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METHODOLOGICAL PROBLEMS IN THE CALCULATION OF ENVIRONMENTALLY ADJUSTED INCOME FIGURES (GREEN STAMP)

SUMMARY FINAL REPORT

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I. OBJECTIVES

The purpose of this research project was to develop recommendations for useful ways in which National Accounting Systems can be adapted and exploited to construct indicators of macro-economic performance *vis-à-vis* the environment. The main task was to appraise options for the definition and estimation of environmentally adjusted national income figures (henceforth 'green GDP', for short). This has to be viewed against the backdrop of a wider concern that national accounting systems be developed as sources of information for evaluating policy and investment alternatives in the pursuit of economic, social and environmental sustainability goals.

The project was set out initially to resolve a set of methodological and practical problems with identifying and quantifying 'environmental costs,' consisting of environmentally defensive expenditures and avoidance costs. The expectation was that, once having established how to calculate these expenditures and costs, they could be estimated for any real economy on a sector-by-sector basis. Then, when these costs were subtracted from traditionally measured national income (GDP), the resulting environmentally adjusted national income figure would provide policy makers with a better compass for macroeconomic performance evaluation.

In the course of the project, these identification and quantification problems were recognised to form just one part of a much more complex issue. Investigating the range of existing proposals for adjusting gross domestic product (GDP) brought to light the remarkable range of propositions about what makes GDP a useful policy indicator and what the role could be of an environmentally adjusted GDP figure in policy decision-making processes. The project at this stage became a process of reflection and clarification around existing work, as well as the development of some original ideas and applications.

Within the project, rigorous statistical procedures were developed and tested empirically for the construction of abatement cost functions for emissions of various nitrogen compounds in a national economy. The experiences gained in the calculation of avoidance costs for these specific pollutants made it clear that calculations based on sector-by-sector statistical information are not, on their own, an adequate basis to come to a meaningful adjustment of a macro-economic aggregate like GDP to obtain a sustainability indicator. This led to reconsider what figures for avoidance costs actually represent within an adjusted GDP figure. As a result, the role proposed for the calculation of costs to respect environmental norms, as a component in estimation of an environmentally-adjusted national income figure, changed considerably between the beginning and the end of the project.

Most proposals for adjusting GDP, including the ones coming initially from project participants, seek to turn a short term indicator derived from a periodic accounting system of the economy in the past (namely GDP), into a long term indicator of economic and environmental success. This transformation is achieved, in theory, by putting prices on the intertemporal scarcity of environmental assets (natural resources, ecosystem services, etc.). The calculation of a 'green GDP', sometimes also supposed to be a 'sustainable national income' figure, by making deductions from current period GDP, is the main example of this.

After making an appraisal of the difficulties, both theoretical and practical, in making inventories of environmental services and their possible depreciation and in estimating a set of shadow prices that might be proposed to induce market actors to behave in a sustainable way, the project abandoned this deduction-based approach. The project's perspective shifted from delivering estimates based on welfare-theoretic "optimising" criteria, to estimation procedures based on cost-effectiveness relative to "satisfycing" criteria.

A satisfycing approach seeks a "good" result while acknowledging that uncertainties, complexities and the variety of principles for judgement make it impossible to decide what is 'the best'. Cost-effectiveness analysis in environmental policy seeks to estimate a "least cost" way of achieving specified environmental goals. For this project, the objective became to develop procedures for the definition and empirical estimation of a highest-possible national income consistent with respect of a specified set of goals representing long-term maintenance of key environmental services. The team considered this satisfycing approach to constitute "best practice" for providing macro-economic policy-relevant information concerning efficient and equitable use of the environment.

The project's objective thus became more complex than initially envisaged. It is, of course, still proposed that the environmentally adjusted national accounting system should support traditional accounting uses such as defining the money value of national output, sectoral statistics, employment, and so on. But in relation to environmental and economic sustainability concerns, the project did not propose the simple calculation of a

green GDP. Rather than using environmentally adjusted national accounts as merely a descriptive instrument permitting calculation of a 'corrected' macroeconomic indicator, the team suggested that it should be developed as a policy support data bank for a variety of analyses and modelling purposes aimed at clarifying prospects of ecological-economic sustainability.

II. METHODOLOGY

There are many perspectives on the questions of green GDP and indicators for sustainability. This section provides a short recapitulation of the approaches adopted in the project, and the reasons why the team considered them best practice.

