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STRATEGIC QUESTIONS ON ENVIRONMENTAL-ECONOMIC ACCOUNTING

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Strategic Questions of Environmental-Economic Accounting (EEA)

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1 Environmental-Economic Accounting: an overview

1.1 Objective and approach of EEA

The United Nations Committee of Experts on Environmental-Economic Accounting according to its terms of reference has the overall objectives "(a) to mainstream environmental-economic accounting and related statistics; (b) to elevate the System of integrated Environmental and Economic Accounting (SEEA) to an international standard; and to advance the implementation of the SEEA countries"[1]. This paper aims at supporting the discussion of the Committee by way of showing the topography of basics and surroundings of EEA.

(Integrated) Environmental Economic Accounting has the following objectives: It

- extends national accounting to environmental aspects
- makes Sustainable Development measurable (relation Economy – Environment),
- combines policy relevance with the neutral/objective position of official statistics,
- ensures scientific consistency with respect to economic and ecological sciences,
- provides an adequate quality of data, in which reliability, coherence and consistency play a major role,
- applies internationally standardised methods / concepts
- follows the code of ethics of the UNSC
- guarantees free access for everyone.

[1] Minutes of the Preliminary Meeting of the United Nations Committee of Experts on Environmental-Economic Accounting, New York 29-31 August 2005, Annex I Terms of Reference of the UN Committee on Environmental-Economic Accounting.

Statistical information is a result of three processes:

- Adequation = translation of questions (from users) to a statistical working system, that is able to provide optimal information; statistics is a result of an optimisation and convention in a dialogue between users and producers; output of this process is a statistical working system.
- Production = application of the specific statistical working system; output of this process are statistical data.
- Communication = Statistical figures are (re-)translated into the sphere of the user; meta-data are added; output of this process are statistical information.

Good quality in all three processes is needed in order to achieve excellent quality of statistical information (relevance, consistency, reliability).

The following paper will focus primarily on the first process. Consequently, it is neither a pure description of scientific fundaments of “green accounting” nor a manual for the production process in statistics. Rather, it aims at the elaboration of an optimal working system that translates concepts, which have been defined in theoretical sciences, into the empirical sphere. Actually, an optimisation approach is applied, that has to take goal functions and constraints into account. The scientific frame for this paper therefore is at first a statistical one. As a matter of course, this frame has to rely on the state-of-the-art in socio-economic and natural sciences.

All actors in the field of EEA may they be in sciences, in politics or in statistics have their specific starting points and their specific views towards these questions and some of the problems occurring in the discussions in the past were due to the fact that this was not made explicit.

1.2 Historical roots

The collection of approaches and methodological concepts, which are comprised in the SEEA 2003, reflect very different starting points and theoretical considerations that have emerged over the last decades in order to enlarge, adjust or extend the core system of national accounting. It cannot be the aim of this paper to submit a comprehensive inventory of the diversity of approaches. Nevertheless it seems to be meaningful to highlight the most important ones:

- Natural / national resources: Concerns around the depletion of minerals, timber, oil, land etc. have lead to a full-fledged accounting (opening stocks +/– flows = closing stocks) of these natural capital goods.
- Pollution / emissions: A focus on flows of materials (pressures) and the interface to the responsible economic activities (driving forces) have created approaches which use input-output-techniques. Pure physical accounts (like Physical IOTs) and hybrid accounts (like NAMEA) belong to this family.

- Defensive Expenditures: Starting from a welfare perspective it has been suggested to make those expenditures as part of national accounts visible that are not needed to fulfil social needs but which are a consequence (response) to former created environmental damages.

Even if these three approaches have been elaborated from different starting positions and focus on different problems, they have in common that they all apply accounting techniques for their specific purposes. Furthermore, they can be understood as complementary even if their first inventors would deny this possibility. It is a logical consequence that, after 20 years of methodological development, the three approaches have found their places side-by-side in the SEEA 2003.

Beyond this core set of accounting approaches we can find a great variety of theoretical debates which had great influence for the debate in "Green Accounting":

- Valuation: Theoretical and empirical work on a micro-economic level has produced an immense quantity of material about extended (market) valuation of environmental goods and services. Cost-benefit-analysis as theoretical background was tried to be transferred to macro-economic accounting.
- Ecosystem theory and thermodynamics: The knowledge about the functioning of systems from the viewpoint of natural sciences can easily be matched with economic techniques of Input-Output-Analysis.
- Physical Accounting has delivered heuristic and useful models like the "Pressure-State-Response-Approach".
- Indicator development: Political requirements for quantification in terms of broad and comprehensive indicators have produced many concepts and solutions which all aim at the solution of the problem that too many data are needed and available to reflect the complexity of reality in total. This part of the discussion includes those proposals which are suggesting one specific type of highly aggregated measure and concept, like the "Ecological Footprint" or "MIPS=Material Intensity per Service Unit".
- Modelling: Different types of economic models have been widely used to elaborate scenarios for development paths which are relevant for the political debate.

The reference to these concepts in the background makes often the difference in the concrete application of an accounting tool.

1.3 Goal functions

1.3.1 Keep capital intact

This long-term objective embodies the core of the principle of sustainable development. Capital in this context comprises real, financial human and natural capital. In total it means that each generation of human mankind is responsible to deliver the same patrimony to the next generation as itself has got; each generation should have the same opportunities at its start [2].

[2] The income definition by Hicks leads to the same conclusions; it could therefore also be a starting point for the concept design.

The principle itself can merely be disputed as it corresponds with fundamental ethic considerations (H. Jonas, Principle Responsibility). To make it concrete and for accounting measurable it is however necessary to break the total global capital of a generation down to subsets with respect to time, territory, ownership and types of capital. Questions of substitutionability between capital types, responsibilities for public capital goods (i.e. the atmosphere), relations between cause and effects for cross-border/time phenomena and problems of missing information have to be solved, before measurement and accounting can start. Often these preconditions cannot be fulfilled by statisticians since they include value judgements. Nevertheless the principle “Keep Capital Intact” is the most important guide for EEA.

1.3.2 Maximize productivity of natural input

The second guiding principle aims at setting up a framework for short-term orientation of EEA. The input of natural resources is as unavoidable for every kind of production or consumption as the use of functions is that nature delivers. A contribution to an increase of entropy is however connected with every kind of human activity, that needs energy and material flows as an input. Consequently, if natural resources have to be used, a maximum of benefits should be taken out of them. Globalisation and technical development have shifted the scarcity problems: Whereas labour cannot be seen as the restricting and scarce factor input, natural resources and services become more and more limiting or even hazardous factors for future economic and social development. In contrary to that, political and economic incentives, like tax systems, still are oriented towards an increase of labour productivity. As a consequence, research and development as well as innovations predominantly aim at reducing (gross) labour costs, which results in both effects: unemployment and deterioration of nature with increasing speed. In a statistical accounting system the major flows from nature into the economy and the flows from the economy back to nature have to be observed / quantified in order to link these factor inputs with their corresponding economic outputs. Such kind of accounts can widely be used in a decision making process. Comprised indicators can be built upon them, political targets can be set and a controlling of the achievement of those targets is possible. For more specific analysis of environmental hazards detailed analysis of single material flows is needed, however.

