Prof. Dr. F. Schmidt-Bleek
www.factor10-istitute.org
www.worldresourcesforum.org
www.factor10.de

La Rabassière
Carraire de Bravengues
F – 83660 Carnoules/Provence
Tel/Fax +33 4 94 33 24 58
biovar@orange.fr
President
Prof. Dr. F. Schmidt-Bleek

ENGLISH GLOSSARY

SUITED FOR THE APPROACH TO ECOLOGICAL AND ECONOMIC SUSTAINABILITY

06. March 2011

Abiotic raw materials are the resources extracted domestically – excluding agricultural and forestry products – and all imported abiotic materials (resources, semi-finished products and finished products), including extracted materials which are not used (for example mining waste, excavated material from constructing a basement or a house, other excavated materials, etc.).

Abiotic Raw Material Productivity This sustainability indicator expresses the life-cycle-wide amount of abiotic raw material (in tonnes) used to produce one unit of output, e. g. gross domestic product (in EUR, price-adjusted), a product, one unit of utility or service (See Material Productivity)

Air is included in the MIPS concept if it is changed in its chemical or physical characteristics due to chemical, biological or physical processes in the technosphere.

Auxiliary materials (operational materials) are materials which are involved in a process but merely fulfill an auxiliary (supporting) function and are not present in the end-product (for example solvents, cleaning or cooling agents). They are part of the MI in MIPS.

Biotic raw materials are all organic materials extracted directly from nature, for example mushrooms, grass, fruits, timber, fish, wild animals, and unprocessed cotton.

Capacity utilization denotes the actual use of the volume or the capacity for which a good is designed (for example, a fully-occupied car = 100%, a half-filled dishwasher = 50%).

Capital in the language of economics denotes the total assets of money, machinery, facilities, as well as land. To describe monetary assets only, the term financial capital is used.

Capital productivity is the amount of goods and services produced per unit of capital employed. If the same product can be produced in the same quantity and quality on two different machines which have different prices, then capital productivity is higher if the cheaper machine is purchased. (Note: one does not talk about "capital efficiency" as opposed

to the case of natural resources!)

COPS (Cost Per Unit of Service) refers to the monetary costs for a defined unit of utility which is rendered either by a person with the help of technology, or by machines directly (for example, dispensing cash). All services generated in the technosphere require products, energy and infrastructures.

Cycles are natural and technical material flows which return to their original state at their point of origin. There are no technical cycles without energy and material losses.

Dematerialization is the radical reduction of natural material resources for satisfying human needs by technical means. Neither environmental nor economic sustainability can be attained without dematerializing the current western economy.

Eco-efficiency means the delivery of competitively priced goods and services which satisfy human needs and produce quality of life while progressively reducing ecological impacts and resource intensity, through the life cycle, to a level at least in line with the earth's estimated carrying capacity (Frank Bosshardt, Business Council for Sustainable Development, 1991) (Compare Efficiency, Productivity, and Intensity related to the use of natural resources).

Eco-innovation means the creation of novel and competitively priced goods, processes, systems, services, and procedures that can satisfy human needs and bring quality of life to all people with a life-cycle-wide minimal use of natural resources (material including energy carriers, water, and surface area) per unit output, and a minimal release of toxic substances. (Reid, Alasdair, Miedzinski, Michal (2008), EUROPE INNOVA, Final Report for the EU Sectoral Innovation Watch Panel on Eco-Innovation, www.europe-innova.org) [1].

Eco-innovation is the introduction of any new or significantly improved product (good or service), process, organisational change or marketing solution that reduces the use of natural resources (including materials, energy, water and land) and decreases the release of harmful substances across the whole life-cycle." – Eco Innovation Observatory, EIO (2010)

Eco-industry is that part of industry which conducts eco-innovation in a pro-active and verifiable manner, including businesses that provide new solutions for legal standards, norms, and requirements.

Eco-intelligent services satisfy needs in a purposeful manner, using technical means with the highest possible resource productivity (materials, water, space).

Ecological price of a good encompasses the entire material input or the material added value in units of weight (kg or metric tons) from the cradle of the resources to the product when it is ready to be placed on the Market in order to provide a service. It is the ecological rucksack of the product plus the product's weight, measured in mass units.

Ecological rucksack of a product is its complete material input MI (including all materials needed to generate the energy) for manufacturing a product from "the cradle to the point of sale", minus its own weight (own mass). Unit: kilograms, metric tons.