Economic theory, environmental science & statistical practice

The call for sustainable development at all scales (North-South, European Union, national and sub-national levels) signals the emergence of a set of policy preoccupations quite distinct from the post-World War Two fiscal management and macroeconomic performance preoccupations that were the backdrop for the original systems of national accounts. The new requirement is for use of national accounts statistics to explore long-term environmental prospects as well as economic performance prospects. This new application of national statistics is emerging within political contexts where conflicts emerge and must be resolved between competing economic and environmental interests, between people holding different value systems and different principles of judgement, and also between different representations of future states and visions of the world.

The approach to calculation of environmentally adjusted national income figures that was adopted in this project responded to four broad sets of considerations in an integrated manner:

scientific adequacy: do the description and evaluation methods deal well with the important features of the natural world and of the ecological, technological and social change processes in question?
social adequacy: do the methods furnish information in ways that respond to stake-holders' needs and that support social processes of decision-making?
economic rationality: do the suggested choices or courses of action that emerge from the valuation, statistical analysis and modelling procedures respect economic efficiency, in the sense of appearing to be reasonably cost-effective ways for moving in the desired directions or for arriving at the envisaged outcomes?
statistical adequation: can the methods and measurements proposed be implemented in conformity with established quality standards in statistical work, within the budgets available for this work?

No one of these four criteria, on its own, is enough to judge the adequacy of an approach for the development of macro-economic indicators for sustainability. The work has consisted of a process of "tuning" theory, statistical concepts, actual measurement and the corresponding interpretation and use of results. When it has turned out that a theoretical concept is not applicable to the situation being analysed, or that it cannot be measured in a reliable way, then this has been abandoned as inadequate for offering policy guidelines.

This section summarises the perspective on sustainability that underpins the research, and the way it assigns complementary roles to monetary and non-monetary information in sustainability analyses, and then the team restate their favoured approach to defining an environmentally adjusted national income. In the next section they provide a synthetic set of recommendations deriving directly from the project work, and mention some fields of further research that they judged as very important though they were not specifically addressed within the project.

Economic and ecological dimensions of sustainability

An ecological economics perspective was adopted, suggested in the figure below, from which point of view economic resource management must fulfil two complementary functions:

the delivery of an ecological welfare base through assuring maintenance of critical environmental functions and amenity (lower portion of the diagram), and
the delivery of an economic welfare base through production of economic goods and services (upper portion of the diagram).

ECONOMIC SYSTEM	**GDP** : Outputs of Economic Goods and Services	**Final Consumption** (national income)
Economic Production	**EDEs** (Double-glazing, Health care, etc.)	**Economic Goods and Services** (monetary units of value)
Natural resource use	**Intermediate economic inputs**	
EDEs (Expenditures on waste management, damage prevention and environmental restoration)	Pollution, toxic by-products, and disruptive side-effects	Wastes **INDIVIDUAL & SOCIETAL WELFARE** Noise and Nuisance
Resource Renewal / Repair		
Natural resources and ecosystem productive services	Damages to health, etc. Habitat degradation Damages to environment	**Ecological Goods and Services** (non-monetized values)
ECOLOGICAL SYSTEM(S)		Landscape, Amenity, etc.
(Soil, water, air, energy, etc.)	**Direct environmental services**	Life place (habitat) and Life-support

In this perspective, a basic design criterion for "greening" national accounts should be to furnish an information base allowing cost-effectiveness in the allocation of economic resources for the pursuit of economic and environmental output goals. This means information sets covering production and exchanges of economic goods and services (including final consumption), changes in the state of the environment, and the economy-environment interfaces which bear on these two domains. The question is, how should monetary and non-monetary information be applied?

Many manuals on the construction of environmentally adjusted accounts suggest procedures for making monetary estimates of the value of environmental benefits and damages, in order to quantify natural capital depreciation in monetary terms. This research does not endorse this perspective for the calculation of a green GDP.

The committing of scarce resources in order to maintain or recover the desirable level of environmental quality corresponds to a kind of "social demand" for maintenance of environmental functions (i.e. sustainability). In economics it is habitual to ask: is the value of the benefit obtained, or of the loss avoided, worth the investment of economic goods and labour needed to obtain it? Yet this 'demand' for environmental quality, which will include provision for future generations and a demand for protection from environmental harms, cannot easily be expressed as a value in monetary terms. Even if such estimates can be made, the numbers obtained often have very large error bars and can be highly sensitive to underlying parameter assumptions (e.g., concerning possibilities and elasticities of substitution, endowment and income distribution, technological progress prospects). So the application of traditional cost-benefit analysis aimed at identifying a Pareto-efficient allocation of resources is difficult and often controversial. Many environmental decisions involve problems of risk distribution, management of uncertainties, and conflict of interests that cannot be dealt with very well as cost-benefit "optimising" problem. Attempts to put monetary values on environmental benefits and damages that are spread over time, and whose significance is sometimes as much ethical as biophysical, are often quite artificial.