1.3.3 Combination of the goal functions

In theory it can be argued that these two goal functions are redundant. One of the both would be sufficient. The “Keep Capital Intact” goal is adequate for the development of clear guidelines in many cases. In particular, if capital goods are clearly bound to national and time limitations or when even the ownership is not in question (like a coal mine or a forest), then accounting can give clear answers. Stock accounts and the corresponding flow accounts can check the sustainability of the utilisation of nature by human activities.

In those cases however, when flows and stocks belong to different parts of the world or different years or even centuries, another conceptual framework has to be used, that might not be able to ensure sustainability in absolute terms on the one hand, that is however a means to achieve procedural rationality on the other. The cost-effectiveness approach “Maximize Productivity of Natural Inputs” provides such a framework.

1.3.4 Sustainability as a basis for EEA

There are some elements in the philosophy of sustainable development which - even if they are still vague - could be used as guidelines for a framework of environmental accounting and sustainability indicators. These elements are:

a) Sustainability (keep capital intact!) and development (increase your income!) have to be balanced out. Neither isolated sustainability nor pure developments are successful long-term concepts.

Behind that guiding principle the following characteristics are hidden:

b) Globalisation: today's economic, social and environmental developments and problems tend to untie from national boundaries.
c) Long time scales: cause-effect-relations of environmental problems tend to extend and to untie from periodic boundaries.
d) Uncertainty: Damages from environmental deterioration can not be precisely measured but only predicted in terms of risk and probability.
e) From an economic point of view environmental damages are caused by external effects of individual production and consumption decisions, and they often affect natural elements which have the character of public goods.

The tools for diagnosis (statistics, science) and therapy (politics, science) have to be selected with respect to the size and character of the problems. Global issues must not be treated with weapons which have been developed for local or regional questions.

f) Traditionally environmental politics used command and control instruments. As insustainability problems are very complex those instruments have partly to be substituted by economic instruments (e.g. tradable permits or eco taxes).

Closely connected to sustainable development, but independent, is the call for an integrated assessment of environmental issues. The separation of environmental problems in isolated (political and scientific) boxes is seen as one of the major obstacles for further progress in that field.

g) From the cradle to the grave: outputs of residuals stem from inputs of resources. Depletion and degradation must not be seen separately. Even if the objective is to reduce pollution it is necessary to start preventive politics at the input side of the society, i.e. at the consumption of raw materials and energy. Furthermore, a systematic approach has to be followed when it comes to an inventory of nature (bio-diversity, etc.).

Sustainability is not a term which might be described as a generally accepted convention. It can rather be observed on closer examination that, although this topical keyword is used by everyone, it is used to mean very different things when it comes to the details. However, the fact that this keyword has been included in the various action programmes at both interna-

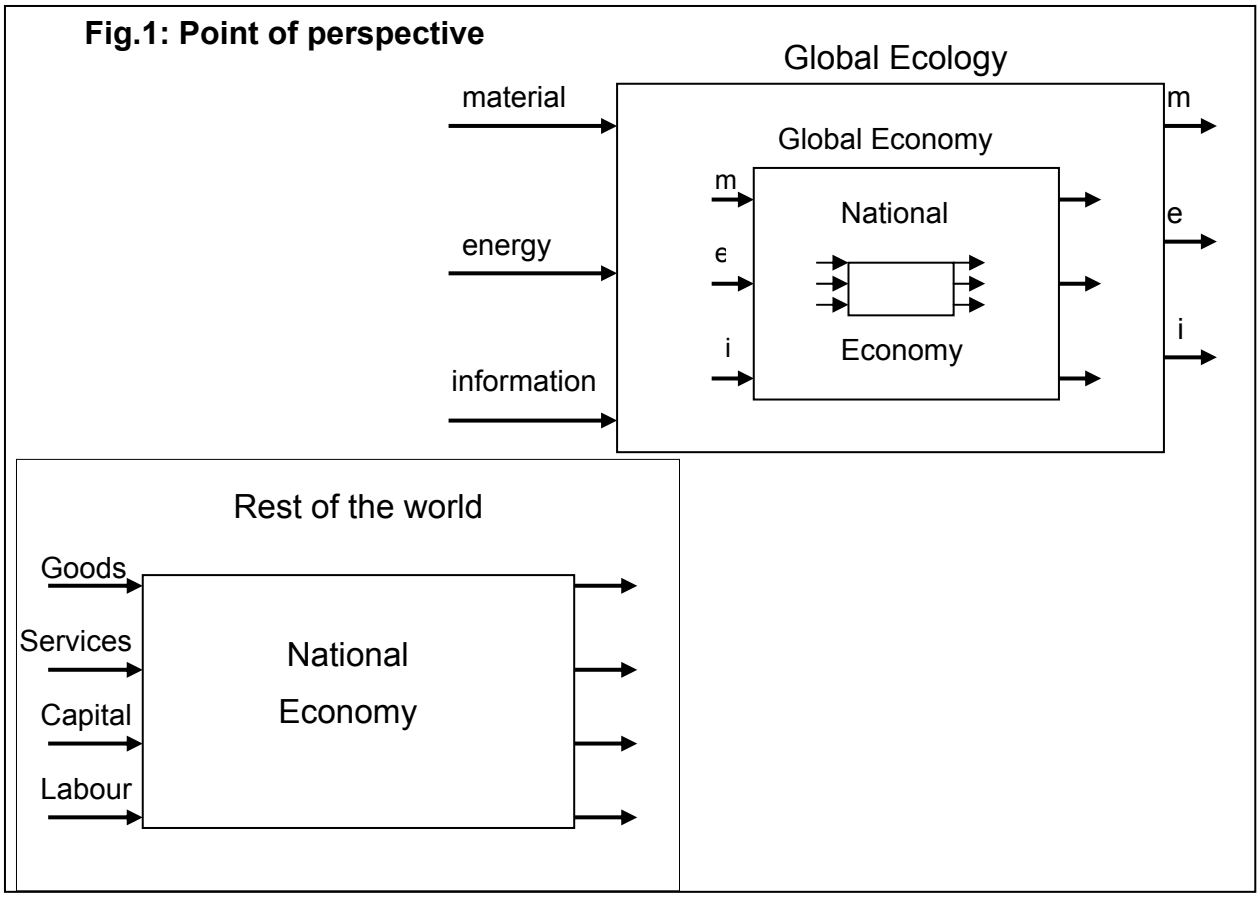
tional and national level shows that it has been managed to make the general public aware of the interconnections between development and environmental policies, between growth and consumption of natural resources, etc. It should be kept in mind that "sustainable development" is a normative political value serving as an orientation and a target whose meaning has to be discussed and defined in detail.

