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INNOVATION FOR A SUSTAINABLE FUTURE

F. Schmidt-Bleek

Summary

In order to ensure a lasting protection of the eco-system functions and services, as well as in order to maximize the competitive economic advantage of the EU, the following **actions**, **legal provisions**, and **R&D** pertaining to eco-innovation are recommended.

A. The Eco-Innovation Action Plan

In order to give direction to eco-innovation, increase the efficiency of EU actions, as well as for minimizing confusion and costs, all matters relating to eco-innovation should be in tune with the definitive meaning given to it by the EU Sectoral Innovation Watch Panel on Eco-Innovation in 2008 (Reid, 2008).

The following actions are recommended:

- Focus on fulfilling human dreams and needs with brilliant eco-innovations, rather than on “greening” existing technical, economic, social, and institutional solutions;
- Mobilize all stakeholders in support of these objectives;
- Develop specific well-targeted actions for mobilizing further stakeholders and delivering concrete results;
- Encourage continuous eco-innovation;
- Minimize mobilization and use of natural resources by maximizing their productivity in generating goods and services;
- Ascertain full-cost pricing of food, goods, energy, infrastructures, and services, e.g. by shifting taxes and levies from labor to natural resource, and curbing subsidies;
- Take action to make it profitable to produce, install, and consume eco-friendly food, goods, infrastructures, and services;
- Establish centrally placed “System Policy Units” in government, administration, and industry. Their principal task is to ascertain that each envisioned action is consistent with minimizing ecological, social, economic, and institutional risks;
- Establish a publicly accessible institution that generates, collects, verifies, reviews, and analyzes data and information related to the mobilization and use of natural resources; an institution that supports eco-innovation, training and education, eco-design, and the work of “System Policy” and other decision making units. It reports regularly on the resource intensity of GDP, and the performance of important sectors of the economy, employing prescribed key indicators;
- In public procurement, give preference to goods, infrastructures, and services with high resource productivity and longevity;
- Set targets and monitoring procedures for the medium and long-term *per capita* mobilization and use of natural resources (material, water, land use); e. g. a 6-8 ton limit of yearly material use per capita by 2050;
- Promulgate key indicators for social, business, and economic decision-making that reflect the dependency of all human activities on stable eco-system functions;
- Repeal or adjust legal requirements and privileges, standards, and norms that demand or encourage excessive resource consumption;
- Eliminate or adjust subsidies that stimulate consumption of natural materials, water, and land use;
- Dematerialize the generation of energy, its storage, transport, and its application to the highest degree feasible;
- Begin international negotiations with countries willing to join common eco-innovation and establish future oriented eco-social market economies, including the control of mobilization and use of natural resources. To the extent necessary, re-negotiate or repeal membership in international organizations with charters that fail to recognize that the economy must be constrained to function *within* the limits of the environment and its resources.
- Promulgate comprehensive legislation that supports eco-innovation;

B. Legislation for Stimulating Eco-Innovation

There follows the skeleton of recommended legal provisions seeking to ascertain continuous eco-innovation.

The timely promulgation of such legislation is indispensable. It should take into consideration existing legal requirements for the quality of goods and services. It should encourage the use of market forces for maximizing the resource productivity of all natural resources. It should address at least the following matters, as well as spell out how its provisions will be enforced.