For project appraisals and localised cost-benefit policy problems, the magnetisation of environmental benefits/damages can be extremely useful. However, for purposes of macroeconomic performance analysis the team recommended that statistical work in monetary units should be confined to the stocks and flows of produced economic goods and services (the upper portion of the diagram), but not be generalised to environmental functions and services (the lower portion of the diagram). At macro-economic levels of analysis, the best operational specification for a society's 'demand for environmental quality' will be in non-monetary terms, through defining environmental standards that express the society's priorities for the delivery of the ecological welfare base to both present and future generations.

Of course, any society's environmental performance goals will involve compromises which will be the product of explicit and implicit negotiations. The debates over priority-setting may to some extent be aided by attempts to quantify in monetary terms the relative welfare significance of natural resources and of different environmental amenities, life-support functions and other services. Nonetheless, for the various reasons discussed at length in this report, the team have concluded that in empirical work supporting the calculation of environmentally adjusted national income figures, full monetary valuation of environmental benefits and deterioration is not needed and should not be the objective.

Multi-criteria decision-support approaches that bring together cost-effectiveness frameworks with non-monetary information on environmental changes contained in satellite accounts, will be an effective way to organise the information needed to calculate macro-economic performance indicators adequate for the purposes wanted – a single-period green GDP, or a time-series of green GDPs, or several scenario time-series of green GDPs. Also, the matrix structures of environmental satellite accounts linked to the monetary national accounts in aggregate or sector-by-sector can be an effective and highly communicative way for presenting the costs and benefits associated with environmental policy and other development options. The multi-criteria perspective provides for the presentation of information for discussion and support of decision-making procedures in ways that do not yield a unique ranking of options, but that help make explicit the sorts of social choices and ecological and economic trade-offs that underpin the macro-economic aggregates and time-series that are constructed.

Defining an environmentally adjusted national income

The intuitive idea of an environmentally adjusted national income figure (a 'green GDP') is quite simple. It is an estimate of the level of output (or of consumption, or of national income, etc., depending on the exact measure proposed) that a national economy would be able to achieve while simultaneously respecting the environmental quality and resource husbandry requirements for sustaining welfare levels in the long-term.

Although the idea is simple, good empirical estimations of 'green GDP' and, by extension, of a 'sustainable national income' (SNI) are not simple matters, for several reasons. First, the estimations do not involve only the measurement of a level of real aggregated economic activity, rather they are inferences about what is or might be feasible for the future. Second, there are a lot of differences of opinions, including social/ethical value judgements as well as scientific uncertainty, about the ecological and economic determinants of feasibility -- technological change possibilities and risks, new natural resource discoveries, the resiliency and stability of ecosystems, the importance of biodiversity conservation, and so on.

In the course of the project, the team distinguished and discussed three main approaches to the calculation of an environmentally-adjusted national income figure considered as a macroeconomic indicator for sustainability. These are:

Estimation of an environmental net national product (ENNP) as defined in neo-classical growth-with-natural-capital, and interpretation as an estimate for a "sustainable national income" (SNI). The ENNP can, in theory, be estimated through making deductions from the economy's GDP, these deductions representing the depreciation of capital stocks, including economic (produced or machine) capital, human capital, and, most importantly in this context, natural capital.
Estimation of an environmentally-adjusted GDP figure as initially proposed by Hueting and colleagues in 1992, through making deductions from conventional GDP representing the economic costs of achieving independently specified environmental quality and conservation standards (e.g., costs associated with pollution emission reductions) sufficient for achieving long-run sustainability of all important environmental functions.
Estimation of a 'green GDP' and, by extension, of a sustainable national income (SNI) based directly on empirically calibrated modelling of a national economy in order to calculate feasible economic output subject to respect for environmental quality (ecological-economic sustainability) norms.

The first approach depends strongly on imputation of monetary values to all flows of benefits and damages from natural resources and environmental functions during present and future periods of economic activity. The second and third approaches, by contrast, do not monetize the social demand for environmental goods and services. Rather they designate environmental sustainability standards in non-monetary terms (e.g., critical thresholds for pollutants).