It is striking that in the discussion of environmental problems people in the same breath refer to examples of quite different magnitudes. Often no differentiation is made between issues that relate to a small region - which have to be settled by the polluters and persons affected who live in that region - and others where the group or region concerned is large, very large or even global. In a similar way, this is true of the lapse between cause and effect. Such magnitudes are, however, just as important for the assessment of an environmental phenomenon as for its cure.

In particular the global environmental problems, such as the greenhouse effect, the hazards of nuclear energy, or the extinction of species are spheres showing an urgent need for action from the point of view of sustainability. It is however precisely these spheres that involve great difficulties both with regard to diagnosis and to therapy[3].

Within the concept of sustainability the aspect of global interlinkages between national activities plays a major role. The Rio Conference 1992 for the first time linked two separated policy fields: environmental protection and development aid. Global environmental problems can be properly treated only on a global political scale and with an explicit internalisation of social and economic aspects in developing countries. Hence, it must be an important task for a statistical concept of EEA to represent the international trade in different categories of goods and services and the corresponding "trade" - actual or imputed by origins - in environmental burdens. A purely national focus could lead to completely wrong signals and conclusions. A highly developed country with an essential share of service industries, banks, insurances, etc. may look perfectly sustainable in a separated national eco-balance because it has succeeded in exporting the polluting production industries. The statistical trends over the last 30 years are, in fact, widely in accordance with such a pattern of "unequal" development: An increasing amount of total international trade combined with a decreasing share of imports of raw materials into the industrialised countries and a decreasing share of toxic pollutants.

[3] See Zimmermann, H.: "Ökonomische Aspekte globaler Umweltprobleme", in Zeitschrift für angewandte Umweltforschung, No. 3, 1992, p. 310 ff.



So, an important question we have to answer is from what point of perspective do we look at the problems we are facing? Is it the national economy as we do in SNA or do we step back and look at global economy or global ecology? (see fig. 1)

1.4 Constraints

1.4.1 Criteria for EEA-building

First, EEA is to provide data for economic and political decisions, not for technical checks and regulations, not for the implementation of administrative measures by environmental or planning agencies, but as instruments for assessing external effects and for developing efficient economic countermeasures. Second, environmental-economic accounting has to be seen as part of official statistics. Thus data have to be provided at the macro-economic level, ex post and with reference to accounting periods. Third, the average pressure is recorded rather than incidents, extreme situations, etc.

1.4.2 Value judgements

Though value judgements are needed, because ordinary market valuation is not available for external effects or public goods, there are two arguments against valuation as part of EEA:

- Theory: Valuation of non-market goods or external effects might be meaningful as long as separated studies are concerned. The adjustment of national economic performance measures by means of a depreciation is however not meaningful.
- Quality: EEA belongs to the work programme of official statistics, which are based on measurements or scientific models. Value judgements must not be a (internal) part of statistical information.

The only way to deal with this problem is, to use external value judgements as a reference (for details see chapter 9).

1.4.3 Complexity, feed-back effects, missing knowledge

The theoretical framework has to take into account that external effects from the economy that tackle natural reserves or functions of natural elements normally are far away from being observable. The causes and effects in a driving forces-pressures–state of the environment–response chain can only partly been quantified. Even the potential risk of all substances / materials that are transported, used and emitted is not sufficiently known. The permanent and detailed monitoring of every parcel of land or ocean will remain an illusion for at least a long while. Hence, EEA must not claim to provide information which is in any sense the only correct plus comprehensive one. Instead, it should – based on the conceptual framework – provide adequate knowledge for the decision making processes combined with a clearly described quality (metadata). A complex situation under uncertainty might for example ask for alternative pictures from the same real object (like maps of different scales from the same landscape).

2 System boundaries

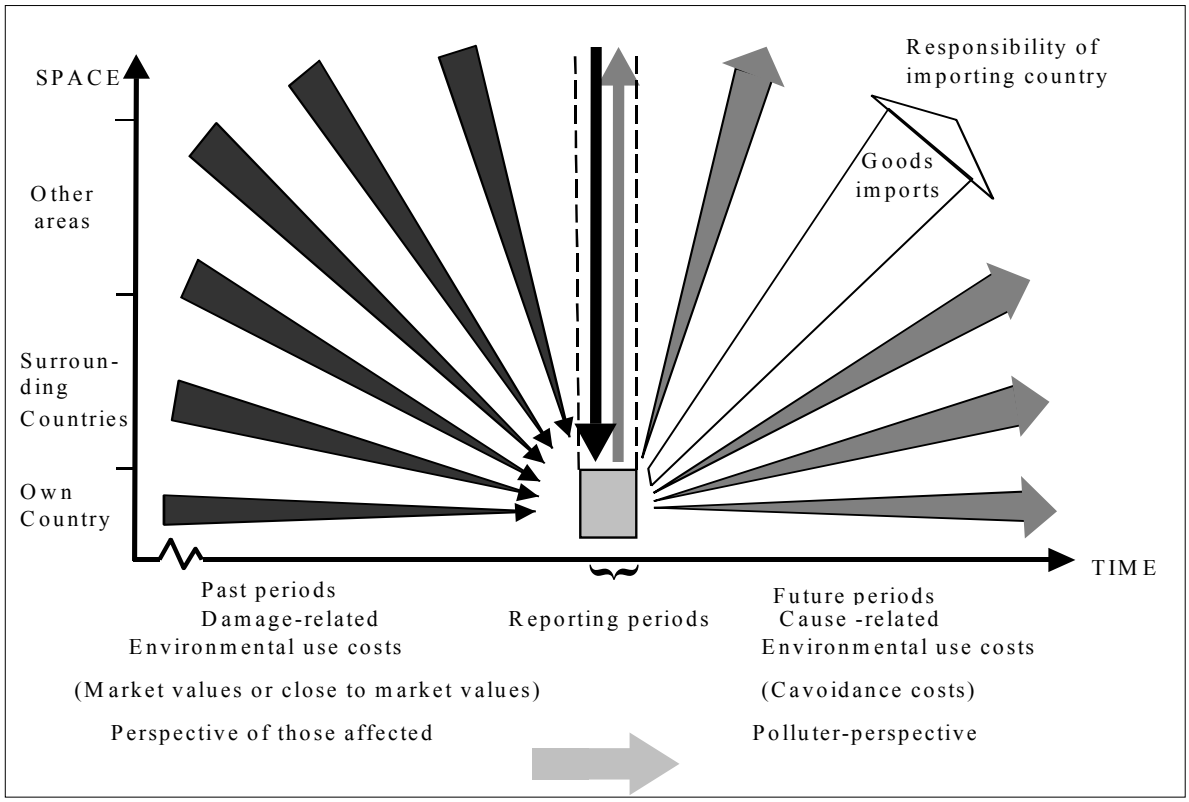
The relations between causes and effects may not only be characterized by (partly) great distances of space but also by distances of time. SEEA has worded it as follows: “It has been noted above that the agent producing degradation is often not the agent who suffers the damage and equally the agent who incurs costs to mitigate degradation is often not the agent who benefits. Further, the time period in which degradation takes place may not be the same as the period when the damage takes place and the country where the degradation takes place may not be the one where the damage is experienced.” (see SEEA 2003, no. 9.119) So, the implicit assumption that degradation in this period leads to damage in this period and that damage in this period comes from degradation in this period usually is not valid. Pollutants cumulate in environmental media and may cause damage long after they were discharged from the economy. (see SEEA 2003, No.9.120)

