in respect, standing and influence.

TOWARD ECO-INTELLIGENT PRODUCTS AND CONSUMPTION

As we have seen, one of the necessary conditions for moving decisively toward sustainability in industrialized countries is the innovation of radically dematerialized products and systems, as well as the change of consumption habits.

In fact, in order to reach a factor 10 or more, technical innovations are frequently not enough. System changes, reaching beyond the immediate decision sphere of individual manufacturers or end-user are usually called for. System changes may involve whole supply chains, changes in tax and incentive structures, and revisions of use.

As we have also seen: When striving for improvements in resource productivity in terms of MIPS, either lowering MI for a given S, or increasing S with a given quantity of resources can be applied. We have also understood that both changes can be achieved through technological as well as managerial personal adjustments and innovations.

This means that from a resource conserving point of view, designing *eco-intelligent products*, services or infrastructures requires to extract from each investment of natural materials the largest possible number of service units for the longest possible time span.

It also follows that the capacity/size of "utility delivers machines" should - wherever possible - be adapted to the actual needs. Thus, public transportation systems that are oversized or that have a short life time are ecologically counterproductive. Equally, buildings which are constructed with safety marging in static’s far beyond calculated needs and apartments which cannot easily be adjusted to changing needs, are ecologically (as well as financially) sub-optimal utility-delivery-machines. And certainly computers which are short-lived while offering a glut of functions that hardly anybody uses are not very intelligent machines from either an ecological or a financial point of view.

Here follow some definitions that could be helpful for orientation when discussing technical and economic issues in the context of dematerializing the economy.

In recent literature, the term *Eco-efficient* appears more and more frequently. This word was coined by Frank Bosshart, assistant to Stephan Schmidheyni during the preparations of the Business Council For Sustainable Development before the 1992 UNCED (United Nations Conference on Environment and Development) meeting in Rio. It is a term referring to both, economy and ecology:

"Eco-efficiency is reached by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle, to a level at least in line with the earth’s estimated carrying capacity" (Business Council for Sustainable Development, 1993).

Eco-efficiency is therefore a concept for improving the ecological character of production related activities while maintaining/improving their profitability.

More recently, a plethora of different definitions has been assigned to *eco-efficiency*, making orientation rather difficult. However, the term has found a wide acceptance, perhaps in part because it allows wide interpretations. *One could say that it is an operational concept which implies the use of less nature for producing more output under profitable conditions and which serves people.* It provides no measure for gaining sustainability. But the *MIPS- and the Factor 10 concepts* are entirely compatible with it. The MIPS-concept provides a framework for quantifying essential parts of Eco-efficiency, it addresses the consumption side of the economy, and the Factor 10 provides a goal against which one may determine how much effort is still needed in industrialized societies to approach sustainable conditions.

When considering the respective *resource productivity* of goods, one is not really comparing *efficiencies*. Efficiency increases normally refer to the output improvement of existing machines and processes at fixed inputs. Such improvements rarely surpass a few percentage points. Historically, less than 1 % per year has been achieved on the average. Improvements in the order of factor 2 would therefore tend to take some 50 years to accomplish.

The resource productivity on the other hand can follow the path of progress that was achieved by the development of labor productivity: Labor productivity did not rise by any significant increase of labor *efficiency* improvements. The typical traditional shoe-maker or tailor could not possibly increase his or her speed of work more than perhaps 10 or 20 % with the old tools. It was the application of more and more intelligent machines that allowed *"labor productivity"* to rise sharply. In a similar way, energy and material productivity can be increased far beyond the technical potential of efficiency increases of current technological systems. As indicated before, the way toward decisive ecological improvements must start with the question "what is the desired utility?", followed by whatever new and old technical solutions can be employed with an overall minimum of natural resources. Increasing resource productivity is not bound to a specific technology, increasing the efficiency of technology leaves no choice.

As the originally defined term eco-efficiency also refers exclusively to the production sector of the economy, potentially important adjustments in consumption and society as a whole are not addressed. And thirdly, this term does not consider the importance of minimizing the use of space, the "consumption" of surface area of the earth (the third important natural resource that we need for wealth production in - addition to energy and material).

For these reasons, one might wish to use the term eco-intelligent - or "low-MIPS" - when referring to systems, goods, services, utilities, consumption, and processes that are more promising than others as regards reaching sustainability, while providing wealth to all people.

ECO-INTELLIGENT GOODS ARE:

Competitively priced services and products (objects, tools, machines, buildings and infrastructures) that yield maximum possible utility - in terms of individual customers preferences - for the longest possible time, with a minimum of natural material, energy, surface coverage and dispersion of toxic materials - from cradle to grave. Among resource productivity experts, Eco-intelligent goods are usually referred to as "low-MIPS".

FIVE RULES FOR ECO-INTELLIGENT PRODUCTS

1. The number of service units obtainable from products ("service delivery machines") must be as high as possible during their entire useful life. Built-in obsolescence must stop.
2. The life-long material input into processes, products, and services must be as low as possible.
3. The life-long energy inputs into processes, products, and services must be as low as possible
4. The land use (surface coverage) per unit service must be as low as possible, from cradle to grave.
5. The dispersion of toxics must be minimal.

ECO-INTELLIGENT PRODUCTION SYSTEMS ARE:

Competitively priced technical and organizational procedures, conducted with the help of Eco-intelligent goods while minimizing the consumption of natural material, energy, surface coverage, the generation of wastes, and the dispersion of toxic or Eco-toxic materials.

LITERATURE

(Adriaanse, 1993); A. Adriaanse 1993: "Environmental Policy Performance Indicators". SDU Publishers, the Hague 1993.

(Bonniot/Manstein, 1998); O. Bonniot and C. Manstein: Rebound effects in industry. In: J. Benner, R. Graaff, T. Schmidt and Co-workers, “Rebound effects in energy saving”, Rotterdam, May 1998.

(Business Council for Sustainable Development, 1993); Business Council for Sustainable Development, Getting Eco-Efficient. Report of the BCSD, 1st Antwerp Eco-efficiency Workshop, 1993, Geneva.

(EEA, 1998): Background paper for Eco-efficiency workshop "Making Sustainability Accountable", 28 - 30 October, 1998, European Environment Agency, Kobenhavn.

(Faktor 10 Club, 1995) Carnoules Declaration of the international Factor 10 Club, available from the Factor 10 Institute, La Rabassier, F-83660 Carnoules).

(Fussler, 1996) C. Fussler, "Driving Eco-Innovation", Pitman, London, 1995.

(Hawken, 1999) P. Hawken, Natural Capitalism, Ltlle Brown, New York, 1999.

(Lehner, 1999): F. Lehner and F. Schmidt-Bleek: "Die Wachstumsmaschine - der ökonomische Charm der Ökologie", Droemer, München, 1999.

(Manstein, 1996) C. Manstein: Sustainability in Industry. New Concepts in Energy and Material Conservation: Material Intensity Analysis. Second Seminar on Industry and Environment, Helwan/Egypt 1996.

(Manstein, 1999), C. Manstein: Material Input Calculation MIC: This new software can be ordered: Society Factor4+ Klagenfurt, Messepaltz 1, A-9021 Klagenfurt/Austria.

(Market 1999) Bedarfs- und Aktzeptanzanalyse zum Vorschlag eines Studienganges “Ressourceneffiziente Produkt- und Prozeßtechnik” an das österreichische Wissenschaftsministerium in Wien, Linz, 1999 (*market analysis for a new study on “resource-efficient product- and process engineering” proposed to the Austrian Ministry for Science in Vienna, Linz, 1999*).

(Paleocrassas, 1999): Y. J. Paleocrassas, "Factor 10 and Fiscal Reforms", a Report by The Factor 10 Club, 1999. Available from the Factor 10 Institute, La Rabassiere, F-83660 Carnoules.

