The Fossil Makers

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Of The Book

Wieviel Umwelt Braucht Der Mensch – MIPS, Das Mass Fûr Ökologisches Wirtschaften

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Introduction

Rachel Carson's book, Silent Spring[1] was an early warning: watch out, folks, you're poisoning the environment--and with it yourselves as well!

That was thirty years ago.

Ten years passed before Europe began with its environmental policies. Let us take a look at what these policies were like.

The concern for reducing the emission and introduction of "dangerous" substances into the soil, air and water was uppermost. Alarmed by the degree to which humans and other lifeforms were found to be already poisoned, lawmakers in many countries began to regulate and restrict the introduction and discharge of anthropogenic chemicals into the environment. The list included DDT, phosphates, nitrates, sulfur dioxide (SO_2), Nitrous oxide (NO_x), mercury, lead, cadmium, dust, chromium, asbestos, PCBs, pentachlorophenol and others. The rationale behind these attempts was usually a concern for the health of constituents, and so the policies targeted those chemicals which threatened people's health. No economic sphere was left untouched: construction and demolition of buildings, production of goods, energy transformation, provision of services, transportation, packaging, goods themselves, as well as their use and "disposal" (Fig.1).

Many people are of the opinion that not enough has been done, that we have been too cautious about avoiding environmental hazards associated with anthropogenic substances. It is true that to date the use of only a small number of those tens of thousands of synthetic chemicals has been in any way restricted or regulated out of concern for their effect on the environment. It is true that this problem must continue to be a focus of ongoing research, especially with respect to certain categories of chemicals, such as those which contain chlorine.

Above all it must be emphasized that without the unfailing initiative of citizens' action groups much less would have been accomplished. But let us also not forget that in working closely with citizens and the chemical industry we began work on the *Chemikaliengesetz* (the German law regulating the production and use of chemicals) and in the mid seventies, long before the news media and sometimes even politicians made it their business to discover the "chemical of the week."

In the public debate over the state of the environment, energy has always played a major role alongside the focus on pollutants. From an ecological perspective the consumption of energy as such is only secondarily relevant. The material flows associated with the transportation, conversion and consumption of energy are what precipitate the important environmental effects. In this context the energy intensity of economic goods and services becomes an ecological question of their indirect and direct material intensity.

Let us summarize: one of the primary goals of environmental policy for the last twenty years has been to curb the introduction of known pollutants into the environment and to bring about extensive restorations. The threat to human health was a primary concern. "End of the pipe" technologies proliferated; referred to as such because they were developed with the goal of separating out the effluents and pollutants generated by existing production techniques and processes at the point of