Again, there are different viewpoints or perspectives with different consequences for interpretation and calculation of EEA aggregates (fig. 2). In the first variant, the changes in natural assets caused by economic use in a given country and during the reporting period are valued

from the viewpoint of those affected and allocated there as additional costs. The second variant considers what the level and structure of economic activities would have had to be during the reporting period to ensure that there would be no negative effects on the environment. (see Advisory Committee 2002, p. 30 ff.)

The different ways of looking at these problems leads to different ways of looking at the issue of valuation. But before looking at this very much discussed issue we should have a look at the selection of relevant theories as starting points for EEA methodology.

Fig. 2: Concepts for the valuation of environmental use



(Advisory Committee 2002, p. 32)

3 The micro-macro gap

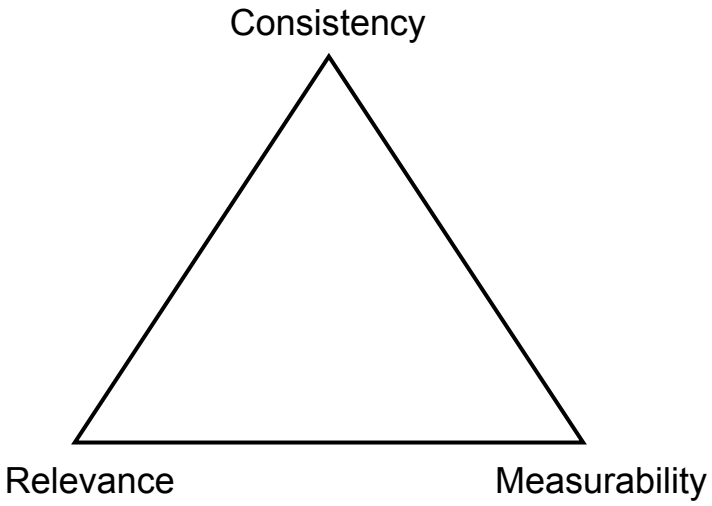
The behaviour of complex systems like nature and society cannot be completely predicted. In the contrary: feedbacks and nonlinearities may lead the development of such systems through abrupt changes or through partly stable situations towards surprising new positions. Hence, it would be not realistic to expect from scientific models or statistical figures that they are able to mirror the structure and development of those systems perfectly. This is a matter of principle and not only because of a marginal lack of capacities, etc.

Difficult and complex matters may arise from the simplest basic elements. The macro-level thus cannot automatically be presented by combining the micro-elements, which is clearly illustrated by the phenomena of intelligence. For many processes, such as weather, this is particularly important as no deterministic forecast can be made at the micro-level, while at the macro-level it is definitely possible to determine scopes for solutions, stable conditions and the like. In economics, this conflict between micro-level and macro-level has traditionally been one of the causes for scientific and political dispute.

4 Quality of statistical information

The determination of goals of developing an environmental-economic reporting system - as with other information systems - is depending on the function we expect it to have. In principle we can not avoid to find a compromise between the three objectives of statistical information which are: theoretical consistency, policy relevance, and measurability (see fig.3).

Fig. 3: Strategic position/direction in the following triangle:



Information plays a major role in the development of complex systems. It influences the direction of the development and it acts as an interface between the various layers and groups within the system. Information about environmental damages leads to new political debates, to new rules or to a new system of taxes, price regulations, etc., and finally to changes in economic decisions. In so far information is a precondition for any type of politics. However, it must not be neglected that information itself depends on the status of the system. Or, simply speaking: the production of information needs money which has to be spent by the society.

Data quality consists of some components which are all relevant for the question (see e.g. Code of Practice of the European Statistical System): Does the figure measure what it is expected to measure? First of all the equivalence of theoretical terms (e.g. income in economic theory) and statistical definitions (income in a specific survey) is most important. In addition to that correspondence in principle there are, however, some factors which determine the suitability of statistical figures: Are the data up-to-date? Does the classification provide enough detail? Are the results reliable?

It is essential to understand that statistical figures - like other economic goods - can be produced and delivered in very different quality and with very different costs. Hence, it is a task for negotiations between data producer and data user to find out an "optimal" quality: The quality of a working system can only be enlarged if the necessary budget is available. This point is in so far of higher importance, as it stresses the fact that a conceptual framework has to reflect also the actual financial capability, administrative restrictions, etc. In a realistic description of today's situation one must suppose that the budget is too short to fulfil all requirements of all users. Hence one has to decide where to save money. A trade-off between different components of validity is unavoidable. A conceptual framework that can be useful in practice has to reflect not just theoretical criteria of coherence but also actual financial capability, administrative restrictions of implementation etc. It would be without practical and political value to elaborate a theoretically sophisticated concept which cannot possibly be fulfilled with real data. Limited budgets for environmental accounting represent society's small collective willingness to pay. It is evident that, under these conditions, the first concepts and figures produced must be far away from being perfect. But again, it seems to be important to understand this as a starting point within a dynamic political process. Creating awareness for the general potential of green accounting and sustainability indicators can aim at improving the budget which again allows providing better quality, and so on.

5 Communication of EEA: The role in decision making

Sustainable development can only be defined and achieved by a complicated restructuring process of the society including the fact that the final results of that process cannot be anticipated by (scientific) assumptions and (statistical) surveys or estimates. On the one hand a statistical accounting concept needs setting from political decision processes. On the other hand decision processes need appropriate information.

Starting from that conclusion, the question arises what the relation between empirical science ("laboratory") and actual decision-making processes ("bazaar") is like. Assessing the global environmental problems, which are referred to under the vision of "sustainability", cannot be a purely technical-scientific matter. Highly aggregated indicators of sustainability can-

not be set up and measured by experts alone. It is generally required that the society takes a decision, so that the knowledge gaps can be bridged. Therefore, the proposal (based on welfare-economic reasoning) that such decisions regarding “social preferences” should again be determined synthetically by means of a scientific method, that is by covering and aggregating the “individual preferences” (e.g. through analyses of the willingness to pay) will fail. When considering the fact that social decision-making is multi-layered and complex, it is obvious that this approach is not suitable for the task to be performed here (assessment and integration of global environmental resources in economic balances). For example, defining a reduction target for climatologically relevant gases, which has to take account also of the interests of future generations and international aspects, cannot be achieved through market and opinion analysis (although its result is certainly important for the process of defining targets). Also, applying such a microeconomic approach to macroeconomic issues disregards, for instance, the fact that prices of market goods would also react to a large-scale internalisation.