(Schmidt-Bleek, 1993): F. Schmidt-Bleek and Co-workers, A Series of Articles in "Fresenius Environmental Bulletin", Special Edition 8/93, Birkhaeuser, Basel, Boston, Berlin, 1993.

(Schmidt-Bleek, 1993/2): F. Schmidt-Bleek, "Wieviel Umwelt braucht der Mensch - MIPS, das Mass für oekologisches Wirtschaften", Birkhaeuser, Basel, Boston, Berlin, 1993. (English translation: "The Fossil Makers", available from the Factor 10 Institute, La Rabassiere, F-83660 Carnoules).

(Schmidt-Bleek, 1995): F. Schmidt-Bleek, U. Tischner, "Produktentwicklung, Nutzen Gestalten, Natur Schonen", WIFI Brochure No. 270, Wirtschaftskammer, Vienna, 1995.

(Schmidt-Bleek, 1998): F. Schmidt-Bleek, "Das MIPS Konzept - Faktor 10", Droemer Knaur, Muenchen, 1998.

(Schmidt-Bleek, 1998/2): F. Schmidt-Bleek and Co-workers, "MAIA, Einführung in die Material-Intensitäts-Analyse nach dem MIPS-Konzept", Birkhaeuser, Basel, Boston, Berlin, 1998.

(Schmidt-Bleek, 1999): F. Schmidt-Bleek, "Öeko-design, vom Produkt zur Dienstleistungserfüllunsmaschine", Wirtschaftskammer - WIFI - Oesterreich, Wien, 1998.

(Schmidt-Bleek/Manstein, 1999): F. Schmidt-Bleek, C. Manstein, Eco-intelligent products and MIPS, a video production by Society Factor 4+, Klagenfurt, 1999.

(Schmidt-Bleek/Manstein, 1999/2): F. Schmidt-Bleek, C. Manstein, Klagenfurt Innovation, Ein EU-Projekt zur umweltgerechten Produktgestaltung mit 50 kleinen und mittleren Unternehmen aus Kärnten/Österreich, Alekto Verlag, Klagenfurt, 1999.

(World Resource Institute, 1997): A joint report by the World Resources Institute, the Wuppertal Institut, the Netherlands Ministry for Housing, Spatial Planning, and Environment, and the Japanese Institute for Environmental Studies, Washington, D.C., April, 1997. This report is based upon the Bringezu Methodology (Wuppertal Institut) for assessing Total Material Flows (TMF) for economic units.

2.3 ASPECTS OF ECODESIGN

Friedrich Schmidt-Bleek, Christopher Manstein

2.3.1 APPLYING THE MIPS-CONCEPT IN PRACTICE: THE TRAINING-CONCEPT OF THE PROJECT “KLAGENFURT INNOVATION” AND SELECTED RESULTS FROM COMPANIES PROJECTS

The basic goal for the Eco-design of products is
to obtain a maximum of utility
at the price of
a minimum of natural resources
and minimal emission of toxic substances.

The following comments are partly extracts from the recently published guide (which appeared in German) on innovating eco-intelligent products through ecodesign (Schmidt-Bleek, 1999). This guide is based upon a considerable number of practical experiences with small and medium sized companies in Switzerland, Sweden, Austria and Germany.

INCREASING THE RESOURCE PRODUCTIVITY OF PRODUCTS

Eco-design of products begins with the definition/description of the utility - or the bundle of services - which the end-user expects from a product. This utility must then be generated with the least possible quantity of natural resources, from cradle to grave.

During the planning stage of a product, eco-design focuses upon the following:

- the selection of materials with small ecological rucksack factor and low eco-toxicity;
- the least possible resource consumption during the entire life span of the product, its recycling and disposal
- the production conditions;
- the construction;
- the conditions of use;
- the options for future uses and re-manufacturing;
- the minimization of transport and packaging;
- the purchasing and the marketing conditions.

THE TRAINING-CONCEPT IN THE PROJECT “KLAGENFURT INNOVATION”

Increasing the resource productivity of products can proceed in five main steps:

1. Reviewing present manufacturing conditions for a *“reference product“* in the sense of attempting to improve *”good housekeeping”*: leaks of energy, storage conditions, transport intensity, and in particular the production generation of waste during manufacturing.
2. Replacing materials with large ecological rucksacks (e.g. copper) in an existing product with low-MIPS materials (e.g. plastics), and imbedding the least feasible total quantity of materials in the product: lowering the *MI in MIPS*.
3. Increasing the number of service units which can be extracted from the product during its life time: *increasing S* in MIPS.
4. Innovating new technical approaches/solutions for satisfying customer’s needs: ”*Lean Products*”.
5. Developing new *purchasing and marketing strategies*.

Based on these five strategies of increasing the resource productivity of products, we developed a so-called ”Step-Concept” as training modules for the project “Klagenfurt Innovation”. This concept consists on theoretical elements (i.e. workshops) and practical elements (i.e. consulting in the participating companies). The aim was to relate the elements and aspects from the training and workshops to a selected product in each company, the so-called ”Reference Product”. Each participating company was asked to develop a special in-house project during the period of “Klagenfurt Innovation”. Responsible members of the staff had to be nominated for the entire lengths of the project before work started. The full backing and interest of the owner/top manager had to be assured.

Selected results of these projects-works can be formed at the end of this chapter.

STEP 1: SELECTING A REFERENCE PRODUCT

The ”Reference product” is chosen by the participating company. On the one hand this product should show a good selling record and on the other hand it should be considered to have superior ecological qualities. The aim is to examine and demonstrate improvement options as regards dematerializing the reference product, without lowering quality standards. Of course, the procedures can later be transferred to other products of a company. For any selection of the reference product, *Checklist I* may be helpful.

STEP 2: DETERMINING THE MATERIAL INPUT (MI) OF THE REFERENCE PRODUCT

Before systematic dematerialization of the reference product (increasing its resource productivity) can proceed, the complete material composition of the existing product need be carefully assessed. This information is usually not on hand before consultations begin. This situation is usually found to be before somewhat akin to the time before chemicals legislation was in place: large chemical firms did not have complete inventories of all products they were ready to sell or had previously already placed on the market during the few years prior to the time when existing chemicals inventories were legally required: Companies do not necessarily know the exact material composition of their products.

A complete listing for all material components in the finished product must be established in kg. The wastes for each component generated during manufacturing are added in kg, and the sum for each component multiplied with the appropriate "rucksack factor". A selected list of rucksack factors or MI-factors can be found in *Chapter 1.1.5* of this report.

Similarly, the packaging for the product, the energy input and electricity consumption during manufacturing, and the (average) transportation in tkm of materials from the production site to the customer, need be assessed. In the case of producing the final product somewhere out in the open (e.g. a building or a bridge) the average distance to transporting construction materials from the vendor to the construction site must also be noted.

The result is the MI of the reference product in kg per kg product (natural materials disturbed in the environment from cradle to the finished product).

We also developed a practical software package ”*MIC – Material Input Calculation*” that permits an easy calculation of the Material Input (Manstein, 1999). For those who are not able to use MIC the *Checklist II.a and II.b* may be helpful.

COMPARING MIPS AMONG “LIKE” PRODUCTS

Like products are functionally equivalent, delivering comparable services. Their MIPS-values can be computed by dividing the MI by the number of service units that the manufacturer guarantees. Alternatively one can also assume some reasonable S value, based on experience with the product. Service units can for instance be defined in terms of person- km for vehicles, or flying-hours for planes, in number of deliverable units of utility during the useful life time, like loads of clean wash from a washing machine, or cups of coffee by a coffee machine, in person-years of occupation for a house etc.