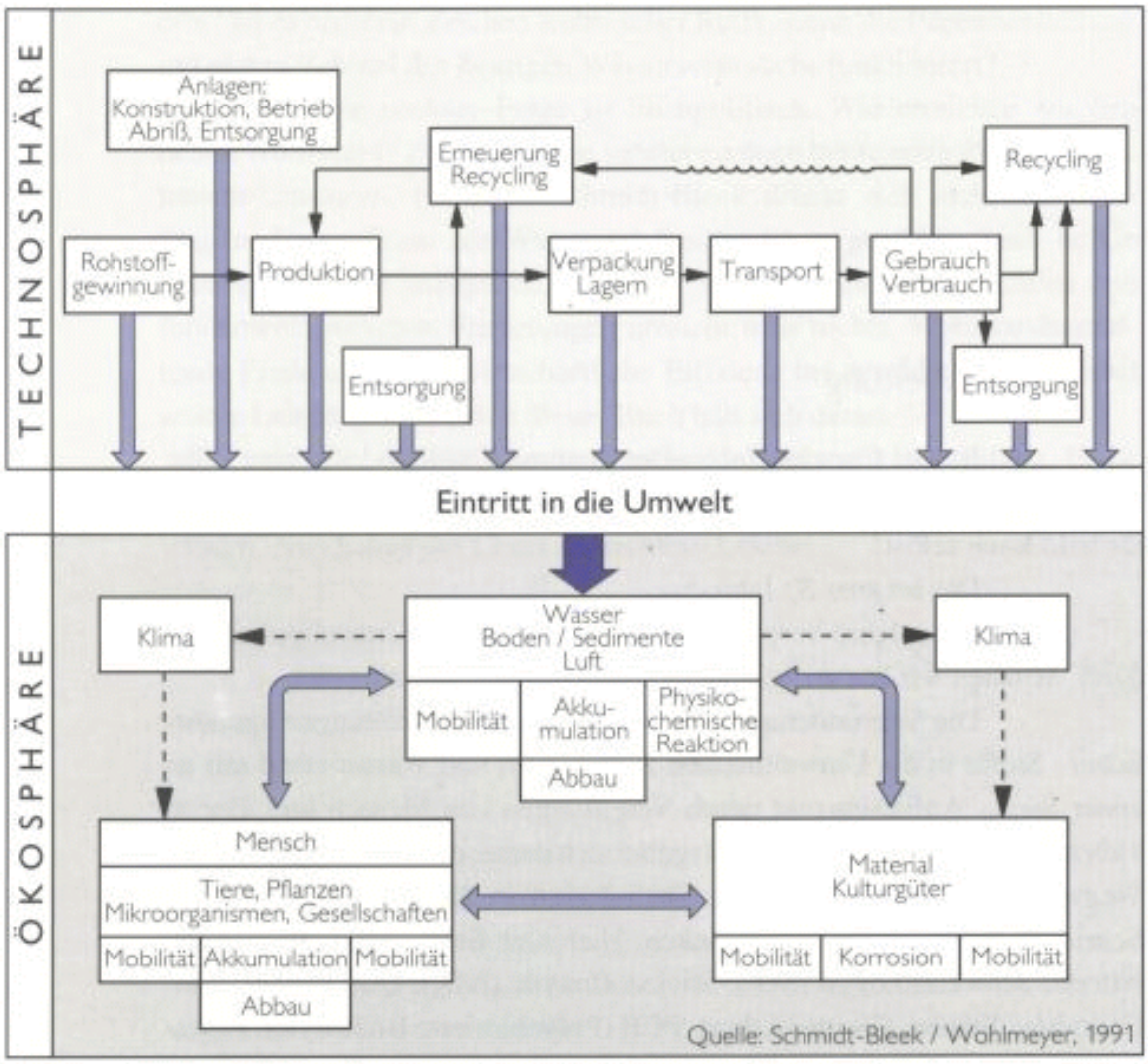

Fig. 1: Schadstoffe werden in allen Tätigkeitsbereichen des Menschen freigesetzt als Folge des Gebrauchs und der Verarbeitung natürlicher Stoffe und Materialien. Auf verschiedenen Wegen gelangen solche Stoffe in die Umwelt und üben dort nachteilige Wirkungen aus.

their emission (at the end of the sewage pipe). As it is impossible to destroy matter, these technologies were designed to render the pollutants harmless through burning, or to detoxify them chemically--as with the catalytic converter in the automobile--or to keep them from entering the biosphere through a filtering system. Technically elegant methods were also devised with which to remove contaminants involved in chemical spills of one kind or another.

Additionally, very powerful analytical procedures were developed with which pollutants could be measured in the most minute concentrations, as long as it was agreed upon in advance which substances were being looked for.

This policy of tracking emissions was both necessary as well as quite successful. It was not an inexpensive approach, though, and it has not been able to arrest the steady decline in the condition of the biosphere.

When compared to the incalculable mass and diversity of materials which make up the earth, one is tempted to caricaturize environmental policy as having been preoccupied in its initial phase with "nanograms,"with the effects of comparatively minute amounts of a small number of pollutants generated by human activities. The possible ecological effects of the "megatons" of material flows diverted by heavy machinery and gigantic structures have not been of much political concern. This category includes draining swamps and wetlands; diverting, straightening, and dredging rivers; drawing off rainwater; erosion resulting from plowing or clearcutting, generation of overburden in mining operations, and the earth movements associated with transportion systems; and finally the structures themselves.

One example: in the Ruhr area of central Germany more than 70,000 hectares of land have subsided so much due to collapsing sub-surface coal mines, that surface water would flood them were it not continually pumped off. If one were to add the energy requirements of doing this and the volume of water involved to the mining activity, in the long run a negative materials and energy balance would result. It will then be up to our children and grandchildren to make up the difference--if they are still in a position to do so. We will be returning to such examples throughout the book.

Not only the "megatons" were overlooked in the past. The meticulous search for the "nanograms" was bound to come up against certain difficulties and limitations. We wish to particularly stress at this juncture that it is scientifically impossible to know, simulate, quantify, let alone express in fiscal terms the totality of all effects that even a single material would have on the environment. For material flows characterized by complex and changing configurations this is even more obviously the case. Therefore the Cost-Benefit-Analyses, which the economists like to perform so frequently as a means of determining the environmental costs of human activity or economic production, are fundamentally imprecise and thus a woefully inadequate basis for ecologically and economically meaningful decision making. This for the simple reason that they are based solely on the measurement of *known* pollutants.

From pollutant of the week to an economically useful ecological measure

Focussing the concern over the environment on toxins quite naturally led to the phenomenon of a "pollutant of the week." After accidents, or as the result of scientific research, new materials and new consequences of using these materials on humans and the environment were discovered. Nothing about that tendency is humorous or even ridiculous, even if it may often appear that way in the news media. How else should eco-toxicology proceed, if not by scientific observation of nature, precisely in the wake of such accidents. A systematic and gradual examination of theoretically conceivable cause-effect relationships inside and outside of the laboratory is required to make headway.

In the 1980s a decisive change occurred. *Waldsterben*, or forest dieback, became a political watchword, and an increasingly international understanding of

how chlorofluorocarbons, or CFCs, were destroying the ozone layer propelled environmental policy into a new phase: the concern over the actual and potential harm to humans associated with industrial chemicals was drastically expanded to include the global ecological changes that we seemed to be bringing about.

CFCs were invented by scientists and have been prized for decades as an outstanding achievement of chemistry for physico-chemical reasons, as well as for their toxicologically excellent behavior. Nature does not seem to have deemed them worth "inventing,"or else the composition of the atmosphere would have been different from the beginning. In 1974, Sherry Rowland had already warned of the effects that would result from emitting these compounds into the environment[2]. In 1978 West Germany's Federal Government hosted an international conference on this topic in Munich. But the breakthrough for environmental policy did not occur until very recently: an international "Convention for the Reduction of Ozone Depletion in the Upper Atmosphere" was created.

Carbon dioxide, besides being absolutely essential to life on earth, is an unusually abundant gas in the earth's atmosphere. It has only been a matter of a few years since it made its debut in the political arena in the context of anthropogenic environmental damage. How could that be? A naturally occurring substance--and one of the most important compounds plants require at that--is supposed to be a pollutant? Even a pollutant capable of changing the climate upon which we depend so critically for our survival?