Solving environmental problems means first of all dealing with incomplete and uncertain information on the consequences of economic action and on future developments. Quite a lot can be done to reduce the scope of decision-making. However, a considerable number of more or less suitable solutions will finally remain, out of which the one must be selected that can be borne most easily by society and that minimizes human intervention.

If it is not a single figure like “Green GDP” that will result from EEA and if all similar proposals for one-dimensional indicators have failed and will fail because of fundamental obstacles, a multidimensional approach has to be the approach of choice. As a matter of principle (and fact) it must be noticed, that EEA will end up in a set of indicators. Having accepted that, one has to deal with the consequences of that statement: Which role do these indicators play in the corresponding decision making processes? How can we ensure that the message is transported properly (metadata)? Which media are appropriate to provide a broad access to the indicators?

6 Monetary vs. physical accounting

The traditional controversy about whether monetary or physical indicators are better suited is futile. Both types will be needed anyway. Most of the information required for analyses and decision-making will be offered and used in various physical dimensions. All possibilities of aggregation should already be used here. In addition, and based on the above, it would however be considered useful to have a set of monetary indicators. In any case, it must definitely be assumed that "one figure" – such as the gross domestic product (GDP) – is not

suitable to integrate all the different data needs from the complex decision-making processes.

A secondary question arising here is whether a changing philosophy should entail changing terms. This applies in particular to the "green domestic product". This term involves the expectation that it would be necessary and, at the same time, feasible to replace the “old” and biased GDP by a new and corrected one that would be calculated by the nation’s bookkeepers, i.e. the statisticians (see Nordhaus & Tobin 1972; United Nations 1993; Van Dieren 1995) – an idea which represented the very charm of that approach. However, such expectations cannot at all be fulfilled. Therefore, it seems to be necessary to use also new terms (plural form!) which can better represent the actual results.

An interdisciplinary approach is an indispensable requirement for dealing with the issue in a manner that is adequate to the problem and for achieving acceptance of the results. Although that requirement seems to be a matter of course, it is seldom met in practical work because it is too much in conflict with the various disciplines’ (understandable) striving for methodical consistency. However, it is inconceivable that nature can be integrated into economic balances without taking account of methodical elements of monitoring and covering natural processes and situations.

As it should be possible to take due account of current and serious problems such as the reduction of biodiversity or climatic changes, it is therefore necessary to use another pluralistic concept, even though it is not “monolithic” like, e.g. an accounting system. To avoid the other extreme situation, that is an arbitrary collection of individual data that can no longer be interpreted, it is highly important that common reference values are defined, that the same systematic limits are used for the monitoring system, etc.

In German EEA, this is reflected by the fact that the system includes issues whose function corresponds to national accounting (e.g. stocktaking of assets), but whose method has been adjusted to the issue concerned (e.g. indicators, geo-information systems).

7 Holistic vs. reductionistic approaches

A decomposition of factors behind the creation of pressures to the environment provides the following simple formula:

Pressure = Population x Activity/Capita x Intensity/Activity x Pressure/Intensity

For example are the pressure / pollution linked to the traffic in a country depending not only on the technical performance of the car fleet, but also on the particular consumption habits (utilisation of cars, bicycles etc.), on the welfare /consumption level and the population in total.

Political strategies can tackle the problem of pollution from different angles, accordingly. One might follow a strategy of technical improvements, which concentrates on the last factor. One might try to change habits of consumers or producers, in order to gain a decoupling of welfare and corresponding negative external effects. In combination these two strategies would be optimistic in a sense that they try to avoid rebound effects from environmental policy to economic and social development goals.

The data requirements for a policy of technical improvements partly are extremely high. Specific knowledge about flows of single materials has to be linked with complex and costly information about their particular hazards. Even if it is doubtless, on the one hand, that in theory and under an assumption of perfect information it would be necessary to work on that very detailed (reductionistic) level also in accounting, this approach is not successful in practice. On the other hand, the application of accounting on a more aggregated (holistic) level has shortcomings in its significance for detailed pollutants. Nevertheless, it is a meaningful tool for the analysis of decoupling strategies and for the statistical balance of results of environmental policy on a highly aggregated level.

In that sense, the discussion around the appropriate level of material flow accounting (total material vs. single material flows) can and should be stopped. Neither the one nor the other approach can fulfil the data requirements of the users. They should be interpreted as complementary.

8 Satellite accounts vs. core system of SNA

The SEEA concept assumes that the presentation of the economic and ecological interactions should not be included in the traditional structure of national accounts, and instead institutes a supplementary data system, a so-called satellite system, to the national accounts. Naturally, a core system and its satellite system must be closely linked through common definitions, systems and period references, thereby allowing macroeconomic analysis of environmental problems. (see Advisory Committee, p. 30)

“The aim of Environmental-Economic Accounting is to show the diverse relationships between economic activities and the environment – such as use of the performance by natural assets for the production process and the effects of economic activities on natural capital.

The economic system uses the primary inputs provided by the environment, such as raw materials, land and environmental services (in the form of sink, buffer and recreational functions). At the same time, the economic activities place undesired pressures on the environment. Non-renewable resources are removed, with the result that they are no longer available to future generations. At the same time, residuals and pollutants, particularly in the form of waste, waste water, or air emissions, are discharged into natural capital. Those material discharge and additional structural interventions (for example due to land use) can destroy or degrade the environment.

The economy itself is comprehensively described by national accounts or by the above-mentioned System of National Accounts (SNA) of the United Nations. The SNA is used throughout the world as a general standard for comprehensive, consistent representation of the economic process. Therefore, it is an obvious point of departure for a more far-reaching system whose objective is to describe the interactions between natural capital and the economy.

The SNA provides a definition of the economic system and an unambiguous specification of the system limits that is based on the definition of production used there. However, as the SNA is primarily oriented to market transactions, the relationship between the economy and the environment, which generally does not have a monetary equivalent, is for the most part omitted. Therefore, the SNA had to be expanded to include an environmental-economic accounting system that will record, measure, and – wherever possible – value in monetary terms the environmentally relevant flows and stocks that have previously not been taken into account.