Obviously services or utilities cannot be measured as such. However, their relative values can be compared by relating them to measurable quantities like MI, hours of labor input or price.

A comparable ("like" or functionally equivalent) product can be similarly analyzed and the two MIPS (resource intensities) or S/MI (resource productivity) for the competing products directly compared. Here, again, comparability of the utilities delivered is a key issue.

Detailed conventions and instructions for computing the material intensity of materials and products can be found in a recently published *handbook* of the Wuppertal Institute (Schmidt-Bleek 1998/2).

”KLAGENFURT INNOVATION” **Checklist I: Selecting a Reference Product**			
Product or Service:	”Product A”	”Product B”	”Product C” ...
Production per year:			
Unit:			
Economic ”Success” (0 = low, 1 = medium, 2 = high)			
Profit share of total production			
Competitive advantage			
Customer complaints			
Future chances			
...			
SUM:			
AVERAGE:			
Environmental ”Success” (0 = low, 1 = medium, 2 = high)			
Energy consumption			
Material consumption			
Renewable resource inputs			
Waste intensity during production			
Dangerous materials			
Weight			
Longevity			
Reparability			
Multi-Functionality			
Material composition complexity			
Re-cycling potential			
Combustion potential			
Impact after disposal			
...			
SUM:			
AVERAGE:			

Source: C. Manstein, G. Weihs

"KLAGENFURT INNOVATION"

Checklist II.a: Calculating the Material Input (MI)

a) Material composition: "PRODUCT-NAME" AND "COMPANY"

Materials / components	Mass / Product [kg]	Waste / Product [kg]	Sum Mass + Waste [kg]	MI-Factor [kg/kg]	Material-Input (MI) [kg]	Comments
Sum:						

b) Packaging materials:

Materials / components	Mass / Product [kg]	Waste / Product [kg]	Sum Mass + Waste [kg]	MI-Factor [kg/kg]	Material-Input (MI) [kg]	Comments
Sum:						

Source: C. Manstein, F. Schmidt-Bleek

”KLAGENFURT INNOVATION”

<u>Checklist II.b</u>: Calculating the Material Input (MI)

c) Energy consumption: ”PRODUCT-NAME” AND ”COMPANY”

Energy (Oil, natural Gas etc.)	Quantity [kg]	MI-Factor [kg/kg]	Material-Input (MI) [kg]	Comments
Sum:				

d) Electricity consumption:

Electricity (Public net, wind energy etc.)	Quantity [kWh]	MI-Factor [kg/kWh]	Material-Input (MI) [kg]	Comments
Sum:				

e) Transports:

Transport-system	Transport-Distance [km]	Transported Mass [t]	Distance x Mass [t·km]	MI-Factor [kg/tkm]	Material-Input (MI) [kg]	Comments
Sum:						
Total Sum: a) - e)						

Source: C. Manstein, F. Schmidt-Bleek

STEP 3: DEMATERIALIZING THE REFERENCE PRODUCT

Next, the listing as described in checklist II.a and II.b above can be analyzed for opportunities to dematerialize the reference product:

⇒ *MATERIAL SUBSTITUTION:*

Replacing materials with large ecological rucksacks (e.g. copper) in an existing product with low-MIPS materials (e.g. plastics), and imbedding the least feasible total quantity of materials in the product: lowering the MI in MIPS.

When analyzing the various rucksack components for instance of a house built of wood (not counting the technology inside), it was found that the foundation (armored cement) and the gold-plated windows made up each ca. 1/3 of the total MI. Changing the foundation design and replacing the gold-plated windows with normal ones, - adding instead venetian blinds to all windows - nearly tripled the resource productivity of the house. Compared to a brick building with "like" service characteristic and life time expectation, the wooden house yielded a more than threefold higher resource productivity.

Another example would be a solar collector by the company Greeneonetec (a participant in the project ”Klagenfurt Innovation”). After establishing the MI for the existing product (a solar-product that had been "ecologized" before in a traditional sense and sold very well), the copper parts were replaced with plastics, leading to a dematerialization of about a factor of 7 !

REPEATED MISUNDERSTANDINGS

Repeated misunderstandings lead us to the following note: dematerializing a product does not mean that it must be made in a smaller size, even though this may be sensible in certain cases (e.g. a city car). To produce a chair for instance which stands 10 cm tall is a nonsensical preposition. Rather, the task is to create a new service delivery machine, in this case a chair-like device, which allows sitting (conveniently, safely.....) with an tenfold smaller consumption of natural resources from cradle to grave. This may even be a very similar chair but has a much longer lifetime.

“ECOLOGICAL HOUSEKEEPING”

Although many companies especially in Austria have been quite successful in past with the UNEP-initiated ”Cleaner production” program, it was found that ”ecological housekeeping” could still be improved considerably in a number of cases:

⇒ *WASTE MINIMIZATION*

In general, the actual situation in Austrian companies with respect to waste avoidance during production is rather satisfactory. Nevertheless, further reduction-potentials should be analyzed in each case, like internal and external cascading use of waste materials and energy or other strategies for “zero emission“ (Pauli, 1996).

⇒ *MINIMIZATION OF TRANSPORT*

Improvement of the transportation capacity utilization so as to meet real needs in terms of timing, distances, quantities, weights and sizes of shipments. For example: renting capacity instead of owning, hiring out ones own truck when it is not in use, purchasing local or regional products, and marketing preferentially to near markets.

⇒ *OPTIMIZING OF PACKAGING*

Packaging should reflect the choice of low-MIPS materials (e.g. plastic instead of paper) and should be kept to a minimal necessary size and weight if used only once. Re-usable packaging systems should be rented or designed wherever it is feasible (considering distances of transportation). In all cases, cascading or consecutive uses of packaging should be considered. For instance, the packaging of a bicycle could serve later as a puppet theatre for children, glass containers could serve for storing home-made confiture or as vases for flowers, and plastic packaging for roof tiles as building materials etc. In some cases it is possible to use parts of dis-assembled products as packaging during shipping.

ECO-INTELLIGENT PACKAGING

One of the most eco-intelligent pachaging system on the market is the so-called “trow-away camera”. Essentially it consists of 30 grams of plastic with lens and service to house, use, and protect a film. In order to utilize the content (obtain the pictures), the package has to be return to the point of origin or another dealer who is automatically part of the system. The film is removed and processed, the container is being returned to the fil-producer and re-filled – and returned to the market up to 80 times. The system thus forces the return of the packaging to designated points without any extra costs with a succes rate very close to 100%. Not surprisingly, this system leads to the lowest-MIPS photographs while yielding entirely satisfactory pictures for hobby purposes.

⇒ *AVOIDING DANGEROUS SUBSTANCES*

Conscientious application of existing regulations should suffice in most cases.

⇒ *RESULTS*

The systematic analysis of existing products and their MI-improvements as outlined above leads regularly to increases in resource productivity by factors of 2 to 5 without loss in the quality of performance.