- ☐ Scope, needs, and intentions;
- ☐ Exemptions and their reasons;
- ☐ Consequences of failure to fulfill the requirements;
- ☐ Establishment of centrally placed “System Policy Units” in government, administration, and industry;
- ☐ Limits of domestic mobilization, import and use of specific natural materials as well as water in all forms;
- ☐ Limits of land use;
- ☐ Targets for the yearly per capita use of natural resources within specific time periods., including natural resources used for providing energy;
- ☐ Measures for approaching full-cost pricing of food- and feedstuff, goods, energy, infrastructures, and services, so far as feasible by economic instruments e.g. by shifting taxes and levies from labor to natural resource, and curbing subsidies;
- ☐ Measures that make it profitable or otherwise attractive to produce, export, and consume food- and feedstuff, goods, infrastructures, and services with high resource productivity;
- ☐ Powers for enforcing public purchasing and leasing of goods, infrastructures, and services with high resource productivity and longevity;
- ☐ Powers for eliminating or adjusting all subsidies that tend to encourage natural resource consumption;
- ☐ Powers to repeal or adjust legal requirements and privileges, standards and norms that demand or encourage resource consumption;
- ☐ Key indicators for social, business, and economic decision-making that reflect the dependency of all human activities on stable eco-system functions;
- ☐ Establishment of a publicly accessible institution that generates, collects, verifies, reviews, and analyzes data and information related to the mobilization and use of natural resources; an institution that supports training and education, eco-design, and the work of “System Policy Units” and other decision making units. It reports regularly on the resource intensity of GDP, and the performance of important sectors of the economy, employing the prescribed indicators.

C. R&D for Eco-innovation

It is recommended to prepare and commence at the earliest possible time an R&D program aiming at the improvement of the productivity of natural resources (material, water, and land) through eco-innovation. It should utilize funding set aside for R&D in energy areas, because dematerializing energy provision means reducing the use of fossils and uranium ores. The R&D program should contain at least the following elements:

- ☐ Analyze the potential savings in energy need for a fivefold and tenfold dematerialization of the EU economy.
- ☐ Analyze eco-innovation efforts in non-EU countries and draw conclusions;
- ☐ Describe the functions, responsibilities, and costs of a publicly accessible Resource Information Centre (Resource Agency);

- ☐ Assemble and analyze the provisions in existing legal instruments that regulate quality and quantity of products (including food, energy carriers, natural materials and water), as well as buildings, services and infrastructures;
- ☐ Analyze expected scarcities of natural material, water and land within the EU as well as world-wide with a view toward needs to discourage, regulate or replace their use;
- ☐ Develop realistic scenarios for reducing the per capita resource use (material, including energy carriers, water and land) to presumably sustainable levels by 2020 and 2050 in the EU and world-wide;
- ☐ Analyze to which extent governments, administrations, and industry in the EU have installed centrally placed “system-policy units” with the power to stop actions that do not consider the potential risks to all dimensions of sustainability, and in particular to the need of respecting the laws of nature;
- ☐ Establish the root cause(s) for the recent financial crisis and propose policy changes that are likely to avoid a renewed catastrophe in the banking sector. In proposing changes, make sure that eco-innovation plays its proper role.
- ☐ Analyze the power and costs of economic and other instruments for increasing the resource productivity in the EU;
- ☐ Establish and analyze realistic scenarios for the number and origin of people that could be displaced by sea level increases, water shortages, lack of food, lack of fertile land, desertification and other significant changes due to man-made changes in the environment;
- ☐ Analyze to which extent the importance of natural resource use, and options for its improvement, are being taught at all levels of education in the EU with the aim to improve the core competence of future generations in dealing with resource questions in all professions;
- ☐ Develop practical guides for improving the cradle to cradle resource productivity for producers and service providers;
- ☐ Develop within the shortest possible time and at all costs practical technical options with high resource productivity for decoupling EU’s energy needs from importing and use of domestic fossils;
- ☐ Develop (to the extent still necessary) “*decoupling”* indicators, and make their use mandatory (including labeling), for the ecological, social, institutional, and economic dimensions of sustainability;
- ☐ Develop synthetic materials that can replace scarce natural materials;
- ☐ Develop materials/Products for the market that mimic nature and fit physical-chemical cycles in nature after use.