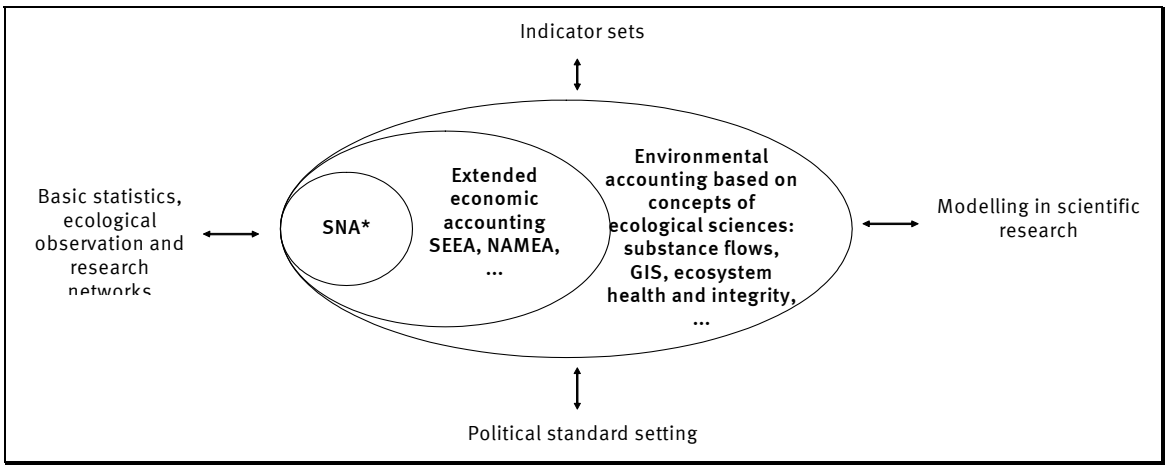
Based on international discussions about an environment-based expansion of national accounts, the traditional national product accounts have been retained as an important source of information for short and medium-term economic observations. An additional independent reporting system in the form of a so-called satellite system must be created to show economic–ecological interactions.

A satellite system follows the concepts (for example the definitions, delineations, valuation principles and sectoral divisions), classifications (for example, economic sectors and goods and transaction groupings), and rules and posting requirements of the standard system, deviating from it only in isolated cases to show relationships that are important for the expanded presentation. The main cornerstones of the satellite system include accounting for the activities of economic sectors on an accrual basis, a distinction between flow and stock accounts and the primarily macroeconomic orientation of data recording and analysis. The

systematic connection of the Environmental-Economic Accounting satellite system to the still-unchanged standard national accounts system guarantees that the data of both subsystems can be consistently interlinked.

There are many reasons in favour of using a satellite system. Complete integration of the environment into the standard SNA systems would involve comprehensive changes to that system, such as changing the definition of the gross or net domestic product. However, that would have considerable disadvantages given the divergent objectives and viewpoints of the two approaches and the clear differences in the data quality that can be achieved. The statistical nature of the corresponding variables is in some cases very different. The standard system is substantially limited to the depiction of market processes, so it is based on monetary data that relate to those market processes. Therefore, much greater accuracy can generally be achieved than is the case when presenting environmental-economic processes, which due to patchy or even missing data often can only be presented using model calculations. However, the current high quality of data in the standard system is indispensable for many analyses in the area of short or medium-term economic reporting, for example for monetary policy or labour market policy. In contrast, environmental-economic analyses are oriented toward a longer-term horizon. Further objections to complete integration also result from concepts discussed in the environmental sector which seek to include the environment in the SNA not only from the viewpoint of production or income objectives, but also with regard to aspects related to social welfare." (Advisory Committee, p. 36/37)

Fig. 4: Scope and context of environmental accounting



(Radermacher 1997, p. 6)

9 Valuation approaches

Do environmental services have a measurable price? An answer to this question seems to be the crucial point in the ongoing discussion. Obviously the conflicting positions concerning this question are based on different scientific backgrounds and approaches: In a neo-classical economic interpretation the (shadow-) price of an environmental function has to be a result of a calculation which takes into account merely the supply and demand (or cost and benefit curves), which are aggregated from individual preferences. Furthermore the neo-classical approach assumes implicitly that an aggregation of individual preferences can comprehensively and correctly reflect (or at least approximate) the "preferences" of the entire society. This assumption is, however, very doubtful (see Brouwer/O'Connor/Radermacher 1996). The opposite position stresses the problems of complexity / uncertainty, the difficulties of measurement. In the sense of Max Weber it emphasises that social research not only has to be theoretically coherent but also empirically adequate. Consequently, this approach underlines the necessity to concentrate on empirical solutions to find measurable indicators and to provide adequate interpretations for the application in real decision processes.

How can sustainability be integrated into economic science and practice? The current scientific discussion about this subject is very lively and has produced numerous publications[4]. Simplifying matters, one might say that there are two opposed viewpoints: "Environmental Economy" attempts to integrate the environment as a particular type of asset or commodity into the neo-classical model. On the other hand, "Ecological Economy" considers the economic system as part of the global ecological system.

For economic experts, the main focus is on the first viewpoint: Models that are well-founded in terms of micro-economics are the mainstream of theories, and neo-liberal advice is prevailing in economic policies. The fact that societies consist of more than just the market and individual purchaser preferences, and that their evolution is the result of highly complex and multi-layered processes which one has to understand in order to be able to appropriately analyse the problems, sometimes does not seem to be in the focus of economic research activities. What is more, there are very few approaches including the social context, and they even suffer from an image of being hostile to theory. In interdisciplinary co-operation, it is necessary to (at least partially) abandon the self-containedness and purity of theories. Such a way of working and thinking is required when focusing more on real processes that can empirically be covered and when taking account of actual decision-making structures and

[4] See e.g. Beckenbach, F. (Ed.): "Die ökologische Herausforderung für die ökonomische Theorie", Marburg 1991; Hampicke, U.: "Ökologische Ökonomie", Opladen 1992.

their information demand. The price to be paid for this is that the general concept of theory must change and that some axioms are called into question.

Against this background, it does not surprise that the most difficult and most controversial issue is the valuation of environmental goods and services: First of all, the quantity and price of assets are not entirely independent of each other so that separate valuation would not really be correct. But what is even more critical in the case of natural assets is that there is no consensus on the method of valuation to be applied. This is particularly evident for damages whose occurrence and extent are uncertain and which affects humans, animals or plants. One may have just as long arguments about the value of a human life as about the right value to be forecast for a maximum credible nuclear accident or on the interest rate to be applied for discounting the valuated future damage.

Value judgements are needed, because ordinary market valuation is not available for external effects or public goods. There are two arguments against valuation as part of EEA:

- Theory: Valuation of non-market goods or external effects might be meaningful as long as separated studies are concerned. The adjustment of national economic performance measures by means of a depreciation is however not meaningful.
- Quality: EEA belongs to the work programme of official statistics, which are based on measurements or scientific models. Value judgements must not be an (internal) part of statistical information.