For the practical implementation of *Step 3 “Dematerializing The Reference Product” we developed a series of checklist and questions which are helpful to find new solutions (see the following checklists III a-c).*

”KLAGENFURT INNOVATION”

CHECKLIST III.A: DEMATERIALIZATION

QUESTIONS TO THE MANUFACTURER	ACHIEVABLE ?			PROFITABLE ?		
▪ **Minimizing material intensity:**	Yes	Check	No	Short-term	Medium/long-term	Check
1. Is it possible to substitute components with a high ecological rucksack factor?						
2. Have the materials/substances/products been manufactured taking into account their ecological rucksack factors?						
3. Is the manufacturing method as simple as possible?						
4. Is the material composition as simple as possible?						
5. Are all materials marked/known?						
6. Is the weight as low as possible?						
7. Is the size/volume of the product as small as possible?						
8. Are the product’s space requirements as small as possible?						
9. Can the rejection rates be further reduced and the throughput rates in internal circuits minimized?						
10. Can productivity, exploitation be further improved?						
11. Is the design (particularly for leasing products) sufficiently simple and the product sufficiently robust?						
12. Can product-accompanying information systems be integrated?						
13. Is the material expenditure of the works plant itself and the machine park optimized?						
▪ **Minimizing energy intensity:**	Yes	Check	No	Short-term	Medium/long-term	Check
14. Is the use of energy in production itself optimized?						
15. Are forms of energy with small ecological rucksack factors used?						
16. Can (additional) automatic “sleep“ or “power down“ functions be integrated into the product?						
17. Can the drives for products be optimized? (Low ecological rucksack factor)?						
18. Can drive units for options be avoided? Can “external“ drives be used?						
19. Can product-accompanying information systems be integrated?						
20. Can the energy in the factory building be subject to multiple use e.g. in cascades?						
21. Is the energy expenditure of the works plant itself and the machine park optimized?						

Source: F. Schmidt-Bleek

"KLAGENFURT INNOVATION"

CHECKLIST III.B: DEMATERIALIZATION

QUESTIONS TO THE MANUFACTURER	ACHIEVABLE ?			PROFITABLE ?		
▪ **Avoiding or reducing waste:**	Yes	Check	No	Short-term	Medium/long-term	Check
22. Have provisions been made for returning the products by the end-use (by the manufacturer)?						
23. Can materials be reused within the plant (packaging, waste, water, solvents, energy)?						
24. Is the design as simple as possible? How can packaging and packaging systems be made reusable (no laminates in packaging, marking, considerations whether the goods can be stacked without packaging)?						
▪ **Reduction of transport intensity:**	Yes	Check	No	Short-term	Medium/long-term	Check
25. Have transport alternatives with minimum resource requirements been considered?						
26. Can internal transport distances be reduced?						
27. Can the transport distances from suppliers be reduced?						
28. Can the average transport distances to the dealers be reduced?						
29. Can the average transport distances to the end user be reduced?						
30. Can the transport distances to recycling enterprises be reduced?						
31. Can local products be given priority?						
▪ **Avoiding hazardous materials:**	Yes	Check	No	Short-term	Medium/long-term	Check
32. Has account been taken of the fact that all hazardous materials regulated by the law must be avoided?						
33. Has account been taken of the fact that there should be no problems caused by halogenated materials (chlorine, bromine) occur where the development of fumes (fires etc.) can endanger human beings?						
34. Has account been taken of the use of materials that do no develop toxic material in the event of fire or contact with water?						

Source: F. Schmidt-Bleek

"KLAGENFURT INNOVATION" CHECKLIST III.C: DEMATERIALIZATION						
QUESTIONS TO THE SUPPLIER	**ACHIEVABLE ?**			**PROFITABLE ?**		
▪ **On the use of materials**	Yes	Check	No	Short-term	Medium/long-term	Check
35. Have the materials/substances/products been manufactured taking into account their ecological rucksack factors?						
36. Are the raw materials and supplies, the fabricated materials and spare parts available for many years?						
(Where fabricated materials are supplied, all the above listed relevant characteristics should be questioned)						
▪ **On the use of energy**	Yes	Check	No	Short-term	Medium/long-term	Check
37. Were the energy media selected after a comparison of rucksack factors?						
38. If electricity is needed, can the method of generation be chosen that uses the smallest possible rucksack factor?						
(Where fabricated materials are supplied, all the above listed relevant characteristics should be questioned)						
▪ **On transport costs:**	Yes	Check	No	Short-term	Medium/long-term	Check
39. Has the solution with the most favorable resources been selected?						
40. Can internal transport distances at the supplier's facility be optimized?						
41. Can transport distances to the supplier be reduced? (e.g. supply of raw materials from abroad)						
▪ **On the creation of waste**	Yes	Check	No	Short-term	Medium/long-term	Check
42. Can the waste created at the suppliers' plan in connection with the deliveries be reduced?						
43. Does the supplier take back parts supplied from the manufacturer (end-user)?						
44. Does the supplier pay attention to the recyclability of the packaging and packaging systems?						
▪ **On the avoidance of hazardous materials:**	Yes	Check	No	Short-term	Medium/long-term	Check
45. Are all the hazardous materials regulated by law dealt with in accordance with regulations?						

Source: F. Schmidt-Bleek

STEP 4: THE POWER OF "S" IN MIPS - INCREASING THE SERVICES

“I am convinced that customer service
and customized production will continue to gain importance.
With this I mean not only the increase in customized mass production
but also the response to very specific wishes of customers
through key accounting and considering market conditions
- no matter how small the wish of a customer may be”

Prof. Klaus Steilmann
(Major enterpreneur)

As we have seen earlier, S cannot be measured. However, it can be defined and then related to measurable quantities like a price or the MI (the rucksack) in order to compare the “price“ for getting the desired results from one or the other machine which can deliver the utility.

What is new within the MIPS and Factor 10 Concept is that the utility of a product replaces the product itself in relative importance. Realistically priced access to products and their use as “service delivers machines“ moves into center court and goods become mere technical artifacts to make services available. We have just described the essence in moving from a material throughput economy to a knowledge based service society. This is the core of the future knowledge driven customized economy! (Lehner, 1999) Here, the continued manufacturing of new products is replaced to a considerable degree by a decentralized labor intensive systems maintenance.

In the future accessibility to desired services could be described as the basis of the wealth of people. The totality of accessible services within a country would then be a proxy of the wealth of this nation.

The foremost task for anyone involved in the design, production, packaging, transporting, marketing, storing, and even in financing future products is to invent reliable and compatibly priced products which provide the principal utility - and as many additional ones as desired by end users - with the least quantity of natural material, energy, and are requirement for the complete life span and for the longest possible time.

This of course, is nothing new to manufacturers in principle. One only has to replace the words “material“, “energy“ and “area“ with the single word “money“ in the above sentence in order to see the point. However, resources are so cheap today that saving them makes little difference to the bottom line of manufacturers or consumers.

Whenever cost cutting becomes crucial much more efficient for producers to release labor than saving kilowatt hours or cutting down on material use. This circumstance is frequently blamed on the so called globalization. In reality it is primarily the consequence of political signals to the market which have deliberately undervalued natural resources for many years through policies of taxation, privileges and subsidies.

As we have noted before:

There are *two basic strategies* for improving the ”S” in MIPS: (1) Extending the lifetime of use, and (2) increasing the number of service units by making the product ”multifunctional”

One example for combining both approaches is a new concept for an office desk which the carpenter Kapeller developed (he was a participant in the project "Innovation Klagenfurt"). After calculating the Rucksack for an existing desk, Kapeller developed a new concept for a long life and multifunctional office desk called ”AVENA”. This desk consists on massive wood and has a natural surface. The design is simple, therefore the desk is expandable and can be adapted to different uses. And: Kapeller offers a guarantee for about 30 years !

Checklist IV is developed with questions concerning the service improvement of any product.

”KLAGENFURT INNOVATION” CHECKLIST IV: IMPROVING THE SERVICE						
	ACHIEVABLE ?			PROFITABLE ?		
	Yes	Check	No	Short-term	Medium/long-term	Check
46. Are spare parts available over a long time?						
47. Can the device be made more user-friendly?						
48. Can a timeless appearance be designed (“manufacturing antiquities”)?						
49. Can automatic functions be built into the product in order to reduce material consumption during use?						
50. Is the nature of the surface optimized (corrosion resistant, weather resistance, washable)?						
51. Can cleaning be made easier for the end user of the product?						
52. Is a modular structure possible, so as to permit the product to be dismantled, repaired, and subsequently upgraded simply, quickly and without special tools?						
53. Can maintenance be made easier?						
54. Can reliability be further improved?						
55. Can the product be made more robust?						
56. Can premature wear and tear of individual parts be avoided?						
57. Can important components be standardized to make them compatible with components in rival products?						
58. Can the product be combined with other products?						
59. Can the product be used for a variety of purposes?						
60. Is the design of the reusable components optimum? (Subcomponents, casing, etc.)?						
61. Can the product be used for other purposes after the end of its original use (cascade use)?						