Background Notes

Introduction

Recently, the world has witnessed how foresight incompetence and unwillingness to act before disaster strikes have impaired the stability of the global financial system and with it the entire world economy. The ecological crisis has some of the same roots: e.g. Market failures due to systems and foresight incompetence, lack of adequate early warning systems, short-term profit maximization, “toxic products” (Stiglitz), and wrong prices of goods and services. However, to most observers the ecological crisis apparently does not as yet seem as acutely threatening to the world economy as the financial disaster, in spite of the fact that the costs of repairing environmental damage are sharply rising, and that man-made destruction of life-sustaining ecosystem functions can rarely be repaired. In 2009, an EU Commissioned study headed by Pavan Sukhdev for the Deutsche Bank found that the global economy is losing more money from the disappearance of forests alone than through the banking crisis. The current economic system is *not* sustainable, because it causes overuse of natural capital and it destroys the eco-system services [1] on which the survival of the human race depends (Schmidt-Bleek, 2008).

Human economies are subject to the laws of thermodynamics. On a finite planet, there clearly are limits to the amount of matter that can be mobilized by an economy before its eco-system functions and services are affected and begin to deteriorate (Schmit-Bleek, 1994).

Already today, consequences of the excessive use of resources can be observed, e.g. massive soil erosion, *extinction of species,* water shortages, desertification, loss of species, and climatic change, as well as increasing catastrophic events like hurricanes and floods. Some of these changes are irreversible, and others are reversible only over long periods of time as measured by the length of human life. It is known that the ecological risk threshold has already been passed.

The extension of current patterns of western resource consumption to the entire world population is not possible because of insufficient natural resources and the environmental impacts of their mobilization and use through the human economy. For these reasons, one of the most fundamental requirements for moving towards a sustainable human economy is to strengthen eco-innovations that can help to dematerialize economic activities. A range of technical possibilities for this already exists, but even they remain largely unimplemented because of a lack of economic incentives to move in this direction (Meyer, 2009).

The human economy must be constrained to function within the limits of the environment and its resources and in such a way that it works with the grain of, rather than against, natural laws and processes. This argues for a strong conception of sustainability, whereby the economy respects and adapts to ecological imperatives, rather than seeking to substitute manufactured for natural capital where the former fails to deliver the full range of functions and services of the latter (Ekins, 2009).

The EU Eco-Innovation Action Plan

In order to exploit the *full* potential of eco-innovation to protect the environment while driving competitiveness, economic growth and job creation, the EU Action Plan must spell out *what eco-innovation means* in operational terms in order to assure its proper impact and effectiveness, and avoid confusion and miss-placements of funds.

In 2008, the EU Sectoral Innovation Watch Panel on Eco-Innovation has agreed that: "**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, and surface*

1 Eco-system services and functions (Life-supporting functions of the ecosystem) are essential for all life on earth. Humans cannot survive without them. They include the availability of liquid fresh water and unpolluted air; of a range of elements, minerals, and metals; of a high level of biodiversity; of edible plants and animals; of productive seeds, sperms, and soil; of a moderate temperature range on the surface of the earth; and of the protection against radiation from outer space. 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. Already today, con-sequences 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.

area) per unit output, and a minimal release of toxic substances (Reid, 2008).

The EU Innovation Action Plan should also point out certain current policy shortcomings that need be corrected by **systemic eco-innovation**: *First*, Traditional policies attempt primarily to cure unwanted **symptoms** of man-made changes in the environment, and have consequently failed to bring wealth production into harmony with the life-sustaining services and functions of the ecosphere. This has to change. In the future, first priority has to be given to identify the **root causes** of the environmental crisis and employ **system policy** approaches for their elimination (see below). In fact, the same holds for all areas of decision making, including the financial sector. *Second*, the EU needs to concentrate its attention and expenditures on such **eco-innovations** that can eradicate the **root causes** for past failure, not just their symptoms. The reason for this is that without a stable ecosphere and systemic adjustments in all policy areas sustainability cannot be reached. *Third,* the EU has to finally agree on and enforce the use of ecological, social, economic, and institutional **key indicators** that can reliably guide production and consumption in the direction of sustainability. *Fourth* the EU has to concentrate on **R&D** that can support the top priority areas of eco-innovation. And *Fifth,* the Commission would do well to acknowledge that the root causes for **climatic change** are due to the gigantic material flows set in motion in the technosphere (e.g. fossils, cement, copper, nitrogen, erosions, biomass). This would offer the opportunity to pursue win-win options when dematerializing the economy and could save considerable time and funds in reaching sustainable solutions. For instance, dematerializing the economy by a factor 5 could yield some 30% savings in energy.