It may also be noted that both the first and second approaches are consistent, each in their own way, with a neo-classical welfare theoretic interpretation of the environmentally adjusted national product figure as an

aggregate indicator for overall welfare optimisation. By contrast the third approach, based on modelling, estimates a "shadow GDP" — an aggregate measure of a feasible economic output — without any particular welfare-theoretic significance. In the modelling approach, economic output and environmental quality are dealt with as complementary but incommensurate objectives, so no welfare aggregation across ecological and economic domains is needed.

After careful review of theoretical and empirical estimation issues, the team concluded that that the first approach, the production of a figure for "green GDP" obtained through deductions of "natural capital depreciation" from conventional GDP, and, more particularly, interpretation of this figure as an estimate for SNI, is largely illusory for providing a meaningful indicator for sustainability.

Turning to the second approach, the team were in sympathy with Hueting's arguments for defining economic adjustment costs associated with respect of environmental sustainability standards defined in non-monetary terms. This was indeed the starting point for the project in 1994. However, Hueting's 1992 approach, while it avoided some of the difficulties associated with quantifying in welfare-theoretic terms the significance of complex and far-reaching environmental changes, did not in their view resolve adequately the methodological problems involved in (a) defining environmental quality standards and priorities, and (b) estimating economic opportunity costs associated with meeting sustainability standards. In particular, the team did not think that the subtraction of avoidance costs (including defensive expenditures actually made, and also the 'costs' that would hypothetically be incurred to respecting the sustainability standards) from real national income figures is a satisfactory procedure for estimating the feasible national income for a (hypothetical) sustainable economy.

The research thus favoured the third approach, which is to make estimates of environmentally adjusted national income using multi-sector national economic models. This approach unites several sorts of analytical and statistical work, including: (1) avoidance-cost analysis at firm and branch/sectoral level which is the basis for calculating the resource implications of a (hypothetical) reduction of a specific environmental pressure (such as CO_2 emissions, or a heavy metal residue); and (2) whole-economy multi-sectoral modelling, either dynamic simulation or comparative static. The full Project Final Report demonstrates how these sorts of analysis can be brought together in a way that can provide useful information on requirements and prospects for achieving sustainability.

III.MAIN RESULTS OF THE PROJECT

The preferred approach to defining 'green GDP' figures was based on the idea of defining cost-effective resource allocation strategies in the achievement of environmental goals alongside the delivery of economic goods and services. Working in this way, opportunity costs or "trade-offs", in both static and dynamic perspectives, between production output and environmental quality maintenance goals can be identified without the requirement to imput monetary values for ecosystem characteristics and their change over time in the traditional neo-classical economic way. National accounts system can in this way become a support tool for empirically meaningful appraisal of environmental policy options. The following summarises the main findings.

Definition of environmentally adjusted national income

The team worked with the following definition of an environmentally adjusted national product (green GDP) :

the value (in money units) of the highest (or "best") feasible economic production for the accounting period in question, subject to the condition that the economy is respecting a specified set of environmental standards.

It is important to note that : (i) this definition may apply to a real or model situation, (ii) it provides for the construction of time-series of green GDP figures (on a period by period basis), and (iii) it allows that more than one green GDP (environmentally adjusted national product figure) might be calculated, or more than one time-series might be calculated, as a function of the environmental standards specified. The team emphasised that a green GDP, as they defined it, usually does not measure current economic performance or welfare delivery. Rather it offers an estimate based on multi-sector economic modelling (or somesuch), of the level and composition of environmentally respectful economic output that, for each accounting period being considered, may be feasible with currently known technology or under hypotheses about future technological innovation.

Calculation of environmentally adjusted national income

Useful calculations of "green GDP" figures can be based on comparative static modelling or on dynamic modelling.

In the case of dynamic modelling, the model output is a time-series for the aggregate national product that is attainable while respecting, for each period, the specified sustainability guidelines. Such figures are potentially valuable inputs into policy debates, but certainly they are not the basis in themselves for policy choices. The figures obtained will depend on, among other things the environmental standards imposed. Given that uncertainties are quite large, and that the range of different effects of a decision extends to many different ecological, social and economic domains, the processes of standard setting, statistical estimation and aggregation to produce such figures involve a whole range of caveats and contingencies.

The investigation of policy options and the search for "good" options necessarily involves an element of scenario construction. This implies the construction of not one but many "green GDP" figures, usually in the form of time-series.