Source: F. Schmidt-Bleek

STEP 5: DESIGNING NEW ECO-INTELLIGENT THINGS –“LEAN PRODUCTS”

While the improvement of existing ”service delivery machines” is the preferred approach in most cases, far better results in saving resources may be obtained by leaving known technical solutions behind and starting a new design. The first step is taken by carefully defining the principal service that the product is to deliver. Based on serious dialogues with end-users, a bundle of additional conditions and expectations must be noted and added together as an overall goal statement. The task is then to design and construct the future product which is to yield *maximum possible utility at competitive prices for the longest possible time, with a minimum of natural material, energy, surface coverage and dispersion of toxic substances - from cradle to grave.*

Having determined the service bundle expected by the end-user, the designer (engineer) proceeds to design a "service delivery machine" showing the highest possible resource productivity - from cradle to grave - without at first regarding already existing technical solutions (Schmidt-Bleek, 1995). Only materials with the lowest possible rucksack factors will be considered unless very special material requirements must be met, longevity will be one of the outstanding features as well as modular design for allowing easy repair and up-grading. The "machine" will have a minimum requirement of materials, energy, and surface area during its entire life time. A considerable number of additional points must be considered, as is customary when new constructions are being considered (Schmidt-Bleek, 1998).

In summary, the following steps are important when creating new dematerialized products:

IMPORTANT STEPS FOR DEMATERIALIZED PRODUCTS

1. Determination and definition of the ”Service-bundle” of the product
2. Search of dematerialized solutions. Conception, planing, draft.
3. First assessment of the results from an ergonomic, hygienic, and manufacturing point of view. Consideration of laws and standards.
4. Selection of the ”best” solution. Examination with a view toward the previously determined ”Service-bundle” as well as with the help of the attached list (part C) with ecological questions.
5. MIPS-comparison of the solution with previous reference product or with other similar competition-products.
6. Examination of the economic consequences (including marketing) of the new solution under consideration of the availability of the materials and possibilities to produce.
7. Carrying out of necessary adaptations and repeating to steps 2,3,4,5 and 6
8. Realization.

Source: Schmidt-Bleek, 1995

To illustrate this eco-design approach, here is a practical example. Ursula Tischner has designed a new type of refrigerator at the Wuppertal Institute. Instead of re-designing the usual stand-alone piece of equipment, she elected to propose a sophisticated insert for a hole in the wall that uses cold air from the outside during winter and provides heat for pre-heating water while in operation. The cooling machine is housed separately and can be serviced or replaced by the company that produced it and continues to own it. Since an air stream is built into the refrigerator can also be used, in part or in total, as a normal storage place in the kitchen without cooling. The resulting dematerialization, even without selecting materials with low rucksack factors, amounted to a factor of ca. 8 (Schmidt-Bleek, 1995).

From this rough comparison it becomes obvious that reducing for instance merely the fuel consumption of passenger cars would only take advantage of a (relatively small) part of the overall opportunities to provide more Eco-intelligent automotive services in cities.

One can also deduce that one is not really arriving at an environmentally friendly car by merely switching from a gasoline engine to a battery driven vehicle. In fact, batteries have an enormous rucksack and thus worsen the situation when considering the stability of the ecosphere rather than the health of people in a city.

It is furthermore obvious that regulations, taxes, and special incentives (e.g. free parking and easy access to rentals for special occasions) be essential in order to support the move toward a systems change.

The new "Smart" by Mercedes Benz fulfills already some of the conditions outlined above. In addition, the Smart dealers offer free service to hire or lease other cars for Smart owners when need arises. Beyond this, the sale rooms for Smarts are "low FIPS": 8 cars are housed in a tower above each other.

A number of publications exist today that contain many practical examples, demonstrating the opportunities of technical dematerializations in all areas of life (Stahel, 1995; Schmidt-Bleek, 1999; Schmidt-Bleek/Manstein, 1999/2). Additional publications are in preparation, in particular in the USA and Europe. A recent fair in Klagenfurt, Austria, assembled close to 100 exhibits of producers and institutions under the heading "Factor 4 +".

It is to be repeated in October, 1999. MITI of Japan and NIKKEI Tokyo are planning a trade fair for "low-MIPS" products and services in late 1999 in Tokyo. Also the Düsseldorf Trade Fair Organization in Germany, which is organizing the most important trade fair on environmental technology in Europe, the EVITEC, is intending to focus the next event in 2000 on the topic eco-efficiency.

SELECTING PROFITABLE DESIGN OPTIONS

When discussing technical options and management opportunities for dematerializing existing products, or for designing entirely new technical solutions for rendering services in more sustainable fashions, a whole range of possibilities can usually be identified.

These options are then systematically reviewed and prioritized with respect to their potential of increasing the overall resource productivity, S/MI.

As a next step, these options are displayed against the probably least costs - or highest potential for economic gains - if implementation of these options would proceed. In this fashion, the most attractive opportunities appear in the upper right hand corner when displaying increasingly effective dematerialization actions on the vertical axis, and increasing potentials for financial gains on the horizontal axis.

Different time horizons for various options may lead to additional sequencing their implementation.

Three to five realistic and apparently profitable options usually result during these procedures discussions that can lead to substantial increases in resource productivity while offering the chance of short term pay-backs of investments or even immediate additional profits (see also Schmidt-Bleek, 1999).

PURCHASING FOR SUSTAINABILITY

At this time, many purchasing agents show already a remarkable sensitivity to environmental concerns. The MIPS and Factor 10 Concepts add an essential new dimension to the parameters which are already considered on a routine basis today.

Obviously, the ecological rucksacks along with the longevity (as maintenance free as possible) of industrial products are key properties when attempting to make the investment of natural materials and energy count most. However, at this time, many industrial goods are far from being optimized for long useful lives. In saturated markets, companies normally believe they could hardly afford otherwise.

As market prices of products are usually stated in costs per unit product at the point of sale, it is frequently quite easy to mislead customers into believing that they save money by purchasing less expensive merchandise. In particular, public authorities frequently opt for accepting the lowest bids in terms of cost per unit product, without adequately considering follow-up costs which can easily multiply the real costs per unit service - *COPS*. Were all prices for goods be stated in COPS, competition would center on maximizing utility offered and societies would move more readily in the direction of sustainable knowledge based economies (Lehner, 1999).

Nevertheless, there are already important sectors of the economy where long lived products are offered to customers on a routine basis, usually through leasing contracts. The air line industry and the truckloaning arm "Charterway" of Mercedes Benz are examples.

5 GOLDEN RULES FOR AN ECOLOGICAL PURCHASE

1. If possible the potential of the pollution of products should be known "from cradle to grave".
2. The efficiency of the transport should be as good as possible and should last as long as possible
3. The necessary material and energy usage per Service Unit (MIPS) should remain as small as possible during the whole life-cycle and the quality of the service should be very high. This is also valid for the transport, packaging and recycling - and means optimizing the resource productivity.
4. The need of space of the product should be very small, that is also valid for production and sale.
5. The emission of harmful materials should be very small, the emission of toxic materials must be excluded.