Ecological rucksack of a technology-based service is the sum of the shares of the rucksacks of the technical means ("Service delivery machines") employed (for example, equipment, vehicles, refrigerators, buildings, and infrastructures), plus the sum of materials and energy

[1] F. Schmidt-Bleek, .„The Earth: Natural Resources and Human Intervention", Haus Publishers, London, 2008;

(including rucksacks) used while the "service delivery machines" are employed for delivering a unit of service.

Eco-system services (services of nature) (Life-supporting functions of the ecosystem) - such as sewage "treatment", air purification, flood control, pest control, restoration of soils, pollination, the preservation of species, and the regulation of the climate - are essential for all lfe on earth and the human economy. Many have already been or are being pushed beyond their sustainable limits. Services of nature cannot be generated by technology on any noticeable scale. Services of nature are indivisible and cost-free available to all humans around the globe. If they could be traded on the market, they would obviously carry an infinitely high price. Services of nature are vulnerable to human economic activities. The root cause for these changes is the indiscriminate use of natural resources, material, water, and land. Already today, consequences thereof can be observed, e.g. massive soil erosion, water shortages, desertification, loss of species, and climatic changes, including increasing catastrophic events like hurricanes and floods.

Ecosphere is mankind's natural environment.

Efficiency is the measurable extent to which (in each case total quantity of) time, effort, resources or energy are *well* used for the intended task. Originally, the term was used to describe the quality of a technical *performance, e. g. the „ratio of the work done by a machine to the energy supplied to it*" (The American College Dictionary). Today, resource efficiency and resource productivity are frequently being considered synonimous. However, when using the term „productivity" of a process, the emphasis is on the *outcome* (the good, service or value generated), not on its *performance*. Consequently, when describing the efficiency of decoupling the connection between the use of natural resources and environmental degradation, the term *productivity* should be preferred. When computing either the „resource efficiency" or „resource productivity", the *totality* of the productivity factor resource must be considered. In other words, the life- cycle-wide consumption of nature (materials, water and space - surface area) for the service or value created must be considered. (compare productivity)

Emissions are material contaminations of the air, or noises, vibrations, light, heat, radiation, and similar energetic or material phenomena emenating from the technosphere.

Energy carriers are materials of all aggregate states that yield thermal energy (for example mineral oil, oil sands, coal, firewood, or uranium ores). Fossil energy carriers are non-sustainable materials containing carbon.

Enterprise is an organizational unit created for making profits. The size of "Small and Medium Enterprises – SME's depends upon the size of the economy within which they operate. In Austria, SME's may employ up to 400 people, in Germany ten times more.

Environment encompasses animals, plants, microorganisms, water, air, and soils as well as all the interactions between them.

Environmental capital comprises all natural resources that can be used in the technosphere to produce welfare. This term is somewhat peculiar for non-economists because the ecosphere cannot be used for economic gains without changing its life-sustaining eco-systemic services and functions. These changes are rarely predictable, and can seldom be measured, simulated or quantified, nor can they be localized in all cases.

Environmental media are soil, water, and air.

Environmental protection strategy as developed first in the early 1970ies has failed completey as an approach to sustainability. (Factor 10 Club Declaration 2010). This protection policy has not been able to stop continuous environmental deteriororation because it concentrates on *reacting* to *individual symptoms* believed or known to be ecologically disruptive (like climatic change) or detrimental to human health (like mercury in fish). In other words, this policy *reacts* predominantly *after* economic, financial and technical decisions have been made. Invariably it generates „additional" costs and leads to tedious, unsatisfactory and unproductive international debates („Copenhagen"). (See Systemic policies).

Environmental stress (or impact) potential is the capacity of a process, activity, a good or a service to cause environmental change, altering life-sustaining eco-systemic services and functions of the ecosphere. Environmental stress is approximated by indicators such as MIPS on the economic micro scale or "Total Material Consumption – TMC", the yearly "consumed" natural material by a country, including the material rucksacks.

External costs are costs incurred during the production or use of a good or a service that are not contained in the price of these goods and services. They are "externalized", often at the expense of consumers.

Externalized environmental costs (externalities): Cost-inducing effects of goods, processes, systems, services, and behaviors that occu(compare productivity)r via environmental media air, water, and soil. Typically, the costs of such external effects must be borne by the general public, even though the OECD has concluded in the early 70ies that such costs should be born by the producer (Producer Pays Principle). For instance: An external effect of fossil fuel use is climatic change, changes in green plants, and the damage to historic buildings. Environmental externalities can be quantified/monetarized only in rare cases because it is normally *not* possible to link all causes and effects completely and un-equivocally, even for a single type of molecule like CO_2.