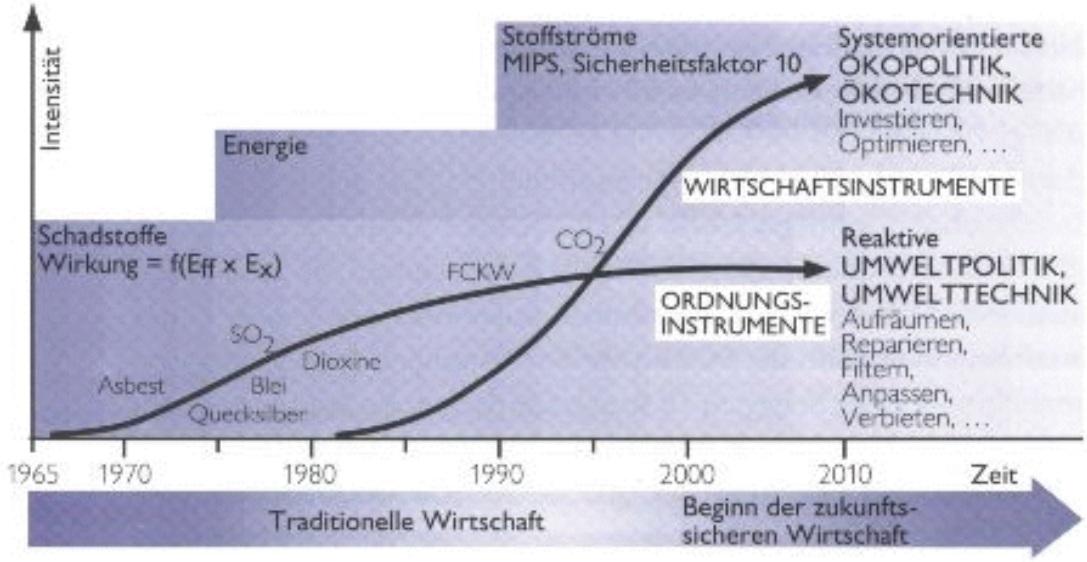

Fig. 2 Von der Umweltpolitik von gestern zur Ökopolitik von morgen. Systemorientierte Strukturanpassungen an ökologische Randbedingungen werden zu zukunftsfähigen Wirtschaften führen. Wirtschaftliche Instrumente werden gezielt zur Erhöhung der Ressourcenproduktivität eingesetzt. Das reicht von Ökosteuern über Subventionsabbau bis hin zu neuen Einkaufsstrategien der öffentlichen Hand. Die dematerialisierte Wirtschaft basiert auf völlig neuen Öko-Technologien.

With this case we have reached a crucial juncture for environmental policy. We can no longer avoid looking very critically at the ecological effects of the material flows generated by human activity, even those material flows which have traditionally been considered ecotoxicologically irrelevant or even beneficient. Alongside the traditional "toxicity" of individual materials we must now also include the destructive potential of anthropogenic material flows--which may have hitherto appeared neutral--in our economic calculations. We now understand that such material flows have the capability of threatening global ecological balances or equilibria. We must not solely be concerned with the toxins *introduced* by humans into the environment, but also with the movement, disturbance, diversion, transportation and manipulation of the environment itself, which we are doing on a very grand scale (Fig 2).

Some people will wish to remind us at this point that within the environment large amounts of material flows are moved though erosion, or even by a volcanic eruption. As we have seen in the example of CO_2, the anthropogenic material flows are not automatically ecologically neutral because they also occur as natural fluxes. Even more important is the consideration of time. Humans are always in a hurry. Time is supposed to be money. They have enormously increased the speed with which the earth's surface and the atmospheric composition are changing when compared to the speed at which geological and evolutionary processes occur. Today humans displace more material than the geosphere. The living world cannot keep pace in terms of its biological makeup and threatens to extinguish itself ahead of schedule.

We must remind ourselves that the volume of materials, the amount of "nature" which we have been moving about, has been steadily increasing. In order to produce the wealth we enjoy; sand, gravel, water, air, overburden, ores, cement, earth and much more must yield to our advances. Each product which we use, each service which we afford ourselves, carries a rucksack of materials around with it which had to be moved or transformed in order for it to become a product or service. The masses which are in these rucksacks are often much heavier than the products themselves (Fig.4). In order to extract one gram of platinum from a platinum mine, for example, we must displace and modify 300,000 grams of rock. Without platinum we would not have the catalytic converter in our automobiles. Two to three grams of platinum are found in one such catalytic converter, in addition to high-quality steels, ceramics and other materials. Thus, the *ecological rucksack* of the catalytic converter, i.e. the total amount of material translocated for the purpose of constructing it, amounts to about one metric ton of environment. This means in effect that the catalytic converter burdens the automobile with as much matter as the car itself weighs. (The calculation looks a bit different if the platinum is recycled from a used catalytic converter.)

If it took only a few years for ur disruption of a natural material flow such as CO_2 to advance to our "most pressing environmental problem,"how can we be sure that the extraction and translocation of far greater material flows as well as their alteration and "return" in the form of garbage won't effect fundamental changes in

ecological equilibria?