Source: Schmidt-Bleek, 1999

MARKETING ECO-INTELLIGENT LEAN PRODUCTS

Experience shows that environmental labels - even official environmental prices for excellence - do no longer enhance substantially the chances for marketing goods on the market in Europe. In part this is certainly due to the flood of environmental labels presented today - officially sanctioned or not. Customers seem to find it difficult to understand most of these labels, or even mistrust them. For instance, on every packaging of imports to France from China, the "Green Point" appears today. This practice not only devalues its original meaning, but is blatantly misleading and even fraudulent.

Labels indicating that food stuff consists of crops raised under "biological conditions" (whether true or not) are still considered seriously by customers, probably because this information relates to health concerns. In this case, customers are apparently willing to pay even considerably higher prices.

MIPS labels for all industrial goods could be developed and assigned internationally and would probably be helpful as a reliable indication for the specific natural resource consumption associated with various products.

When considering marketing strategies for products with high resource productivity, there are several additional opportunities that can be exploited.

For instance, manufacturers can point to the longevity of their products and the price advantages associated with gaining better returns (more service for a longer time period) from robust, high quality products. In a sense, they offer "future antiquities" for sale. Advantages on a per unit utility basis could even be expressed in COPS - COsts Per unit Service - and compared to like products from competitors.

Long term guarantees should underpin claims of longevity. Take-back guarantees should be offered wherever possible. Merck and Co offers even a money-back guarantee on its cholesterol-reducing drug Zocor on the US market. There are several manufacturers on the market today that offer life-time guarantee for their wares (Eddie Bauer, for instance), or open-ended take-back guarantee.

Manufacturers can also consider to begin switching from selling products to selling services, e.g. offering their own products for lease or rent on the market. A member of the board of Daimler Benz recently stated that within 20 years his company will no longer sell cars but mobility services instead. Expensive equipment, such as harvesting combines, planes, trucks, and yachts have always been available under such conditions. There are signs that many more types of industrial products could be for hire in the future, supported by information systems that make leasing or hiring arrangements much easier than may be the case today.

Manufacturers, in cooperation with department stores or through their own outlets, can also offer combination-packages for leasing, take-back, repair, and maintenance services for high quality products.

Manufacturers serving certain groups of customers, like babies, toddlers, or the elders, can combine their efforts and sell in common outlets. Clothes, baby carriages, furniture, shoes, toys, games and food for instance could be offered for babies in such places, together with leasing, repair and take-back services.

And finally, manufacturers can influence public officials responsible for the contents of requests for tender to incorporate within the requests proof of high resource productivity.

THREE STEPS FOR A SUCCESS IN MARKETING

1. To make analysis - The first step for a successful marketing is to find out the wishes and ideas of the consumers. The analysis should also help us to find out how and with which products the consumers are served by at the moment as well as the ways of transport, storekeeping, the available structures of the sale (including the willingness of the trade to take back or repair products). Questions could be: Is ”my” market able to learn? Is it willing to learn? What should happen that it learns? Which colleagues can help me to bring my message on the market? Associations? Public authorities? Schools? Youth groups? Associations for housewives? Churches? Parties? Green Peace? And: Which are those who maybe have disadvantages because of my success?

2. To determine aims - The second step should help us to find out following questions: Where do I have to go and what do I want? Which group of people should be my clients? Who not? Is it for me more important to earn money and finding out gaps in the market or is it more important to help certain people or to do something especially for the environment? What can my ecological point of view contribute to reach my determined aims?

3. Realization - Before a company takes a risk with a completely new direction of business it should talk first with consumers (Prosumers) about what would happen and how the consumers would react.....?

LITERATURE

(Lehner, 1999): F. Lehner and F. Schmidt-Bleek: "Die Wachstumsmaschine - der ökonomische Charm der Ökologie", Droemer, München, 1999.

(Manstein, 1999), C. Manstein: Material Input Calculation MIC: This new software can be ordered: Society Factor4+ Klagenfurt, Messepaltz 1, A-9021 Klagenfurt/Austria.

(Nikkei Journal, 1998) The Nikkei Journal (Tokyo) has reported several times and extensively about the Factor 10 and MIPS Concept during October/November, 1998. A special issue of "CHUOKORON", written and edited by Editor in Chief Mme Yukawa, is to appear early in 1999. A fair in Tokyo, sponsored by Nikkei and MITI, is to exhibit dematerialized products in December, 1999.

(Pauli, 1996): G. Pauli, “Breakthoughts”, Tokyo, 1996.

(Schmidt-Bleek, 1995): F. Schmidt-Bleek, U. Tischner, "Produktentwicklung, Nutzen Gestalten, Natur Schonen", WIFI Brochure No. 270, Wirtschaftskammer, Vienna, 1995.

(Schmidt-Bleek, 1998): F. Schmidt-Bleek, "Das MIPS Konzept - Faktor 10", Droemer Knaur, Muenchen, 1998.

(Schmidt-Bleek, 1998/2): F. Schmidt-Bleek and Co-workers, "MAIA, Einführung in die Material-Intensitäts-Analyse nach dem MIPS-Konzept", Birkhaeuser, Basel, Boston, Berlin, 1998.

(Schmidt-Bleek, 1999): F. Schmidt-Bleek, "Öko-Design, vom Produkt zur Dienstleistungserfüllunsmaschine", Wirtschaftskammer - WIFI - Oesterreich, Wien, 1998.

(Schmidt-Bleek/Manstein, 1999/2): F. Schmidt-Bleek, C. Manstein, Klagenfurt Innovation, Ein EU-Projekt zur umweltgerechten Produktgestaltung mit 50 kleinen und mittleren Unternehmen aus Kärnten/Österreich, Alekto Verlag, Klagenfurt, 1999.

(Stahel, 1995): W. Stahel, "Handbuch Abfall 1, Allgemeine Kreislauf- und Rueckstandswirtschaft, Intelligente Produktionsweisen und Nutzungskonzepte", Umweltministerium Baden-Württemberg, 1995.

Project No. 1: "Skin-friendly watchband with reduced ecological rucksack"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Hirsch Armbänder, Klagenfurt	Watchband leather processing	Watchbands made of leather, synthetic material and metal	320
Project work/Brief description: The aim of this project was to develop a new watchband made of a skin-friendly material, with a "3-D design" and the possibility of different metal and synthetic paddings. The requirements to be met by the production method were "small series" and "flexible production". A prototype was developed on the basis of polyurethane (previously: PVC), and a new production method ("vacuum method") was elaborated within the framework of this project. A MIPS analysis was carried out for the production phase (for material components, packaging, energy consumption and transport) and revealed possibilities of reducing the ecological rucksack by varying the metal and synthetic paddings within the watchband.			

Project No. 2: "Application of the MIPS concept in make-to-order manufacturing"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Wild Austria, Völkermarkt	Precision engineering	Components and systems for precision engineering, surface finishing, laser technology, test device calibration	120
Project work/Brief description: It is difficult to apply the MIPS concept to make-to-order manufacturing. Precise specifications by Wild's customers or by the legislation such as in the military field, American standards and CE regulations only offer a limited scope for the application of the "step-by-step concept" for the production of new products. New solutions can only be designed for products designed by the company itself.			

Project No. 3: "Application of the MIPS concept in the production of abrasives"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Hermes Schleifmittel, Bad St. Leonhard	Stone & ceramics	Different abrasives	250
Project work/Brief description: Measures were elaborated which result in a clear reduction of production wastes (and thus costs) in the production of abrasives. Efficiency gains can be achieved by optimising production runs and by varying the storage system, but may only be implemented to a limited extent by Hermes due to customer specifications.			