Factor 10 is the strategic goal pioneered by Schmidt-Bleek in 1990 for maintaining life-sustaining eco-systemic functions and services, meaning that a strategic *economic goal* should be generating human well-being with (on average) ten times less natural material resources (from cradle to cradle) by the middle of the 21st century, compared to wealth production in industrialized countries in 1990. Factor 10 includes all natural materials used for energy generation [2]. Schmidt-Bleek has suggested in 2008 that by 2050 the life-cycle wide consumption of 6 to 8 ton/year-capita should be reached worldwide, including fossil energy carriers. For Germany this would mean a ca. tenfold reduction in material use, for Japan an eightfold, and for the USA a ca eighteenfold reduction.

Factor 4 was suggested by E. U. von Weizsaecker in 1995 for using two times less material and energy in order to generate two times more human wealth.

Factor X and Factor Y are variations on Factor 10, reflecting the fact that the need of using less natural resources for generating welfare depends on specific circumstances, e. g. the availability of water.

FIPS (in German: Flächeninput pro Einheit Service = surface area per unit of service) is a robust and directionally reliable indicator for the comparison of functionally comparable goods or services regarding their life-cycle-wide surface area requirements. A quantitative measure for the "use of natural surface area" per unit of utility or unit of service. The "ecological surface area price" for utility.

2

Goods are machines, products, equipment, objects, means of transport, buildings, infrastructures (including works of art and musical instruments).

Greenhouse effect: Sunlight falls on the earth's surface, where it is transformed into warmth and partly reflected towards outer space. Some constituent parts of the earth's atmosphere, especially water vapor and carbon dioxide, are involved in the process of capturing part of this warmth. If this natural greenhouse effect did not exist, the Earth's average temperature would not be fifteen degrees Centigrade, but as cold as minus eighteen or nineteen degrees Centigrade. Mankind is currently changing the relative amounts of important greenhouse gases in the atmosphere, especially carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and ozone. As a result, the man-made greenhouse effect is added to the natural greenhouse effect, changing the Earth's climate.

Human Capital refers to (according to the internet) the stock of competences, knowledge and personality attributes embodied in the ability to perform labor so as to produce economic value. It is the attributes gained by a worker through education and experience. Many early economic theories refer to it simply as workforce, one of three factors of production [3], and consider it to be a fungible resource homogeneous and easily interchangeable. Other conceptions of this labor dispense with these assumptions. From a natural science point of view a non-measurable quantity with questionable value, and from a humanistic point of view unacceptable. In Germany „human capital" was officially chosen as the „No-Word" of 2006.

Indicators are measurable and directionally reliable quantities that reduce and reflect the complexity of facts and situations (see resource intensity, resource productivity, MIPS).

Industrial products are goods produced, or partly produced, by a technical processes.

Infrastructure is the term used to describe technical installations or facilities which support modern human life, such as roads, schools, transportation and information networks..

Input includes everything that is inserted into a process. It determines nature and quality of the outcome. In the MIPS concept, the inputs are materials (including all materials for making the needed energy available), counted on a life-cycle-wide basis, measured in kg or tons. (see also Material Input and Resources).

Market is a spontaneous structure involving sellers and buyers, organized as competition by regulations.

Life-cycle-wide (cradle to cradle) means taking all phases of a product's life into account: from resource extraction, through production, distribution, storage, use, and recycling/disposal.

Material flows as defined in the MIPS concept are all movements of materials in the ecosphere and the technosphere which are put in motion by technical means.

Material input (MI) includes the life-cycle-wide use of material inputs required to produce a good (see "ecological rucksack"), or generate service, value or utility (see MIPS). In the MIPS concept, this also includes all fossil fuels as well as the materials which are required to make the necessary energy available. Unit: kilograms or metric tons.

Material Intensity indicators are the inverse of *productivity* indicators. Material productivity and material intensity are decoupling indicators that describe the relationship between the use

[3] Capital, Labour, Resources

of natural resources (e.g. materials) and economic growth or industrial activity. Material productivity can be expressed as the inverse of MIPS, namely S/MI. It is the unit of good or service (value or utility) that is obtained trough the life-cycle-wide sum of all material inputs for producing the good that yields the service, including those masses needed for providing the energy.(see Resource Productivity).

Material Productivity is defined as the quantity of output produced per unit of materials inputs used in the production of the output on a life-cycle-wide basis.

MI Factors or rucksack factors (MIF) are the material intensity values for individual input materials (raw, basic, and building materials) and energy quantities that are required for the life-cycle-wide generation of a service by goods and infrastructures. Unit: kilogram per kilogram or kilogram per megajoule etc.