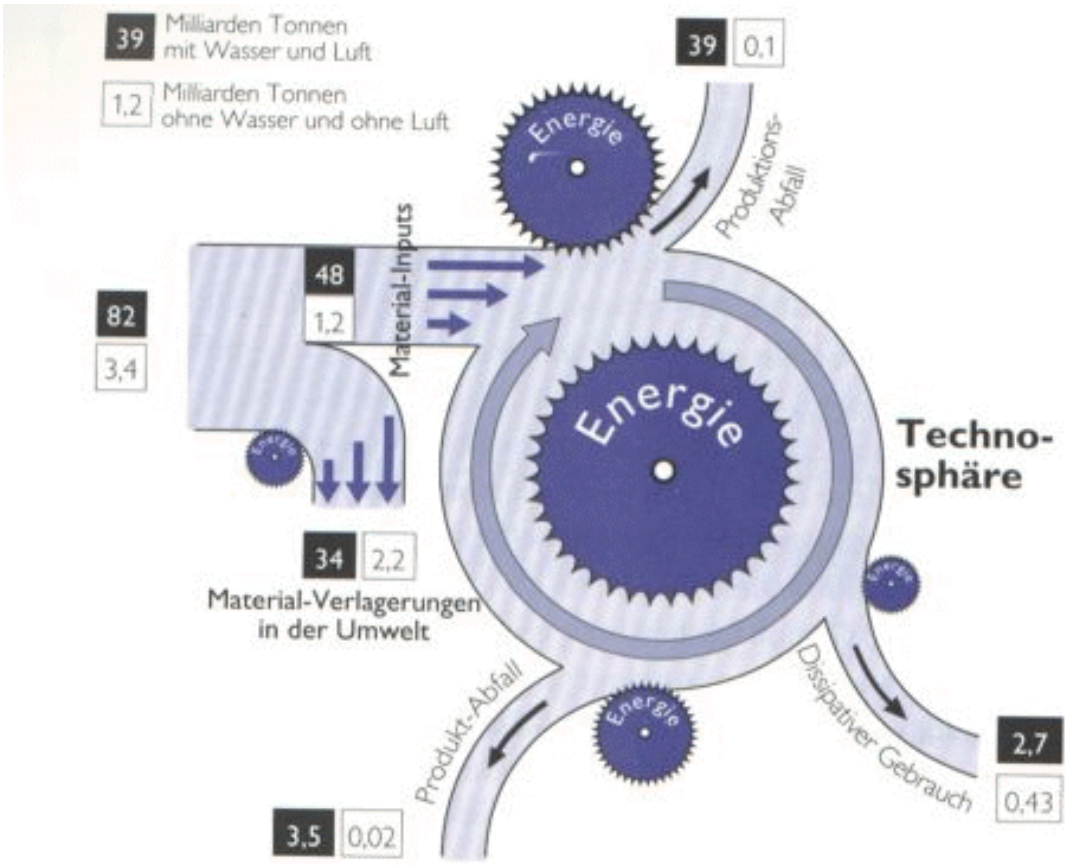

Fig 3: Die gegenwärtige Stoffstromsituation in Deutschland ist hier angedeutet. Wie ersichtlich, wird mehr als die Hälfte der vom Menschen bewegten Stoffstrommengen gar nicht in die Wirtschaftskreisläufe eingeführt. Sie sind daher auch nicht kreislauffähig. Und dennoch müssen sie bewegt werden, um materiellen Wohlstand zu schaffen. Sie sind in den Rucksäcken versteckt! Die Zahlen beziehen sich auf 1990 und gelten für Westdeutschland. Sie sind noch vorläufig, weil erst seit kurzer Zeit die notwendigen, und sehr komplizierten Grunddaten erhoben werden. Helmut Schütz und Stefan Bringezu vom Wuppertal Institut stellten sie dankenswerterweise zur Verfügung.

As scientists can only predict the effects of such material flows to a very limited degree, we should perhaps play it safe and anticipate catastrophic ecological effects. This holds true even if--over the next generation or two--we fail to notice many of the changes we may already have set in motion. We have been notoriously bad at taking note of gradual changes, as we have so far missed the opportunity to establish an early warning system for unexpected environmental changes. Furthermore, many of the changes we may have initiated won't appear on a temporal or spatial scale we can appreciate. The causal relationships have often become so complex, that we are no longer able to decipher them.

The plausibility principle should become the basis for our economic decision making. In other words, whenever possible, the decision making process should

favor alternatives--when such exist--which minimize the environmental stress potential. Only those investments which are ecologically sensible are able to help avoid the need for future attempts at ecological restoration. It is generally accepted that it is better to be safe than sorry--prevention is preferable to mopping up after the fact. The costs of mopping up--of "restoring" the environment--have been regularly paid for with tax dollars,
an interesting solution given our professed penchant for market-based decision making.

Furthermore, it is completely uncertain and even scientifically unpredictable at what point the ecosystems, upon which we depend so critically for our survival, will collapse in chaos. What is certain is that our inventiveness, our machines and our unbridled urge to acquire more material possessions and ever more elaborate services push us in that direction.

Dematerializing the economy would drastically reduce the volume of solid waste.

It is somewhat surprising that the "quantity-problem" first became a political watchword in the context of municipal solid waste, and not, for example, in the lignite mining regions around Cologne and Aachen, or in the context of the very expensive efforts to divert enormous quantities of rainwater accumulating in large cities. For many years the problem of solid waste was tackled by separating out what were perceived as "toxins"; using ever more complex technologies that were subject to rapidly rising costs. The scientific basis for such a regime was never very explicit, and was predicated upon an effective disregard for the ecological consequences of the ninety-nine percent that was sent to the landfill or the incinerator. In the meantime, the German Parliament has discovered the closed-loop economy as the solution, and German industry has put its money on the *Grüne Punkt* or Green Dot. Both are premised on recycling .

It is obviously correct to use those materials which have been taken from nature and introduced into the technosphere as often and as long as possible, to allow them to yield wealth-increasing services. The question of the ecological and economic price of such a strategy remains, nevertheless. Each time something is recycled, more energy and materials are required, as are additional machines, transportation infrastructure etc. (i.e. material flows). The solution could hardly be to admit ever more matter at the front--from nature into the technosphere--and expel a decreasing amount at the back. Picture the biological and economic predicament of someone trying to emulate this with food. (Fig. 3)

It has been the general rule in environmental policy to recognize individual substances, to judge them with our eco-toxicological measuring stick, and to then do our best to isolate them; but this strategy is really not in line with a precautionary approach. We know that the costs associated with our technical approach to avoiding contaminants within existing technological regimes are considerable.