The decision support information of most value is not found in the aggregate figure themselves, but in the richness of information through comparison of the different model outputs and scenarios.

The roles of statistical offices and research institutions

In this project, based on the cost-effectiveness approach, a procedure for the construction of abatement cost curves (ACCs), showing the direct effects of technical abatement measures, was developed and empirically tested for various nitrogen compounds. The empirical work demonstrated that an adequate official comprehensive database for construction of ACCs is not yet available in Germany, the country of application. The required information originates in different (economic and technical) spheres and institutional sources, each with their own data classification and categorisation systems, which have to be brought together. The final aim in the ACC estimation procedure is to have results for the 'homogeneous production processes' as the statistical accounting unit.

Following the lines set out in the Manual on The Construction of Abatement Cost Curves produced in the course of the project, the necessary time to construct one ACC for one pollutant is approximately three-quarters of a person-year. In the empirical study, only the direct micro-economic effects of abatement measures have been estimated. To get to macro-economic results, as are required for the linking of the data with the national accounts, a more comprehensive modelling approach is needed. In the future, statistical offices can offer basic data about abatement costs for selected environmental pollutants, which then have to be linked with modelling-calculations by research institutes. In view of the limited financial resources and the generally poor data situation (relative to the immense complexity of the pollution and environment domain), a full coverage of all processes, products and environmental themes seems unreachable. With the help of a statistical selection procedure (the details of which have still to be developed), a sample of environmental pressures and of polluting economic sectors should be chosen, including the most important environmental pressures and harmful economic processes with a high technical abatement potential. The proposed methodology for calculating ACCs with integrated techniques/changes of production processes may then be implemented empirically.

Having made this assessment of statistical feasibility, the roles that the team have identified for statistical offices in greened national accounts preparation are:

Estimations of the direct costs of cost-effective responses to environmental deterioration on a sector-by-sector and pollutant-by-pollutant basis involving the use of available technologies under existing economic conditions;
The information base for estimations of the indirect effects of cost-effective responses on the individual economic sectors and the economy as a whole, based on the available information in statistical offices about the input-output structure of a nation's economy in a certain accounting year (that is, with the help of *ex post* modelling using fixed Leontief-coefficients).

These two suggestions do not exhaust all possibilities. They are, however, enough to demonstrate the basis for implementing the project's "cost-effectiveness" perspective on resource management for sustainability. The information obtained in the two categories mentioned can furnish preliminary indications of the required economic re-orientations in order to respect environmental standards.

In addition the team recommended the development of scenario modelling that goes beyond the simple compiling of statistics and exploitation of *ex post* data, to the quantification *ex ante* of the feasibility space for possible national economic trajectories. This is work properly carried out by research institutions, in cooperation with policy and statistics agencies. Scenario modelling work permits the quantification of the 'feasibility space' for possible future national economic trajectories, including the calculation of time-series for environmentally adjusted national income (that is, time-series for future green GDPs) based on explicit hypotheses about the environmental quality (ecological-economic sustainability) standards to be respected, the available natural and manufactured resources, consumption patterns to be maintained or changed, and the available technological options.

The project emphasised that the figures obtained in each of these three analysis categories have to be interpreted cautiously.

First, there is often a lack of information about possible interactions (synergy or incompatibilities) between technical measures included in the direct cost calculations.

Second, estimates of direct costs usually focus on a particular type of pollutant emission or environmental quality goal, whereas in reality there are often interactions between environmental pollutants that make estimation of environmental damage strongly site specific. Although several careful studies are proceeding, we still seem to be far away from being able to calculate cost-effective responses in a rigorous way for a set of complicated environmental problems. These estimation difficulties also carry over to the calculations of indirect (cross-sectoral) effects associated with environmental policy implementations.

Third, the statistical data for the costs and the technical measures to reduce environmental pressures stem from different data sources, and often these sources do not correspond with the economic sectors distinguished within the usual SNA. As in the recommend actions later in this report, integrating this information in a meaningful and useful way is perhaps the most important task that can be organised by Statistical Offices.

IV. SCIENTIFIC INTEREST AND POLICY RELEVANCE

Within the project, four major methodological research areas were distinguished:

(a) Review of the theoretical and statistical basis for deriving sustainability indicators;
(b) Defensive expenditures; (c) The construction of avoidance cost curves; (d) Micro-macro aspects of environmental-economic accounting. Keeping in mind this four-way division, the following provides a synthetic set of recommendations deriving directly from the project work.