Perhaps it would also be helpful by pointing out in the introductory part of the EU Eco-Innovation Plan that the principal **physical root cause** for the ecological crisis is the immense and yet technically unnecessary mobilization and use of natural materials, including energy carriers, water and land (Schmidt-Bleek, 1993) (Ekins, 2009), (Bleischwitz, 2009). It may also help readers to remind them, that the overriding **economic root cause** for the mismatch between the stability of the ecosphere and the current mainstream economy is the failure to introduce full cost pricing into the market for the use of natural resources (Meyer, 2009).

Old Policies

Given current economic and environmental policies, nature's life-sustaining services will continue to decline at a rapid pace because the world population grows and the western material consumption habits have become the worldwide norm of behavior. This is one of the downsides of globalization.

Traditional policies have *not* been able to prevent the life-threatening deterioration of the eco-system functions and services. Neither have they been able to avoid the near collapse of the banking system. They are *in principle not* pre-cautionary because they are based on reacting to developments *after* they were discovered and acknowledged to be deleterious. From a systems point of view they cannot be relied upon, nor can they prevent in a precautionary sense hitherto unknown negative environmental consequences of the current mainstream economic model.

Traditional environmental policies focus on dealing with specific symptoms, such as the consequences of mercury accumulation in fish, the need to deal with growing quantities of wastes, or the emission of CFC's and CO_2. In certain respects, this approach has been quite successful. For instance, it has more or less stopped the growth of the “ozone holes”, cleaned up water pollution, it has taken dangerous goods off the market and recycled or cascaded products to some extent.

However, solving individual problems can exacerbate others, for instance by removing air pollutions with filters and cleaning them afterwards with water. With respect to consuming natural resources, demanding catalytic converters for cars that carry rucksacks [2] of 2 tons and more, or demanding (and even subsidize with public money) the acquisition of new cars in order to lower fine-dust emissions or energy use are obviously questionable solutions.

Sustainability cannot be reached without increasing the resource productivity of the whole economy.

While it may seem trivial, it is nevertheless worth recalling that climatic change, too, is the consequence of enormous flows of human-induced material (such as water, coal, oil, natural gas, cement, copper, and biomass) and of large quantities of N_2O emissions, originating from the technical fixation of millions of tons of nitrogen from the air for the production of fertilizer.

Eliminating the emission of climate changing agents from the technosphere does not yield a sustainable economy.

Current policies decisively discourage eco-innovation by not offering the needed incentives to manufacturers and consumers to pursue them vigorously in their own interest. Traditional policies tend to prevent, delay and increase the cost of solving problems that are *not* in the limelight of public attention. Traditional policies have thus caused enormous repair costs that can eventually far exceed the costs of changing course (Stern Report). Business as usual threatens the very survival of humans on earth. Nobody knows, how close we have already come to this already.

Therefore traditional environmental protection policies must be expanded into a *systemic precautionary mode* in order to approach sustainability. And to achieve this goal, focused eco-innovation is the *conditio sine qua non.* Environmental protection policies will henceforth be closely intertwined with economic and financial policies.

System-policies

System-Policies must become the norm because policies seeking to solve individual environmental, societal, economic, and institutional problems one at a time, without taking inter-dependencies among them into account, cannot protect the environment nor can they lead to social or economic sustainability.