Project No. 4: "MIPS analysis of reusable textiles for operating rooms"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Umlauft Textil Service, Klagenfurt	Textile supply and cleaning	Cleaning of working clothes, disposable and reusable operation equipment, linen for rent	135
Project work/Brief description: An analysis of the MIPS value of textiles for operating rooms at hospitals was carried out. Umlauft Textile Service offers a service concept for high-quality reusable textiles in this field which can be used for operations up to 70 times following intense cleaning. The MIPS calculations revealed the following: related to resource consumption during production, including resources consumed during washing, Umlauft's textile service concept is superior to a conventional "single-use concept" by a factor of about 12.			

Project No. 5: "Orthopaedic instrument with reduced ecological rucksack"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
R&D Consulting, Klagenfurt	Research and development	Research, development and consultancy	5
Project work/Brief description: A prototype of a new type of "Homann elevator" was developed. The Homann elevator is an instrument for orthopaedic surgery which is normally made of chromium and nickel alloy stainless steels and has the disadvantage of not being radiolucent during operations. A radiolucent elevator consisting of a carbon rod coated with polyurethane was developed within the framework of the project. As far as the ecological rucksack of production is concerned, the Homann elevator made of carbon and polyurethane has a clear advantage as high alloyed stainless steels are much more material-intensive during production. Moreover, the new Homann elevator can be used up to 500 times.			

Project No. 6: "Savings of more than one million Schillings due to a new washing machine"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
PAGO Fruchtsäfte, Klagenfurt	Food and beverages, semi-luxury foods	Fruit juices	250
Project work/Brief description: Pago is one of Europe's largest fruit juice manufacturers. The fruit juices are bottled in both non-returnable and returnable bottles. Changes in the process design for the first cleaning of non-returnable bottles were implemented in the context of this project. Among other things, analyses revealed the following notable efficiency gains: a reduction of water consumption by 90%, a reduction of heat consumption by 90% and a reduction of mass flow by 90%. By using the new process design, more than 1 million Schillings (about Euro 70,000) can be saved annually.			

Project No. 7: "Factor 3 in heating of detached family houses"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
KELAG, Klagenfurt	Energy supply	Electricity, natural gas, district heating	1,400
Project work/Brief description: A comparison of different heating systems for an average detached family house with a living space of 150 m² was carried out on the basis of the MIPS concept. Both the installation of the heating systems and their operation, i.e. the thermal energy specifically consumed by each facility, were considered in the analyses. The analyses revealed that heating systems based on heat pump technology yield the most favourable results. Over a period of 20 years, including installation of the system, heat pump systems consume fewer resources (abiotic materials) by a factor of 3 than, for example, conventional oil heating systems yet provide the same energy service.			

Project No. 8: "Material intensity of construction materials"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Stoissner & Wolschner, Klagenfurt	Environmental technology	Construction materials, rainwater utilisation systems, sewer pipelines	90

Project work/Brief description:

A thorough MI analysis of S & W's so-called "wood-concrete lining stone" was carried out. Result: the "ecological rucksack" of this construction material is about 20% and is thus very small. Compared with similar construction materials (e.g. brick), the production of this material is more resource-efficient by a factor of about 1.8.

Apart from the calculations, other measures were analysed which might further improve the production of this construction material by a factor of 1.9.

Furthermore, new applications of this lining stone on the market were investigated and were found particularly in the field of noise prevention measures.

Project No. 9: "Centralised heating of several residential units"			
Company names:	**Branch:**	**Products/Services:**	**Employees:**
Herz Feuerungstechnik, Sebersdorf	Steel construction industry, heating and firing technology	Biomass heating systems, pellet heating systems etc..	60
Architekten Justin & Keckstein, Seeboden	Planning	Architecture, urban development	14

Project work/Brief description:

The aim of the project was to compare the resource efficiency of centralised heating (district heating) of 7 detached family houses with that of decentralised heating (individual central heating) of the houses. The installation of a pellet heating system was considered as an example in the analysis.

The calculations revealed that the installation of a decentralised heating system can save resources by a factor of 1.2 already during the installation phase, irrespective of heat consumption.

Further reductions up to a factor of 2 may be achieved by a reduced use of copper pipes.

Project No. 10: "Controlled living space ventilation"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Pichler Lufttechnik, Klagenfurt	Home automation, ventilation technology	Ventilation systems	80

Project work/Brief description:

The aim of this project was to examine the material intensity of the installation and operation of controlled living space ventilation in a detached family house. In this heating system, a heat exchanger withdraws usable thermal energy from outgoing stale air and transfers it to incoming fresh air.

Related to one kilowatt hour of thermal energy, resource efficiency varied by up to a factor of 4, depending on the heating system used and the heat pump with which it was combined.

The most favourable values were achieved by the following systems: "water heat pump", "solar water heat pump" and "wood pellet heating system with afterheating".

Project No. 11: "Gas burner technology"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Kraus Haustechnik, Wolfsberg	Heating, ventilation, sanitary facilities	Heat pumps, oil firing equipment, energy consulting	19

Project work/Brief description:

In this project, the so-called gas burner technology was examined using both a wall-hung appliance and a floor mounted appliance. Factors considered were the installation of the heating system (appliance, underfloor heating, fire-place) and the operation of the heating system over a period of 20 years.

The analyses revealed that, apart from the actual consumption of natural gas over a period of 20 years, the installation of the heating systems (appliance, underfloor heating, fire-place) already required 40 to 45% of the overall resources consumed (installation and operation).

There is only a relatively small difference between the two types of appliance with regard to installation and operation: 0.16 and 0.17 kg natural resources per kWh energy service, respectively.

Project No. 12: "A resource-efficient factor 5 kindergarten"			
Company names:	**Branch:**	**Products/Services:**	**Employees:**
Herz Feuerungstechnik, Sebersdorf	Steel construction industry, heating and firing technology	Biomass heating systems, pellet heating systems etc.	60
Architekten Justin & Keckstein, Seeboden	Planning	Architecture, urban development	14
Heraklith AG, Fürnitz	Construction material industry	Insulating materials	approx. 1,000

Project work/Brief description:

In this joint project, different individual works from other projects were combined into a major project - the construction of a kindergarten - and were supplemented with detailed analyses of the construction design.

A total of 9 different wall constructions and different heating systems were compared with each other on the basis of the MIPS concept.

Compared with a typical modern wall construction combined with an oil heating system ("reference product"), a light-weight timber post and beam construction combined with a pellet heating system results in a resource efficiency gain by a factor of 5.

Project No. 13: "Consumption of natural resources by municipal infrastructure"			
Company names:	**Branch:**	**Products/Services:**	**Employees:**
Architekten Justin & Keckstein, Seeboden	Planning	Architecture, urban development	14
TB Verfahrens-technik, Bodendorf	Environmental and life-cycle management	Planning, process design	1

Project work/Brief description:

Several municipalities in Upper Carinthia were used as examples to examine how many natural resources are consumed for the construction of a typical municipal road.

According to the calculations, an average of 3,280 tons of solid natural resources are consumed for 100 m of estate road. About 1,000 tons are locally consumed solid natural resources (net weight) and about 2,280 tons solid materials used in preliminary processes (ecological rucksacks). The figures include resources consumed for the construction of the road as such, for road lighting, sewers, pavement, etc.

Based on these calculations, various types of settlement (detached family house, group residential buildings, etc.) located along the estate road were analysed and compared with each other.

Project No. 14: "Factor 3 multifunctional partition wall"

Company name:	Branch:	Products/Services:	Employees:
H. Guggenberger, Kötschach-M.	Cabinet-making	Furniture	6

Project work/Brief description:

A new fitted cupboard which simultaneously serves as a multifunctional partition wall was developed.

Contrary to rigid partition walls, e.g. partition walls made of light brick, this flexible wall facilitates a new division or separation of larger living or office spaces at any time without any destruction and without loss of the sound insulation properties, which was an important criterion in this project.