MIPS = MI / S = material intensity = life-cycle-wide Material Input Per unit of Service (of benefit, value, or utility). MIPS is the life cycle-wide mobilization and input of natural material, including fossils, required to fulfill a specific human desire or need (S) by technical means. MIPS ist the material footprint of a service. MI is measured in kg or tons; S has no dimension and must be defined for each individual case (for example 'cleaning five kilograms of clothing' or 'transporting one person for a distance of one kilometer'). MIPS is the unit of decoupling the use of natural material from material wealth generation.

MIPS is a robust, measurable, and directionally reliable *indicator* for directly comparing functionally comparable („like") goods or services, regarding their material and energy "consumption". MIPS is a quantitative measure for the life-cycle-wide "use of natural materials and energy" or the "ecological materials and energy price" per unit of utility or per unit of benefit or service. MIPS could be considered representing the ecological costs (referring to materials and energy use) for making a service available, or the subsidy provided by the environment per unit of service. In the MIPS-Concept, goods are considered to be *"service delivery machines".*

Mobilization includes all movements of earth caused by technology in the construction, agriculture, and forestry sectors, as for instance overburdens, plowed earth, erosion, etc.

Nanogram = A unit of measurement, the prefix 'nano' means 'one billionth.'

Natural Biotic Products are substances, materials and organisms generated by nature through the interaction of energy, water, and nutrients - organized by information stored in DNA.

Natural location or setting of natural resources (material, water) is the place where they are found in nature and from where they are mobilized and removed for producing goods and infrastructures (for example a seam of coal).

Natural Resources in the MIPS-concept include all naturally available abiotic and biotic raw materials (minerals, fossil and nuclear energy carriers, plants, wild animals), materials invested to convert flow resources (wind, geothermal, tidal and solar energy), air, water, and soil.

Output encompasses everything that results from a process, a procedure or a behavior. Output need not be material in nature; enjoyment and pleasure can also be outputs.

Person-kilometer: The number of people transported multiplied by the distance in kilometers yields the number of person-kilometers (pkm). A unit of measurement for transportation performance.

Processes are procedures or techniques in which inputs are intentionally transformed into at least one output (for example, shaped sheet metal, a chemical, or the enjoyment of a painting).

Product is the usable result of a technical or natural process.

Production is the purposeful generation of goods and services by technical or natural means.

Productivity is the life-cycle-wide quantity of a productivity factor (capital, labor, resources) needed to generate a defined economic output.

Productivity of labor: A term used to denote the amount of products or services which can be produced with a given amount of work, that is, within a given period of time by a given number of people.

Prosperity is *not* to be confused with material wealth. Prosperity also includes health, freedom from fear, displacement, and social marginalization, as well as the opportunity for self-determination, freedom of opinion, and the inviolability of the dignity of the individual.

Renewable energy encompasses all forms of energy derived from *non*-exhaustible sources, like solar radiation and geothermal heat. The use of renewable energy does *not* automatically support the approach to sustainability because its transformation into useful energy forms can be very resource intensive, including the non-sustainable use of land. A typical example is the production of bio-fuel by way of planting and harvesting cash crops, even if the so-called CO_2 balance shows an advantage.

Resources (natural) are raw materials, soil, biomass, water, air and land surface. All are limited on planet earth.

Resource productivity and *resource intensity* related to approaching sustainability are key concepts used in sustainability measurement as they attempt to decouple the direct connection between resource use (raw materials, soil, biomass, water, air and land surface) [4], [5] and environmental degradation. Their strength is that they can be used as a metric for both economic and environmental costs. Although these concepts are two sides of the same coin, in practice they involve very different approaches and can be viewed as reflecting, on the one hand, the efficiency of resource production as outcome per unit of resource use (resource productivity) and, on the other hand, the efficiency of resource consumption as resource use per unit outcome (resource intensity = RIPS; material [6] intensity = MIPS = material footprint). The sustainability objective is to maximize resource productivity while minimizing resource intensity (partly from the internet).

---

[4] *Schmidt-Bleek, F. "Wieviel Umwelt braucht der Mensch? MIPS, das Maß für ökologisches Wirtschaften", Birkhäuser, Basel, Boston, Berlin, 1994.*

[5] *Hawken, P., Lovins, A. and Lovins, L.H. 1999. Natural Capitalism: Creating the Next Industrial Revolution. Earthscan, London. Hargroves; K. and Smith, M.H. 2005. The Natural Advantage of Nations: Business Opportunities, Innovation and Governance in the 21st Century. Earthscan, London.*

[6] *raw materials, soil, biomass, water, air*

Resource Productivity in *monetary terms* is the quantity of goods or services (outcome) obtained for the input of resources, expressed as the monetary yield per unit resource expressed in monetary units. For example, when applied to crop irrigation it is the yield of crop obtained through use of a given volume of irrigation water, the "crop per drop", which could also be expressed as monetary return from product per use of unit irrigation water (internet).