Methodological perspectives

There are a range of different concepts and ways of estimating, an environmentally adjusted national product (green GDP). For the construction of useful macro-economic performance indicators, the following definition is recommended :

R.1*An environmentally adjusted national product (green GDP) is the value (in money units) of the highest ("best") feasible economic production for the accounting period in question, subject to the condition that the economy is respecting a specified set of environmental standards.*

This definition may apply to a real or model situation, and it provides for the construction of time-series of green GDP figures on a period by period basis. Moreover it allows that more than one green GDP might be calculated, or more than one time-series as the case may be, as a function of the environmental standards specified.

R.2 *Useful calculations of "green GDP" figures can be based on comparative static modelling or on dynamic modelling.*

In particular, scenario modelling work permits the quantification of the feasibility space for possible future national economic trajectories, including the calculation of time-series for environmentally adjusted national income, based on explicit hypotheses about acceptable pollution emissions levels, the available natural and manufactured resources, consumption patterns to be maintained or changed, and technological options. This sort of approach provides, in the project's view, a much richer and empirically more robust information base for appraisal of macro-economic and sectoral policy options than can be provided by an indicator based on subtracting imputed money values of natural capital stocks from GDP.

European contexts for statistics collection & implementation

In December 1994, the European Commission in its Report COM(94) 670 Final set out a plan for analysis and implementation over several stages for the development of systems of environmental indicators and "green accounting" in Europe. The European Parliament, in its resolution A4-0209/95, affirmed the general elements of the action plan, while requesting some fine tuning, such as provision for the specificity of each country's environmental preoccupations within a common framework and an environmental accounting framework that allows actual and potential causes of environmental deterioration to be identified. Three stages of green accounting were envisaged:

The systematisation of environmental pressure information through agreeing on accounting framework conventions (ESEA) and through implementing a common system of environmental pressure indices (ESEPI);
The creation of a set of integrated economic and environmental indices (ESI);
Implementation of methods for placing monetary values on natural resources and environmental deterioration categories, permitting full "integration" of economic and environmental accounts in monetary terms.

Recent work, including this project, has made clear that the greening of national accounts is not only a question of economic theory and of accounting concepts, but also a question of data availability and information technology. The good organisation of data processing, the improvement of statistical services by means of standardisation and the documentation of data quality by meta-information (pedigree of data, reliability etc.) is essential. A precondition for further progress is the organisation of a "cost-effectiveness information system" close to the sectoral structure of input-output tables of national accounting. The European activities ESI, ESEPI and EPIS under the leadership of Eurostat, are good starting points for this purpose. This project recommended:

R.3*The available economic and technical data-sets should be organised and linked in such a way that they can readily be used for both the calculation of direct economic costs (e.g., changes of weights within the distribution of available techniques) and the multi-sectoral economic modelling (e.g., changes of the average production technique).*
R.4*In addition to ESI and ESEPI, some European countries and Eurostat (European Commission) have started developing an Environmental Pressure Information System (EPIS). These sorts of initiatives be continued.*
R.5*It would be useful to pool current experience, at present fragmented across Europe, concerning the estimation of sector-by-sector and pollutant-by-pollutant avoidance cost curves.*
R.6*Country applications of model-based calculations of environmentally-adjusted national income figures (that is, comparative static or scenario time-series of green GDP figures) must be carried out for several different EU countries in order to gain real experience with the diversity of environmental-economic conditions and with the adequacy (or not) of country data bases and information formats for the calculation of green GDPs.*

Environmental defensive expenditures

The project has dealt intensively with the question which role the environmental protection expenditures should play in an environmentally adjusted GDP. This role depends generally on the objective of the adjustment procedure and correspondingly on the interpretation of the environment-related expenditures in the adjusted domestic product.

In this area, the first question that the project addressed was: for the purposes of green GDP estimation, what is the right way to take account of the welfare significance of the flows of environmental goods/services during the accounting period? The issue to be surmounted is that real GDP as traditionally measured rises as a result of increased production that disregards the environment, and rises still further when environmental damages are then mitigated through further economic activities. This is a perverse characteristic of GDP as a macro-economic performance indicator.

The interpretation of certain expenditures categories as (environmentally) defensive expenditures, or EDEs, is rooted in the debate about analytical deficiencies of the conventional GDP as an economic welfare measure. It has sometimes been proposed that, in order to 'correct' the GDP as a performance indicator, deductions from the conventionally measured GDP should be made for the 'environmental defensive expenditures' (EDEs) aimed at maintaining or improving the level of environmental services (or reducing harm). In effect, this procedure would involve a reclassification of the EDEs as intermediate goods/services in national accounts systems, whereas they have conventionally (for essentially pragmatic reasons) been included in final consumption.