The only way to deal with this problem is, to use external value judgements as a reference. For example, in €-Europe the public deficit must not exceed 3%. Statistics can show the relation to this political target value without being under the risk to get involved in political valuation. With respect to EEA there are potential target values for the capital approach as for the productivity approach. The first type would be oriented at the state of environment (i.e. maximum increase of average global temperature p.a.), the second would concentrate on pressures from the economy (i.e. maximum CO_2 emissions p.a. and country).

Proposals made by (neo-classical) economists for the assessment of environmental aspects are based on model solutions developed in a purely theoretical manner and excel by their methodical consistency and formal elegance. Apart from theoretical inconsistencies discovered during the project, their main shortcoming however is that in many cases empirical implementation is not possible. What is generally done to solve this problem is to have the theoretical model and a pragmatic second best solution, which is declared as an approximation. For example, the pragmatic abatement cost approach by Hueting et. al. (1991) is considered an approximation to a market with supply of, and demand for environmental goods. Closer examination showed the problems of such an approach: The interpretation of the re-

sults is overburdened with theoretical assumptions, and the indicators are attached with a degree of importance they just do not have.

What can be concluded for the valuation project is that, from the start, an approach should be developed that is well balanced in terms of theory and empiricism. In other words: A theory that cannot be measured is just as worthless as a statistics whose relevance and interpretation lacks theoretical foundation. The compromise must be “programme” and cannot be just a "second best solution".

10 Greening of GDP vs. modelling approach

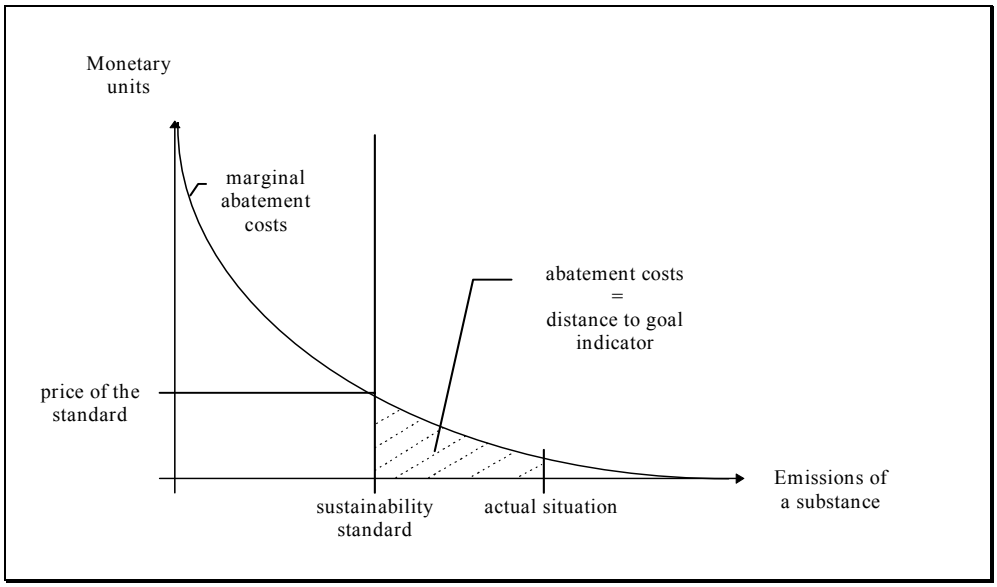
After having elaborated the role of information within the decision processes of societies it seems to be evident that the question, how to put values on natural goods and services, has to be solved accordingly. At the beginning stands the generally accepted understanding that environmental functions are scarce. However, though scarcity of environmental functions definitely exists it can not be quantified in a direct manner, because there is normally no market where, for example, climate and biodiversity units (or the respective services they provide for the economy) are traded. Consequently, if ecological elements can not be traded directly corresponding economic goods have to be constructed which are able to represent them as good as possible. Keeping natural capital intact is the fundamental objective of sustainability. Within the world of economic accounting the Hicks’ income concept represents the same axiom (constancy of capital). The meaning of constancy has to be specified in form of quality goals. These goals have to define what is interpreted as "constant" concerning the complex dynamics of ecological systems. Obviously, this is primarily a task for natural sciences and political decision processes. Given that such quality goals have been set (on a local, national and partly on a global level), the next question is what they mean for the activities in a specific country and period of time. An answer to this question can only be given by negotiations about the distribution of "rights to pollute" between the different countries. The results of those negotiations then can be called "sustainability standards". They define targets in terms of emissions and are oriented towards the economic activities and the origin of environmental burden. Sustainability standards correspond to "rights to pollute" in a specific country and period of time. Under the precondition that economic measures are selected for the realisation of those standards, they define economic goods and economically measurable scarcities. Hence, there are two problems to be solved before an economic evaluation can take place:

- the identification of anthropogenous impacts within the complexity of ecological dynamics, definition of quality goals (stock oriented!), and
- the synchronisation of spatial and temporal scales, definition of sustainability standards (flow oriented!).

This is the first chapter of the story. Obviously it has not been written in the philosophy of neo-classical economics and optimal growth theory. Whether neo-classical models can provide some support for this debate can, however, be doubted (see Daly 1992).

Sustainability standards (rights to pollute) define scarcities in an absolute sense. The price of those rights could (in principle) be detected on real markets by the emission of tradable permits. In theory the price can be deducted from a micro-economic model (fig. 5). It has to be pointed out that in this model the sustainability standard can be interpreted as a kind of supply function (the supply of rights to pollute), whereas the marginal cost curve corresponds to the aggregated micro-economic costs of the demand side. Under the assumption that the standard can be achieved by improvements of technologies this model represents the short term equilibrium on separated markets of emission standards. Abatement costs can then be interpreted as indicators for the distances to goals. In a retrospective calculation they represent monetary equivalents for negative external effects caused by economic activities of the period and country under consideration. These indicators are a first iteration towards a corrected national income figure.

Fig. 5: Micro-economic abatement costs



(Radermacher 1997, p. 8)

An "Eco Domestic Product" (EDP) could, in principle, be calculated by a simple subtraction-procedure of all these indicators (= adjustment of the calculation of national aggregates). Because of a lack of finances and relevant data sources, such a calculation can in no way be comprehensive. Furthermore, the meaning of such a calculation is very arbitrary and vague. It can therefore not be recommended as an "official" statistical figure.

It is evident that the micro-economic approach is not sufficient for an adjustment of national income figures, if considerable indirect economic effects have to be taken into account. The adequate conceptual approach seems to be a simulation of an economy which has (hypothetically) integrated the additional set of products (rights to pollute), defined by the sustainability standards. Such a modelling approach should start from the short term prices of standards and tackle the problem of structural changes. Again the problem of scale (spatial and temporal) plays a major role for the design of adequate models (see Meyer/Ewerhart 1998). The result of this modelling approach could be an EDP which is defined as the Gross Domestic Product (GDP) for a hypothetical sustainable economy (= calculation of national aggregates for adjusted economies).