Apart from this great flexibility, MIPS analysis also revealed great advantages of the multifunctional partition wall. Related to resource consumption during manufacturing, the resource input is about 2,700 kg. This means that the material intensity of this partition wall is better by a factor of 3 than that of a conventional light brick wall.

Project No. 15: "Evaluation of different surface finishing methods"

Company names:	Branch:	Products/Services:	Employees:
BIGU, Althofen	Cabinet-making	Furniture	30
Bistum Gurk, Althofen	Diocese, Saw mill	Wood blocks, round timber, square-cut timber and construction timber	50

Project work/Brief description:

In this joint project, the 8 most commonly used surface finishing methods were analysed and compared with each other based on the MIPS concept. Apart from surfactants, the respective machine equipment (belt sander, grinding belt, veneer press) and waste material were taken into account.

The results had a variation of a factor of 8, with material intensities ranging between 0.7 kg per m^2 and 5.6 kg per m^2. The most favourable results were achieved by unfinished, waxed and stained surfaces, while the least favourable values were found in veneered and glazed surfaces.

Project No. 16: "Factor 4 to 10 residential building"

Company name:	Branch:	Products/Services:	Employees:
Planungsbüro Dobernig & Ried-mann, Klagenfurt	Planning Office, Civil engineering, product design	Planning, design	4

Project work/Brief description:

The aim of the project was to develop for the first time a residential building with a low-energy building design fulfilling the factor four criterion, i.e. requiring four times less energy during utilisation than a conventional residential building.

Furthermore, strategies and concepts were developed within the framework of the project which facilitate a further development of the implemented factor 4+ residential building into a factor 10 residential building. Moreover, a detailed material flow analysis of the construction was carried out.

The Federal Province of Carinthia subsidises residential buildings designed in accordance with the factor 4+ principle with a special grant of ATS 50,000 (approx. Euro 3,500).

Project No. 17: "A new factor 8 solar collector"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Greeneonetec-Kanduth, Ebental	Solar industry	Solar collectors/accessories	60

Project work/Brief description:

The aim of the project was to develop a new dematerialised solar collector. A new concept was developed on the basis of the instruction material and a prototype was built.

MIPS analyses revealed that the assembly of the new solar collector is more resource-efficient by a factor of about 8. Related to an entire solar energy system, the new collector still results in an efficiency gain by a factor of 4.

Test measurements showed that the efficiency of the new collector model is only slightly below that of standard collectors despite the use of a completely new material and that it can even be further improved through appropriate modifications in the collector assembly.

Project No. 18: "Power source St. Georgen"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Gemeinde St. Georgen	Municipality	Administration, tourism	20

Project work/Brief description:

The aim of the project was to develop and to introduce a low-impact resource- and energy-efficient as well as sustainable tourism and economic concept in the municipality of St. Georgen im Lavanttal.

The project is based on the municipality's strengths - sun, water, wood and healthy foodstuffs - and integrates both the population and commercial and agricultural enterprises of the municipality.

Project No. 19: "Office furniture made of metal with a long service life"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Ortner Lüftungen und Klimaanlagen	Clean room technology	Ventilation and air conditioning systems, furniture for clean rooms	50

Project work/Brief description:

The aim of the project was to develop a "healthy" office desk consisting mainly of metal, with a long service life. Design details were implemented in such a way that the desk can be easily cleaned and is suitable for persons suffering from allergies, for example.

Among other things, the office desk's long service life is guaranteed by the metal combination.

A detailed MIPS analysis was carried out in order to optimise the material composition.

Project No. 20: "Material intensities of wall constructions for prefabricated houses"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Puschnig Häuser, Kühnsdorf	Timber branch	Prefabricated and log cabins, roof trusses	15

Project work/Brief description:

The aim of the project was to assess the MIPS of wall constructions used for prefabricated houses.

The calculations revealed the following material intensities for the production of 1 m² of wall construction:

external walls: 188 kg/m^2; suspended floors: 887 kg/m^2; sloping tops: 116 kg/m^2; upper floor ceilings: 150 kg/m^2.

Project No. 21: "Material intensities of eco-friendly lightweight concrete"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Sevalite, Klagenfurt	Construction material industry	Polystyrene concrete	3
Project work/Brief description: Sevalite produces concrete construction materials consisting of cement and polystyrene which are used as insulating system in floor constructions for both new buildings and restoration of old buildings. The typical Sevalite construction materials were analysed within the framework of this project and were evaluated by means of a material intensity analysis. Furthermore, first attempts were made to develop a new recipe for concretes. Further improvements of the "eco-friendly lightweight concrete" can be achieved by means of by-products from stack gas cleaning in particular.			

Project No. 22: "Multi-media desk with a 30 year guarantee"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Tischlerei Kappeller, Klagenfurt	Cabinet-making, furniture branch	Wooden furniture	9
Project work/Brief description: A multi-media desk made of solid wood with 30 years' guarantee was developed within the framework of this project. During the design process, special importance was attached to durability. The portion of non-renewable primary resources was minimised (only small connection elements made of metal); the desk was designed in modular mode, i.e. it is suitable for multifunctional use and can easily be disassembled and repaired. The surface (beech or alder) is left unfinished. Kappeller grants a 30 year guarantee on this high-quality piece of furniture. This new desk named "Avena" is to have a significant impact on Kappeller's product range in the future.			

Project No. 23: "Wooden linen cupboard with a 100 year service life"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Tischlerei Wech, Wolfsberg	Cabinet-making, restoration	Furniture, restorations	2
Project work/Brief description: The aim of the project was to carry out a feasibility study for the development of a multifunctional cupboard with a service life of 100 years. For this purpose, profitability, marketing goals and risks were analysed and an implementation scheme was developed. The concept provides for a cupboard made of solid wood which offers a high level of multifunctionality by variation of internal and external elements. Furthermore, the design of the connection elements ensures that the cupboard can be easily disassembled. The company will apply for a patent for this new product.			

Project No. 24: "Second-hand shop for children's toys"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Martin Ritter, Klagenfurt	Purchase/sale	Toys, books, etc.	1
Project work/Brief description: Possibilities of establishing a second-hand shop for children's toys were elaborated. Furthermore, a co-operation with Eco-Agency Grünes Auge was established (cf. Project No. 25.)			

Project No. 25: "Advertising campaign for second-hand shop"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Öko-Agentur Grünes Auge, St. Veit	Trade	Natural colours, used goods	1
Project work/Brief description: A MIPS analysis of natural colours is still in progress and is being carried out in co-operation with the manufacturer of these colours. In addition, an advertising campaign for selling used children's articles was developed and implemented.			

Project No. 26: "Timber transport via forestry road or helicopter?"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Forstner Landwirtschaftsbüro, St. Egyden	Agriculture	Consulting services	5
Project work/Brief description: The aim of the project was to compare the MIPS of a transport of felled wood from a forest via lorries on a forestry road or via helicopter. The detailed calculations revealed an interesting result: when transported on a lorry, about 0.2 kg of solid natural resources per kg timber are consumed, particularly as a result of the construction of the forestry road. If both the timber and the required equipment are transported by a helicopter, the system-wide resource consumption is reduced by a factor of 25 as the resource-intense construction of a forestry road is avoided.			

Project No. 27: "Intelligent pantry"			
Company name:	**Branch:**	**Products/Services:**	**Employees:**
Tischlerei Sterling, St. Stefan	Cabinet-maker	Kitchen equipment, furniture	10
Project work/Brief description: The aim of the project was to develop a pantry that may be retrofitted into existing kitchens. The intelligent concept integrates the pantry into the corners of kitchen units which may usually not be used as space. The company will apply for a protection of patterns and designs for this idea. The material intensity analysis revealed that the ecological rucksack of the production of the pantry is about 50% and is thus relatively small.			