On the one hand, if environmental or natural 'capital' is considered as a factor of production, this reclassification procedure makes sense. However such a correction is difficult to implement in statistical practice, because it is very difficult to draw the line between expenditures conducted for defensive reasons as opposed to productive reasons, or in tandem with productivity gain objectives.

On the other hand, if the environmental goods/services in question are regarded as themselves contributing directly to welfare, the deductions should not be made in a periodic accounting procedure. One question that then arises from a welfare-theoretic point of view, is how to construct a welfare measure that aggregates the value of environmental goods/services together with the conventional consumption of economics goods and services.

This project has adopted the convention that economic and ecological sources of welfare should be treated as complementary but not commensurate. The positive environmental effects of environmental protection expenditures are not monetarized in the existing SNA and are, consequently, not represented as a separate output category in the GDP volume figure. This is actually consistent with the project's cost-effectiveness framework, where a green GDP figure or time-series is considered simply as an indicator of feasible economic activity and there is no compelling welfare-theoretic reason to quantify EDEs separately for the adjustment to national income figures. So the project concluded:

R.7*The environmental outputs of environmental protection activities should not be monetarized for macro-economic accounting purposes. (There are also statistics quality reasons for this too considering the well-known uncertainties and degree of arbitrariness of monetary estimates of many environmental damages and benefits.)*

On the other hand, environmental functions and services should be identified in qualitative or multi-criteria terms for their welfare significance, but they do not need to be evaluated in monetary terms. It is necessary and urgent to supplement the data on monetary environmental protection expenditures (and costs) by physical data. Useful information about the environmental effects of actual environmental protection expenditures is only obtained when this information can be linked to physical environmental indicators. So the project further recommended:

R.8*The current European initiatives for EDE data collection should be pursued, and high priority should be given to defining ways that this information can really be used in environmental policy priority-setting and policy evaluation.*

R.9*In particular, Eurostat should pave the way for including environment-orientated in-process modifications (integrated environmental protection measures) in the SERIEE data system on environmental protection expenditures. It is well-known that these measures are becoming increasingly important in the environmental management strategy of enterprises, substituting more and more the dominating role of end-of-the-pipe-measures.*

R.10 *Eurostat should work out with high priority the 'natural resources use and management account' foreseen as a part of SERIEE.*

It is possible to add the following remarks. Measures of enterprises to increase the efficiency of energy and materials use in the production processes are becoming more and more important. These measures are often included in the environmental cost accounting of enterprises. In many cases they are the most important integrated option for reducing environmental pollution induced by the production process. They are not included in the Environmental Protection Expenditures Account (EPEA) of SERIEE, because they do not fulfil the *causa finalis* criterion. So it seems necessary and urgent to develop an operational concept and classification of this type of measures and to record reliable data as well. Otherwise SERIEE will publish data on environmental protection expenditures in the near and further future which are less and less representative of the total array of efforts to reduce pollution and material and energy consumption.

Also, there are a few observations about terminology. In some accounting approaches, guided by a notion of 'optimising' resource allocation (where marginal cost is equal to marginal benefit obtained), information on EDEs is considered as a proxy for the money value of environmental degradation that is being avoided or repaired or compensated for. Of course, this is valid only to the extent that the EDEs reflect real marginal benefits. For several reasons including the diffuse nature of environmental damages and services, free-rider

behaviour, limited expenditure budgets of economic actors, irreversibilities, lack of information and so on, EDEs will often relate to a very incomplete set of benefits to be regained or damages to be avoided.

The project did not favour the interpretation of EDE or 'avoidance cost' information as a proxy measure for the value of environmental services maintained or regained. Rather, it placed the emphasis directly on the quantification of economic costs that are, or that would be necessary to reach or regain desired environmental quality. This is considered the most appropriate way to deal with environmental deterioration in a periodic accounting system.

Calculations of the costs of improving environmental quality or avoiding environmental degradation depend crucially on the environmental quality to be reached serving as a standard for these cost calculations. The reference level proposed in the existing SEEA is that the nation's domestic economic activities during the actual period should not impair the environmental quality as it exists at the beginning of the period. Of course other reference standards are thinkable. For example in the "Sustainable National Income" project at Statistics Netherlands, ecological sustainability standards are established for a number of environmental problems in a scientific way within certain uncertainty ranges. Contrary to the standard advocated in the SEEA, this sustainability standard does not refer to the state of the environment at the beginning of some accounting period, but to an ecologically sustainable state — that is, the sustainable rate and type of use of environmental systems and their products and services.