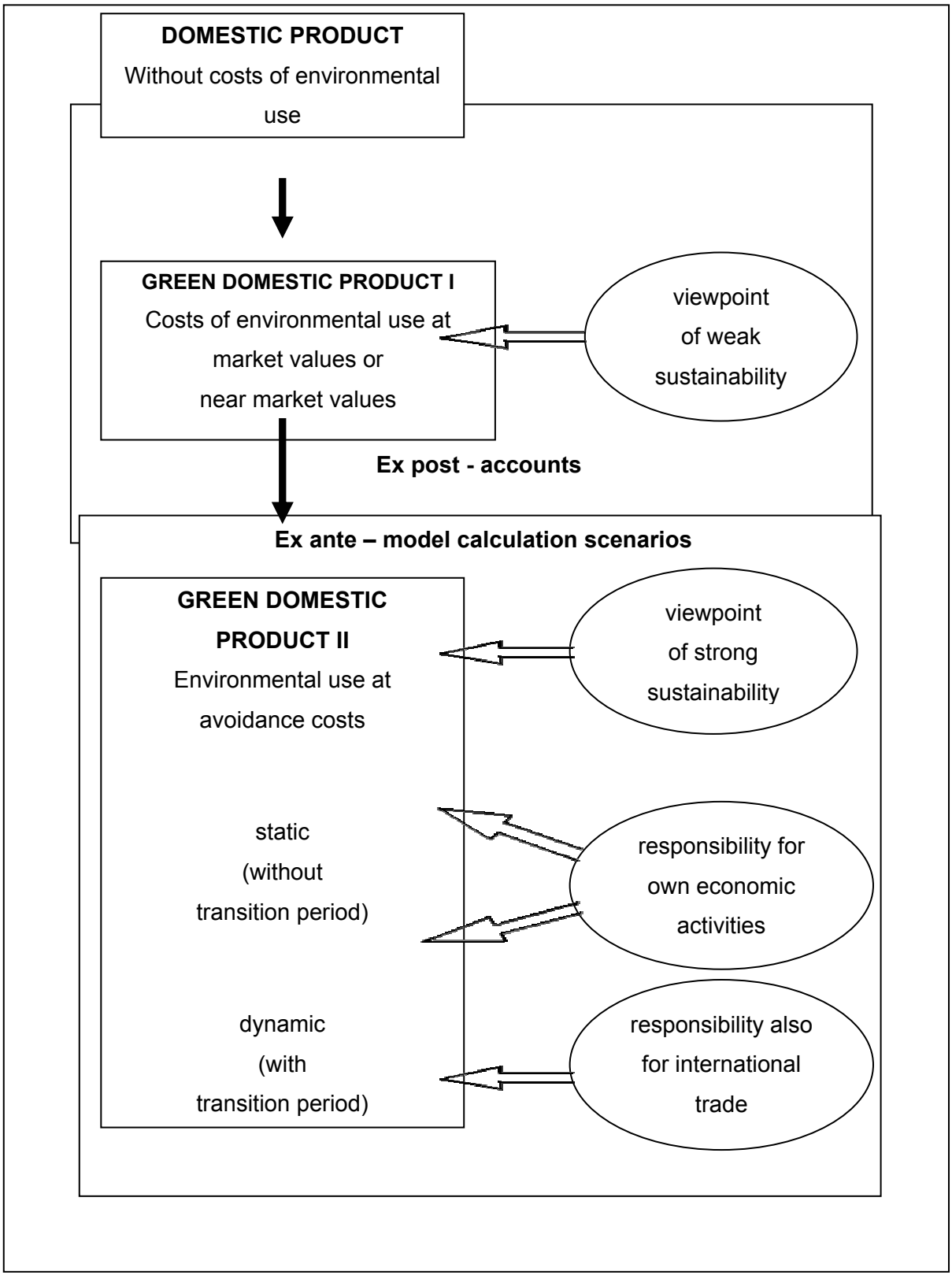
Accordingly, figure 6 (see below) shows the transition from traditional integrated accounting methods to model calculations that is necessary when economic actors abandon the viewpoint of an affected party and want to assume full responsibility for their individual activities as driving forces. The green GDP then shows the model-based economic level that would be possible within a sustainable economic system. The economic activities can also be made environmentally compatible through two very different forms of response:

- Actors can limit themselves to reducing their economic activities, for example by shutting down production of environmentally harmful products or renouncing consumption that poses a threat to the environment. This form of behaviour is described as the sufficiency solution.
- Actors can also use environmentally compatible production processes and environmentally friendly products instead of environmentally harmful products. Although economic performance remains the same, environmental pollution will decline. Such activity results in increased eco-efficiency.

A combination of sufficiency and efficiency solutions will have to be used in practice to achieve an environmentally neutral economic system. The motto can then only be: “As efficient as possible, as sufficient as necessary.”

If the economy is to be environmentally compatible, plans will certainly have to include a transitional period that will need to be measured in decades rather than years for cases involving the largest quantities. A fundamental transformation can hardly be expected from the introduction of improved production processes and changes in consumer behaviour for the most important cases in terms of quantity and quality. A sudden transition to environmental compatibility can be achieved only by drastically reducing production and consumption. However, that one-sided sufficiency solution would have so many other societal disadvantages that only the ecological dimension of sustainability would be taken into account, while the economic and social dimensions of a sustainable society would be completely neglected.

Fig. 6: Standards of economic performance



(Advisory Committee 2002, p. 35)

Calculating a sustainable economic level is subject to the additional difficulty that it is not sufficient to develop alternatives to the current economic situation (comparative-static view) and that dynamic development paths toward a sustainable economic system must be pinpointed. The green GDP would then be the future, environmentally friendly economic level that would exist only after a longer transitional period. (see Advisory Committee 2002, p. 34)

If development in the direction of a sustainable economic system is to be modelled, the question of the political instruments to be used also arises. There is a great deal in favour of making the production factor of natural capital more expensive, which will gradually reduce the above-mentioned subsidies. A different path to development will be taken as a function of the political measures that are selected. That results in an additional difficulty for calculating the green GDP: neither statisticians nor model designers can determine the list of objectives and select an appropriate set of political tools. That requires an intensive political discussion on development of related objectives. (see Advisory Committee 2002, p. 34/36)

The calculation of depreciation for natural capital involves numerous methodological problems (problems of valuation/ aggregation, limited knowledge of cause-effect relations, significant regional differences). For this reason, one must not expect too much of such a calculation. It would certainly be wishful thinking to believe that such a calculation could provide one single objective and indisputable depreciation value in monetary terms from which a sound, sustainable growth of the national income could in turn be derived. It seems to be more realistic to calculate pathways for a sustainable economy with the help of dynamic multi-sectoral models. Such modelling calculations in Germany are conducted by independent research institutes (not by Federal Statistical Office). For these multi-sectoral models EEA may provide a wide rang of basic data.

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