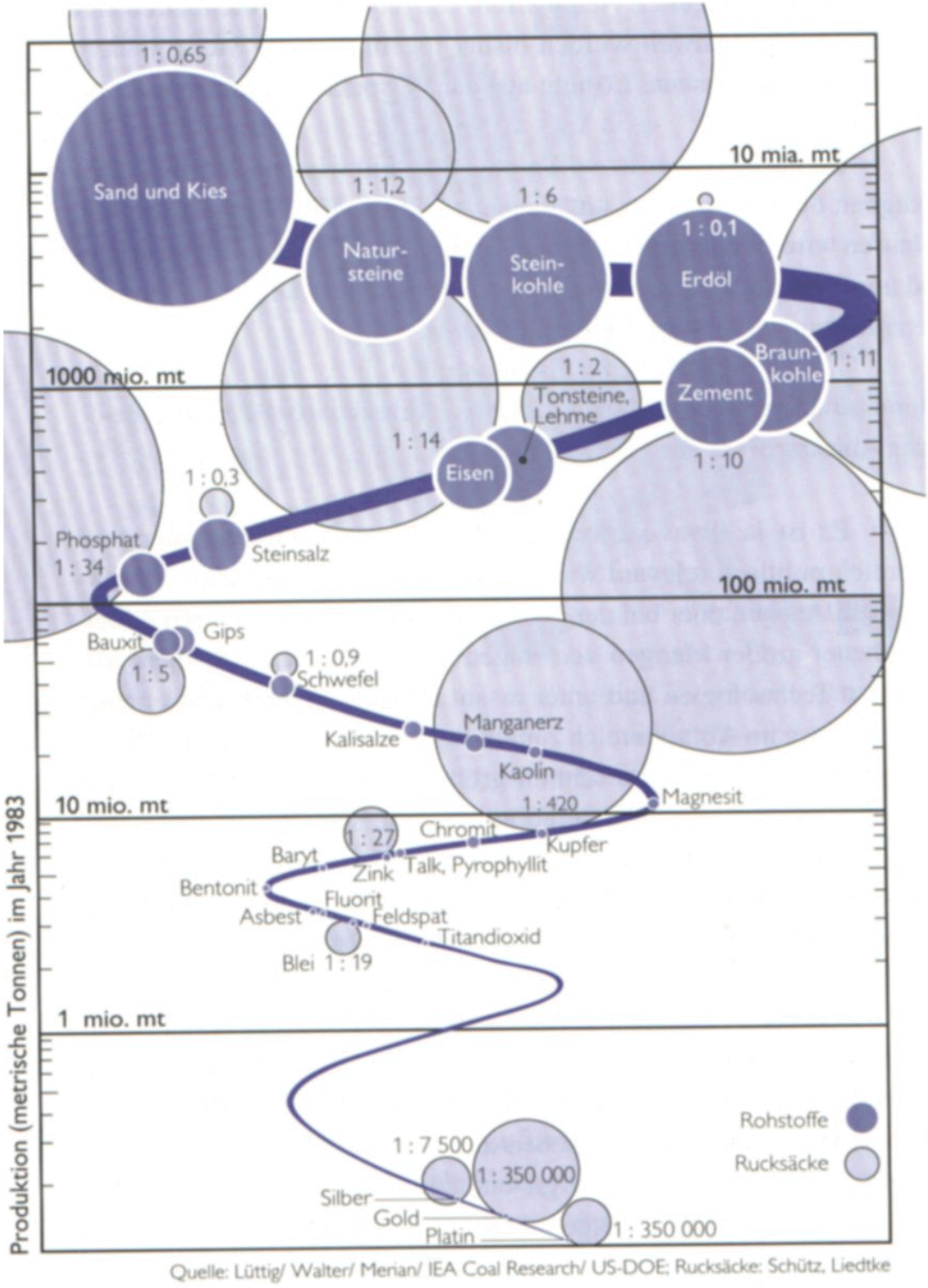

Fig 4: Die dunkleren Felder stellen die Weltproduktion verschiedener Wirtschaftsgüter dar (1983). Die helleren Felder sind die jeweils dazugehörigen “ökologischen Rucksäcke”. Die “Rucksäcke” stellen Mittelwerte dar, da sie von geologischen Verhältnissen und Technologien abhängen.

Furthermore such technical follow-up strategies are generally short-lived and prone to failure. The catalytic converter illustrates this.What we call ecological structural change cannot derive from an approach which merely recognizes the effects of pollutants on the environment. Our

knowledge of these linkages changes constantly. Foundations which change continually are not well-suited to long-term planning efforts; especially not when the future well-being of humanity is at stake.

The last twenty years of OECD policies show that internationally harmonizing what are believed to be the environmental dangers of individual substances is difficult and rarely acheived. The very frustrating and expensive results of Life Cycle Analyses to date show that the problem of reducing the multitudinous effects of harmful chemicals to a level at which they can be compared remains unsolved.

The call for a directionally stable and rugged measure with which to represent and compare the environmental stress intensity of processes, goods and services is thus more than justified.

It is difficult to imagine how we could plan, carry out and continue to monitor the progress of ecological structural change without the ability to measure the ecological effects of our economic actions on an international level.