Root cause *(physical)* for *endangering eco-systemic services and functions* is the extirpate mobilization and use of natural resources (material (including fossils), water, and land use). The *economic* root cause for excessive resource use is the near zero costs for using nature.

Root causes for *unhappiness and inadequate wellbeing* of people can include: unemployment, social unrest, missing protection of human rights and dignity, lack of freedom of speech and from violence, unfair wealth distribution, as well as insufficient health care and education. Bhutan has decided to measure the happiness of its people rather than GDP.

Root causes for *economic and financial instabilities* include: lack of systemic policies, poisonous products (Stiglitz), wrong market prices of products and services (e. g. caused by subsidies), low productivity of natural resources, short term planning, inadequate book keeping, and excessive profit taking. Many of these causes are also responsible for the environmental crisis.

Service within the economy is the purpose-oriented fulfillment of a need by technical means. All man-made services require the use of technical infrastructures, equipment, vehicles, and buildings etc. Services can be rendered by humans using machines or by machines directly. From the end consumers' point of view, technology based service is the ability of goods to satisfy needs or provide utility.

Serviceable products are goods that were produced for use or consumption and that can provide utility by being used (for example, robots, sundials, automobiles, mousetraps, spoons, oil paintings). There are also non-serviceable goods, such as bars of gold or aluminum profiles.

Sufficiency means reducing environmental damage by refraining from excessive personal consumption ("Erhalten durch Masshalten"). Sufficiency means saving money. In the MIPS-Concept, sufficiency is the reduction of MI by volontarily reducing S. A case in point is the use ot towels in a hotel for several days rather than using fresh ones every day.

Sustainability means the capacity of the economy to create wellbeing and welfare for *all* people while ascertaining that the natural, social, economic, and institutional bases are maintained upon which this capacity depends.

Sustainability has several dimensions: *ecological, economic, social* and *institutional*. The ecological dimension forms the guardrails within which the human society must function because (1) the earth's natural resources are limited, (2) because economic activities can damage and destroy the vital eco-systemic services and functions of the ecosphere, and (3) because these natural functions *cannot* be re-placed by technology.

Ecological Sustainability means the continuous existence of vital life-sustaining eco-systemic services and functions of the ecosphere that are suitable for the biosphere as we know it. Currently one assumes that a maximum of 6-8 tons of non-renewable natural material (including fossiles) could be „consumed" per year and person in order not to put the ecological stability in question.

Economic sustainability means generating wellbeing and wellfare for *all* people comparable to that enjoyed by effluent societies at the beginning of the 21st century. This economy is service oriented and knowledge based (see service). The radical dematerialization of the western type economy is a necessary, but not sufficient condition for approaching sustainability.

Sustainability Indicators are not as yet available in internationally harmonized fashion for the social and economic dimensions of sustainability. For the ecological dimension, agreement seems to emerge that resource intensity and resource productivity are important (key) indicators (see also eco-innovation).

Systemic policies aim to improve happiness, welfare and wellbeing of people by optimizing the efficiency and precautionary nature of measures by avoiding and eliminating *root causes* of harmful developments, rather than separately repairing their symptoms, which regularly provokes the risk of delaying, increasing the costs of, and even preventing the solution of others. Systemic policies reduce the risks associated with taking actions by optimizing precautionary measures in all policy areas. The need for systemic approaches apply to all policy areas.

Technosphere is the environment created by mankind, using natural resources and energy.

Total Material Flow (TMF) or Total Material Requirement (TMR) is a robust economic indicator to measure the annual total amount of natural materials (abiotic, biotic, and movements of earth) – including rucksacks – which are processed through an economic entity by technical means (metric tons per year).

Utility (benefit, value, service) is generated by utilizing goods and energy for satisfying people's needs. Utility has a higher value than the goods and services employed to produce it. MIPS is the ecological price of utility.

Wastes are materials or products without economic value which are either disposed of or recycled.

Water as defined in the MIPS concept encompasses all water taken directly from nature. It is advisable to differentiate between surface water (including rainwater), groundwater, and deep ground (fossil) water.

WIPS = WI / S stands for Water Input Per unit of Service (of benefit, value, or utility). It is the life cycle-wide mobilization and input of water, which is required to fulfill a specific human desire or need (S) by technical means. WIPS is the water footprint of a service. WI is measured in kg or tons; S has no dimension and must be defined stringently for each individual case (for example 'cleaning five kilograms of clothing' or 'transporting one person for a distance of one kilometer'). WIPS is the unit of decoupling the use of water from material wealth generation.