For instance, calling for “growth” without simultaneous dematerialization of goods and services, increases the environmental crisis. It is doubtful, whether taxing profits from financial transactions alone will prevent the financial sector from rocking the world economy again by frivolous behavior of

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2 The *Ecological rucksack of a product is* the complete material input MI (including all material utilized for making energy in all forms available) for manufacturing a product from “the cradle to the point of sale”, minus its own weight (own mass). Unit: kilograms, metric tons.

bank officials. Attempting to improve the employment situation by stimulating consumption has negative impacts on the stability of the ecosphere because of the commensurate increased consumption of natural resources and energy. Subsidizing the sale of Millions of new cars with billions of euros under condition of forcing the destruction of millions of tons of natural resource investments in existing vehicles is not only ecologically counterproductive, it is as well likely the wrong measure for economic reasons, not to speak of the fact that it prevents urgently needed investments in educational facilities as well as R&D.

System policies take into account that dematerialization is *not* the only pre-requisite for approaching *ecological* sustainability. Excessive use of water and land are others, as well as introducing eco-toxic substances into nature.

System policies focusing exclusively on ecologically harmful developments *cannot* lead to sustainability either, because happiness and wellbeing of people also depend on other factors. For instance, the denial of human rights can be the *root cause* for social instability. These rights include: Access to healthy food, water and other natural resources; dignity; justice; gainful employment; health care and education; liberty; security; freedom of speech; and fair distribution of wealth and income (not necessarily in this order).

System Policies aim to improve happiness, welfare and wellbeing of people by optimizing the effectiveness and precautionary nature of measures through eliminating and avoiding *root causes* for potentially harmful developments. System policies reduce the risks associated with taking actions.

Measuring the Decoupling of Growth from the Use of Nature

The metrics for relating the ecological basis to the human economy are kilograms (of matter) and square meters (of land) rather than Euros or Dollars. Much confusion has been generated in the past in discussions about whether or not there are limits to economic growth by the failure to distinguish clearly between these metrics and specify which is being considered (Ekins, 2010).

Indicators for measuring progress in decoupling the use of nature for generating welfare - and for comparing the performance of producers and consumers in this quest – relate the quantity of natural resources (materials, water, and land use) consumed from cradle to cradle in order to produce a unit of the desired solution (output in terms of service, value or utility).

Decoupling indicators should be based on characteristics that are common to *all* processes, goods and services. Their use must always yield directionally safe answers.

On the economic micro-level such units are “Rucksack” for the cradle to the point of sale, and MIPS for cradle to cradle Material Input [in kg] Pro unit Service (per unit value or utility) obtained. (Schmidt-Bleek, 1994, 2008).

On meso- and macro-levels of the economy, indicators such as yearly Total Material Consumption (TMC), or yearly Total Material Requirement (TMR) are applied to defined economic units such as countries, regions or companies (Bringezu, 2004).

Technologies for Tomorrow

At present, more than 90% of the resources lifted from nature are wasted on average before finished goods reach the market. And many industrial products— such as cars and washing machines—demand additional natural resources while being used. A typical medium sized car consumes about 450 grams of natural material *per kilometer* (including some 60 grams of gasoline). One wonders, why politicians and the car industry insist that saving gasoline is the best avenue for eco-improving cars. System policies would prevent this greenwashing exercise.

Traditional “environmental technologies” must be joined by technologies that can deliver goods and services with life-cycle-wide minimal use of natural resources (material including energy carriers, and surface area) per unit output, and a minimal release of toxic substances. During the 21st century, the 6th Kondratieff Wave will likely be dominated by high resource productivity technologies across all areas of human activities.

From an eco-innovation point of view it would be *suboptimal* to give preference in support to sectors of the economy solely on the basis of having high profit or export potential. It makes mor sense to focus on sectors with large contributions to the overall resource flows in the economy. These sectors include the following: Building/construction, final metal goods, vehicles, energy carriers, and the agricultural sector (Bringezu, 2004).

There is *no technology fix* involved when generating dematerialized goods and services. Priority sectors for supporting eco-innovation should be selected on the basis of their contribution to the overall resource flows.