To do this we require a new ecological measure; a simple, directionally stable and reliable indicator with the help of which we could at least approximate the environmental consequences of our economic actions--as well as of our products. Much of what will be said in this book is informed by this thought. And it should be obvious that all our knowledge of the toxicity of anthropogenic material flows will necessarily inform our decisions with respect to new processes, products and services. It would be naive to believe that sand is as toxic to humans as dioxins. The present book is concerned with the long-term stability of the biosphere, which has never been threatened by dioxins.

Only a simple measure can persist and be relevant in everyday decision making with respect to millions of different purchases and other economic decisions. Only a reliable and scientifically defensible measure, that--in all its simplicity--still has the ability to indicate at least the proper direction, can hope to find favor across borders and with people of diverging interests. Such a measure cannot be understood as scientific, in a restrictive sense, any more than money is a scientifically accurate measure of the value of a product or service. It will turn out to be a measure which people understand and can use without having to always review the ecological ramifications of their economic decision in all their complexity.

The material flows tied up with producing the wealth we have come to enjoy, are, especially for the people of the rich countries, a global phenomenon. It is our conclusion that our present goods, services and infrastructures are too material and energy intensive. This is calculated "from the cradle to the grave," or, as Walter Stahel[3] says, "from the cradle to the cradle," as all the materials and energy we use

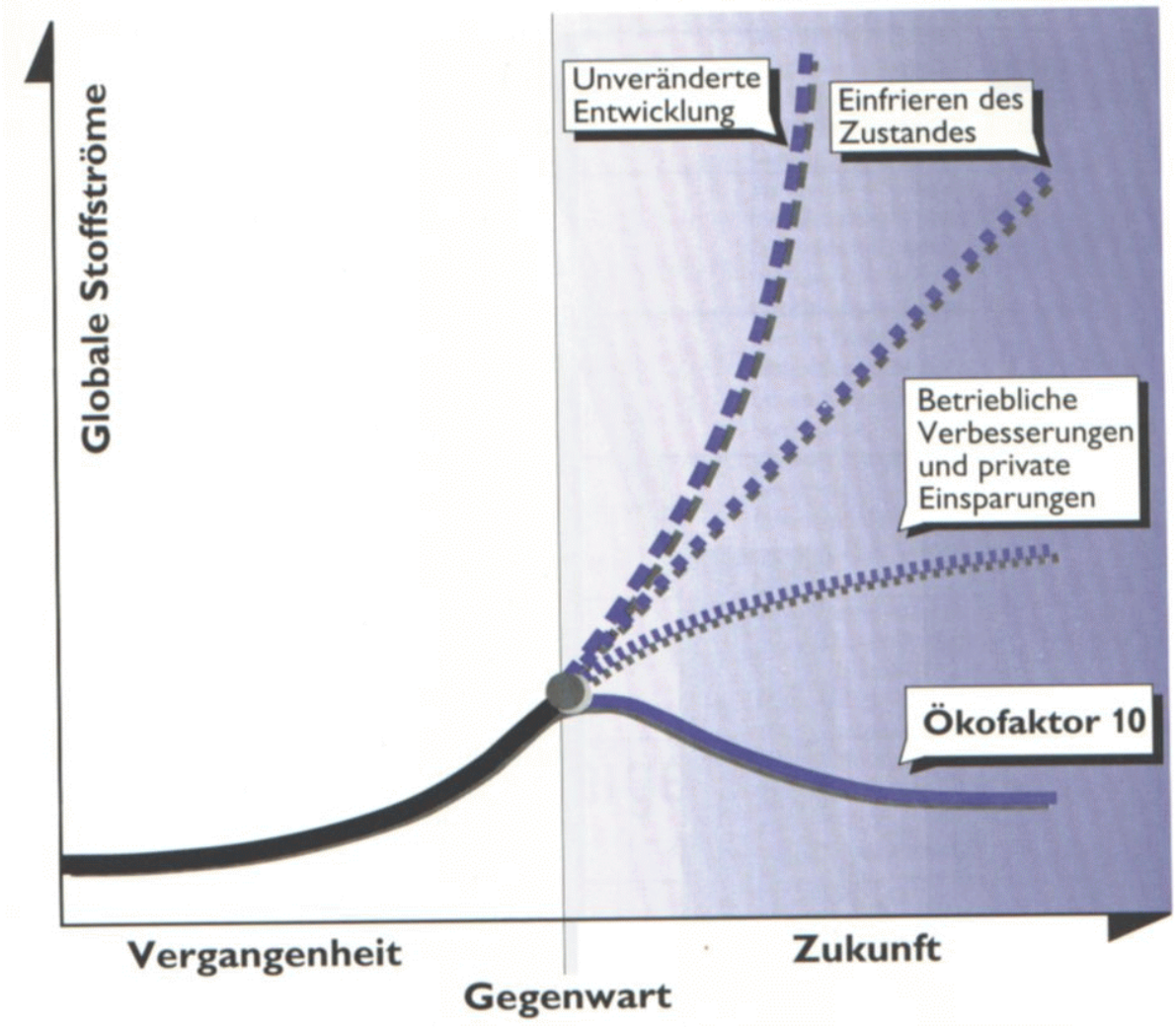

Abb 5. Die Abbildung zeigt die hypothetischenVerläufe globaler Stoffstrommmengen unter der Voraussetzung daß (1) die Entwicklung unverändert weitergeht, (“) bei Einfrierung des gegenwärtigen Zustandes, (3) bei erheblichen betrieblichen Verbesserungen, und schließlich (4) unter der Annahme, daß es gelingen wird, die gegenwärtigen globalen Stoffströme zu halbieren. Der erste Fall ist offentsichtlich mit einer stabilen Ökosphäre nicht vereinbar. Der letzte Fall ist wahrscheinlich der einzige Weg zu einer zukunfstfähigen Wirtschaft.

eventually return to the earth. We must create a dematerialized economy, supported by a completely new technology and informed by a concern for the welfare of future generations. In this book we shall also entertain the question of whether or not the demands our economy makes upon surface- or land-use are too high, and how one could possibly measure surface-use in an ecologically meaningful way.

If our present economic activity, i.e. the methods by which we generate wealth, stands a chance of ruining what is perceived to be a more or less beneficent environment, any future eco-politics, or "earth-politics," as Ernst Ulrich von

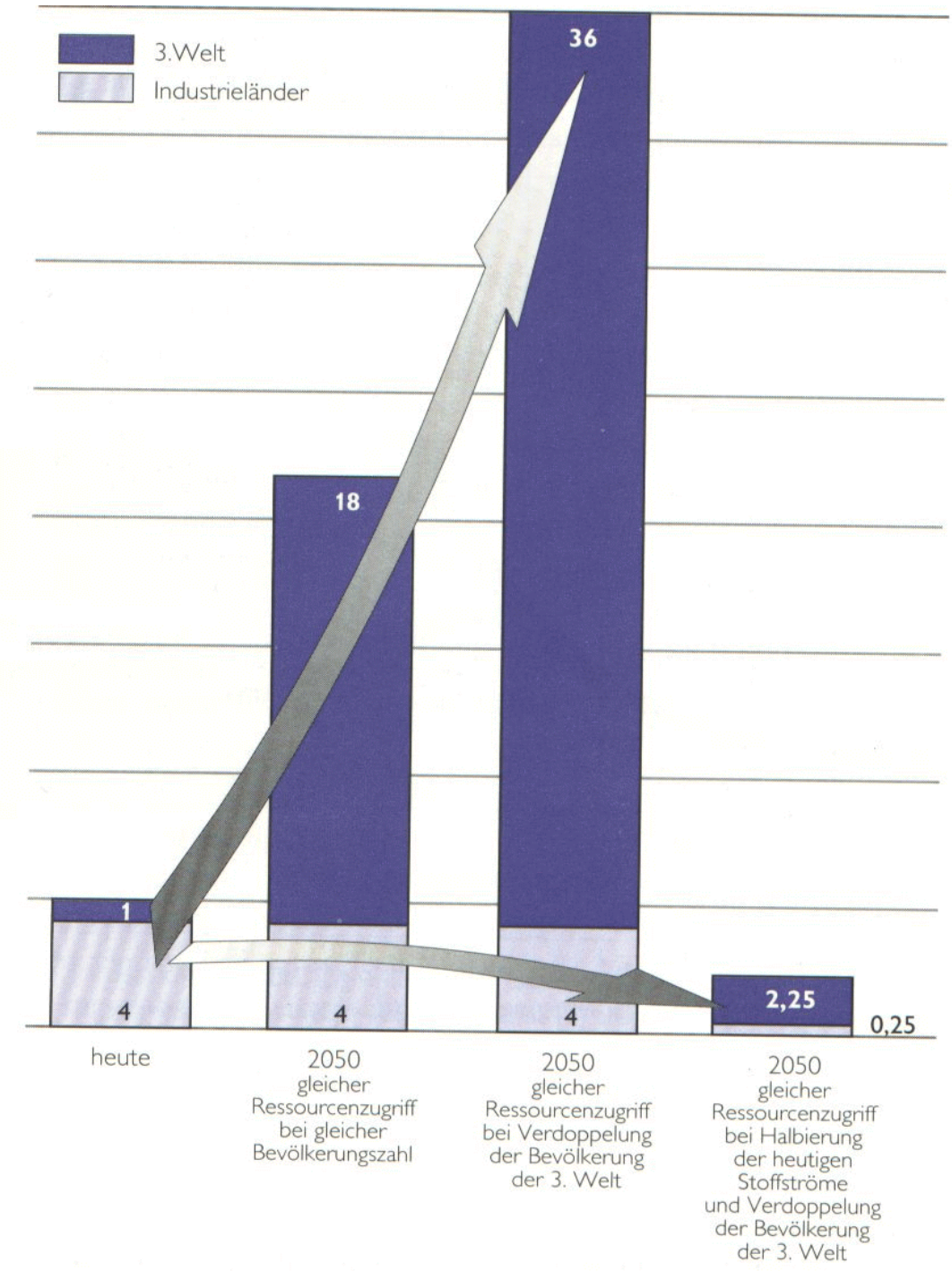

Fig 6: Der Pro-Kopf-Zugriff auf gloablae Stoffströme als Grundlage des materiellen Wohlstandes ist heute ungelich verteilt zwischen “Süd und Nord”. Bei Angleichung des Verbrauches und Verdoppelung der Bevölkerung in der dritten Welt wären auf der Basis der heutigen Materialintensität der westlichen Wirtschaften im Jahre 2050 siebenmal so viele Ressourcen vonnöten. Um auf eine Stabilisierung der Ökosphäre hinzuwirken, sollte der heutige Weltverbrauch hingegen halbiert werden. Dies würde eine Dematerialisierung der westlichen Wirtschaften um einen Faktor von ungefähr 16 erfordern

Weizsäcker[4] would call it, must concern itself with the creation of an ecologically sustainable economy.

We must dematerialize our western economies by an average factor of ten or more, as well as de-energize them, if they are to be sustainable.

Fig 7: Was gestern noch utopisch schien, ist heute wohlfeil: es geht auch mit zehnmal weniger Energie. Allerdings gilt dies nur für den Lebensabschnitt “Gebrauch von PCs” und sagt auch noch nichts über die lebenszyklusweite Materialintensität aus.