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

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

Increasing the resource productivity of goods can focus on a number of aspects:

- ☐ they can be made to last longer, require less maintenance and repair and consume less input of natural resources while performing their assigned tasks;
- ☐ they may be constructed in a modular way so as to allow easy up-dating, re-manufacturing, and re-cycling;
- ☐ they can be designed to yield different types of utility with only slightly increased rucksacks, such as the famous Swiss army knife; and

☐ they can be dematerialized by replacing materials with high rucksack factors by those materials with smaller rucksack factors. In fact, this is usually the fastest and most cost-efficient way to obtain good results.

However, from the point of view of approaching sustainability, a more challenging and far-reaching approach is this: Define first the utility demanded by society - or a bundle of related utilities - and then create a new type of service delivery machine – or a systems solution - that can reliably deliver this utility with the highest possible resource productivity – or with the smallest possible MIPS.

Already today, many examples exist where incremental improvement of existing technologies has increased resource productivity twofold and even more (see publications by W. Bierter, C. Fussler, F. Hinterberger, Christa Liedtke, Ch. Manstein, F. Schmidt-Bleek, E. U. von Weizsäcker, and R. Yamamoto). However, decoupling production and consumption with high effectiveness from natural resources requires new systems, goods, services, processes, and procedures for meeting human needs. One such novel solution is to propel ships by "sky sails," potentially saving up to 60% of fuel for 50,000 freighters at competitive costs and increasing the life-time of conventional propelling systems considerably. Surfaces equipped with the "Lotus-Effect" may eventually eliminate conventional cleaning methods, saving billions of tons of cleaning chemicals and water. Rhombergbau in Austria is now constructing 20 and more floor "Life Tower" buildings made with timber, and the world is re-discovering the multiple use potential of bamboo. To such solutions, the markets of the future will belong.

The German Junior Business Association is now preparing an action plan with the title: "1000 Entrepreneurs for Sustainability" on the basis of a new Guideline , available in English (Lettenmeier, 2010). (Aktionsteam2@wjd.de).

Economic Policies

Currently, no adequate incentives or policies exist for creating a resource-efficient economy. Adjusting the economic and fiscal framework is therefore the most fundamental and urgent policy prerequisite for moving toward sustainability. For this shift, strategic eco-innovation is paramount.

Among forward looking economists, a strong preference seems to be emerging for economic instruments, such as environmental tax reform and market-creation policies, including tradable permits. Instead of value-added taxation, for instance, it may be more efficient to tax natural resource use before goods for final use have been produced, while lowering taxation of labor accordingly. Because economic instruments may not work in all cases, other instruments and measures could be considered, such as information and coordination instruments and command-and-control mechanisms, for instance, adjusting norms and standards. The choice of policy options should depend on their efficiency in dematerializing goods and services at the least possible cost to civil society. The Lindau Group considers these options in more detail [3].

Today, the public procurement of goods and services amounts to some 15 to 20% of final consumption. Preference for dematerialized goods, infrastructures, and services, could give the manufacturing sector a powerful incentive to increase resource productivity. In Germany, this may

3 Contact Professor Bernd Meyer, <meyer@gws-os.de>

be a particularly attractive option as it has been shown that some 20% of resource-input production costs could be saved on average without negatively affecting outputs (Fischer, 2004).

Agreement has also emerged in civil society that improving education and training on all levels, as well as enhancing the public availability of relevant information, will play a central role as part of a progressive strategy.

Literature

(Bleischwitz, 2009). R. Bleischwitz, Stefan Giljum. Michael Kuhndt, F. Schmidt-Bleek "Eco-innovation - Putting the EU on the Path to a Resource and Energy Efficient Economy", European Parliament, 2009

(Bringezu, 2004), S. Bringezu,:"Erdlandung", Hirzel, 2004.

(Ekins, 2009), P. Ekins, B. Meyer, F. Schmidt-Bleek.: „Reducing Resource Consumption. A Proposal for Global Resource and Environmental Policy". gws Discussion Paper 2009/5, ISSN 1867-7290, meyer@gws-os.de

(Ekins, 2010), Paul Ekins, B. Meyer, Friedrich Schneider, F. Schmidt-Bleek "A Proposal for Global Resource Policy", submitted to "Environmental Science and Policy", Contact <bernd.meyer@uni-osnabrueck.de.