This emphasis on the West derives from the fact that in the industrialized North we lay claim to roughly eighty percent of the global anthropogenic material flows to create our material wealth. A more equitable distribution of access to resources would therefore require considerable reductions in the West, if we entertain the hope of merely cutting in half the global environmental burden. In the Chapter "Factor 10" we will discuss this in greater detail (Fig. 5).

It appears that such a dematerialization would also lead to a drastic reduction

in the volume of solid waste, especially if sensible closed-loop options were utilized. Furthermore, entirely new means for limiting the use of toxic substances would emerge. From a technological perspective this is no utopian goal, even if the quality of goods and services remain equivalent. We shall be offering some examples of the "eco-efficiency revolution" in the pages to come (Figs. 6 & 7).

The ecological transformation of the economy is apparently one of the most crucial political tasks for the near future, nationally as well as globally. If we hope to avoid an "ecological revolution," or even an "eco-dictatorship" we would do well to begin conceptualizing ecological structural change--with an eye to bringing it about. The sooner we begin to realign our economy within its ecological guard rails, the better. As important as employment, healthcare, fiscal policies and others are; as uncomfortable as the current recession in the OECD countries may be; once we have used up or ruined our ecological capital--the foundation of our biological existence as well as that of our children--not much will remain to redistribute, let alone enjoy. Recent history has reminded us of the fact that borders of nation-states are very transient structures from a geological or ecological perspective. For this reason alone, the decision making power of national governments requires that attention be paid to the worsening condition of the biosphere and not just to the right to unlimited use of its resources. Accessing resources that lie outside sovereign territories of nation-states should only be allowed with international agreement. This applies most importantly to the oceans and to Antarctica. A symbolically important step would be for Germany to belatedly join the *Seerechtskonvention* (Maritime Convention).

Let us not forget that presently close to four billion people in the Third World, and several more billion in the decades to come, appear to have no greater goal in mind than to emulate our ecologically catastrophic economic system. They merely wish to own the things which we hold so dear. Presently we are even granting foreign aid to increase the speed of this process, for the former East Germany as well as for many other countries. With this type of foreign aid we are financing our own ecological suicide. Something is decidedly wrong here! Reflecting on this, Wolfgang Sachs of the Wuppertal Institute has seen fit to come up with an obituary for the West[5].

The eco-politics of the future consists of system-based management of material and energy flows as well as wise investment in technologies, infrastructures, goods and services.

What is of concern here is the development of an economic policy which allows us the greatest possible space within which to develop and increase our wealth, while abiding by the limits imposed by nature. This book aims to provide some preliminary practical aids and suggestions as to how we might succeed in this. What will be said here should not be misconstrued as the final word. Rather it is intended as a contribution to the discussion of the means for building a more hopeful future. We would like to move beyond the loss of a political consensus, beyond the apparent listlessness of the political decisions and beyond the visionless wasteland of our post-socialist world.

If the remaining contradictions between the traditional goal of economic growth and the requirements for maintaining global ecological stability cannot be surmounted, the loss of political credibility will continue. It will continue to erode until the legitimacy of governments and public institutions at the local, national and international levels is gone, which will bring about changes not unlike those which are still rocking the formerly socialist world. One of the victims in this development could be the market economy, another the liberal society.

In this book we attempt to get at the root causes of environmental changes, rather than trying to trim some of the branches. We believe this root to be the material flows which we set in motion--even those which permit us to use energy. To make this plausible, to draw some preliminary conclusions and to discuss these conclusions is the concern of this book.

We will introduce the foundations for the requisite ecological measure in the *first* chapter by searching for an answer to the question, What it is that continues to make our economy so un-ecological after we put so much time and effort into improving environmental technology? Chapter *two* illuminates several aspects of today's environmental policies in light of the inevitable ecological structural change. We shall also summarize the current methodologies for evaluating the environmental risks associated with economic goods. In this context we shall also be thinking about the necessary extent of the structural change.

What such a measure for the environmental tolerance of processes, infrastructures, goods and services should look like and how it might be introduced into the economic realm will be discussed in the *third* and subsequent chapters. The *fourth* chapter focuses on the surface area demands of human activity and in the *fifth* chapter we shall be entertaining the question of how much abuse we can expect the biosphere to swallow. We shall be asking the question how and by how much will we need to change our economic behavior in order to make it sustainable.

In Chapter *six* the question of what services really are will preoccupy us. We shall make some suggestions about how shopping can become more ecologically responsible. We will also comment on the limits to adjusting prices and satisfying demands by introducing technologies that are more ecologically benign. Chapter *seven* discusses how an ecologically optimized refrigerator was created. We wish to use this example to illustrate how the design of future products can be systematically addressed. In Chapter *eight* we will concern ourselves with economic questions. We especially wish to address how ecological structural change can be set in motion. In the final, *ninth* chapter we wish to show that the transition to an ecologically compatible economy will have to be an international one.

In our attempt to meet the demands of the next century, this may be the most difficult aspect.

[1.1] Rachel Carson, The Silent Spring. Boston: 1962.
[2.2] M.J. Molina and F.S. Rowland, "The Stratospheric sink for chlorofluoromethanes, chlorine atom catalyzed destruction of ozone. " *Nature*, 249 (1974): 810-814.
[3.3] Orio Giarini and Walter Stahel, The Limits to Certainty--Facing Risks in the New Service Economy. Dordrecht, 1993.
[4.4] Ernst Ulrich von Weizsäcker, Earth Politics. London: Zed Books, 199?.

[5.5] Wolfgang Sachs, The Development Dictionary: A Guide to Knowledge as Power. ed. London: Zed Books, 1992.