(Fischer, 2004), H. Fischer, B. Meyer, et. al., "Wachstum und Beschäftigungsimpulse rentabler Materialeinsparungen", Wirtschaftsdienst, 4, April 2004.

(Lettenmeier, 2010), M. Lettenmeier, H. Rohn, C. Liedtke, F. Schmidt-Bleek "Resource Productivity in 7 Steps - How to Develop Eco-innovative Products and Services, and Improve their Material Footprint", Wuppertal Spezial 41, 2010. Contact christa.liedtke@wupperinst.org

(Meyer, 2009), B. Meyer, „Costing the Earth? Perspectives on Sustainable Development", Haus Publishers, London, 2009.

(Reid, 2008), A. Reid, M. Miedzinski, EUROPE INNOVA, Final Report for the EU Sectoral Innovation Watch Panel on Eco-Innovation 2008, <http//www.europe-innova.org.

(Schmidt-Bleek, 1993), F. Schmidt-Bleek and Coworkers, Special Issue, Fresenius Envir Bul Vol 2, No 8, pages 407 - 490, Birkhäuser, Basel, Boston, Berlin (in English)

(Schmidt-Bleek, 1994). F. Schmidt-Bleek, "Wieviel Umwelt braucht der Mensch ?, MIPS, das Mass für ökologisches Wirtschaften" Birkhäuser, 1994. Available in Japanise, Chinese, and Finish translations. The English version can be downloaded from www.factor10-institute.org

(Schmidt-Bleek, 2008), F. Schmidt-Bleek „The Earth: Natural Resources and Human Intervention", Haus Publishers, London, 2008; German and Chinese versions available.

Author’s Note

Consult also “Future: Beyond Climate Change,” position paper 08/01<http://www.factor10-institute.org/files/FUTURE_2008.pdf .

About the Author

Friedrich Schmidt-Bleek has been awarded the coveted Takeda World Environment Award in 2001, together with Ernst Ulrich von Weizsäcker. He was originally trained as a nuclear chemist at the Max Planck Institute für Chemie. After receiving a PhD, he worked with Nobel Price winner Sherry Rowland at the University of Kansas, and as a faculty member of Purdue and Tennessee Universities, while serving as a consultant with Oak Ridge National Laboratory. With ORNL and TVA he founded the UT Environment Center and was its first director. At the newly created (West)German Environment Agency he became responsible for coordinating environmetal research, and later for developing and applying the German chemical substance control legislation. At the OECD he was in charge of harmonizing chemical control management for the Member states, including the testing procedures for chemicals. He subsequently became leader of the Technology, Economics, and Society Program at the International Institute for Applied Systems Analysis, IIASA where his principal task was to support the development of market economic legislation in (former) COMECON countries in close cooperation with the chief economic advisor to President Gorbachov, Stash Shatalin. Realizing that western environmental protection laws could not lead to sustainability, Schmidt-Bleek developed the Factor 10 dematerialization concept, including indicators such as ecological rucksack and MIPS. He built up the Wuppertal Institute with with Ernst Ulrich von Weizsäcker as his first Vice President, and seved as chairperson for the Future Council of North-Rhine Westfalia (18 Million inhabitants). In the 90ies he became the founding president of the International Factor 10 Club and the Factor 10 Institute in the Provence. He initiated the World Resources Forum Davos, and, together with Bernd Meyer, the Lindau Group, an association of concerned economists interested in economic perspectives of sustainable development. Schmidt-Bleek has published hundreds of papers and some 20 books in a number of languages.

BILD DER WISSENSCHAFT named Schmidt-Bleek in 2006 „Father of dematerialization“; DER SPIEGEL called him 2009 „Doyen of the German environment researchers”; Financial Times Deutschland described him 2010 as “one of the best known German environment researchers”.