The two categories of costs — prevention costs actually incurred and potential prevention costs not undertaken by the actors while justifiable from a social welfare or sustainability point of view — directly complement each other. In any one period, without the activities financed by the actual prevention expenditures the degradation of the environment would have been higher than is actually the case. However, if a zero-degradation or stronger sustainability standard is the reference point, then additional avoidance and restoration costs would be needed to fill the gap between the environmental quality actually reached and the more ambitious period standard. Estimates of these additional costs of avoidance and restoration must be made through inferences based on data about available technologies or lifestyle changes and so on — the various estimates of direct and indirect costs as discussed elsewhere in this report.

Environmental performance and reporting at firm level

One of the key tasks of this project was to investigate the extent to which information at the firm or "micro" level on environmental pressures and abatement prospects can become a useful data source for green national accounting purposes. The investigations of empirical estimation of cost curves and of the data requirements for modelling confirm the importance of such information. At the same time, the research showed that enterprise-level monitoring, quality control and reporting practices produce information that is extremely heterogeneous. There is not a simple 'translation' from this heterogeneous information to the technological data base and cost-accounting categories relevant to calculations of green GDP. In addition, much information is commercially sensitive, which can limit its accessibility to researchers.

R.11 *It is useful to distinguish two different senses in which environmental consequences of economic activity are 'taken into account' or internalised. The first is a qualitative sense of internalisation that is reflected in the information categories and reporting purposes of economic actors. The second is the attempt to produce quantitative indicators at sectoral and national levels.*

In qualitative terms, a direct parallel can be drawn between the normative interest in "green GDP" as an indicator of prospects for national economy activity to respect defined environmental norms (including sustainability-related standards), and the increased attention within the private sector for documenting company environmental performance and product environmental quality (for example eco-reporting, best available technology, ISO-14000 protocols). The macro-economic accounting adjustments and the new firm reporting practices are two different ways in which the burden of proof is being shifted from relative neglect of environmental consequences of economic activity towards the obligation to take the "best reasonable measures" in favour of environmental quality.

However, the 'bridge' between firm-level (micro) data and the statistical categories for greened national accounting (macro) is not a simple passage of collection and aggregation. In fact this key finding is common to the three different domains of the project's empirical work — the estimation of abatement cost curves, the classification and estimation of environmental defensive expenditures, and environmental information at firm level.

It is possible to summarise the micro-macro link from the point of view of constructing national accounts and of calculating figures for environmentally adjusted national income (green GDP). The required information comes from many different economic and technical domains, each having their own classification systems. Data about emissions and about major raw materials and energy inputs is usually available at an aggregated level for firms, sectors and the economy as a whole. This sort of data then has to be supplemented by very detailed and disaggregated technical information (where available) about abatement measures and their costs. Such data often derive from various research projects, some within the private sector, much of it within publicly funded institutions. Thus there is a big gap between this detailed but fragmented information on the one hand, and statistically useful figures for abatement potential and costs for representative firms or sectors on the other hand. Bridging this gap depends on the cooperation of researchers, technicians and process managers, and statisticians to share their specialised knowledge and arrive at mutual understanding of their contrasting needs.

There is not a simple accounting or reporting procedure to ensure this 'bridge' between technical-economic research, firm information and statistical figures. What is most important is to encourage a permanent interaction based on the assertion of a public interest in the production and dissemination of high quality information on technical potentials for abatement at firm level, and the costs involved.

R.12 *The project recommended that work should be encouraged involving partnerships between private sector actors, researchers and policy-makers, to further define how this reorientation of priorities and reporting conventions at 'micro' level can be promoted and exploited for more effective policy-making for sustainability in the public domain. A permanent interaction between researchers, statisticians, public policy-makers and private sector stakeholders is essential for good progress in this field.*

The production and sharing of information can be promoted by publicly funded clearing houses such as the European Environment Agency and by giving a high profile to specialised data sets with particular policy importance (such as BATNEEC information as provided for under recent EC Directives). In addition, the development of internationally recognised standards and quality certification, through public policy and corporate protocols (such as the ISO 14000 series) can promote the process of 'internalisation through information'.

Empirical data at the 'micro' levels (that is, technical research data and firm-level information) is an essential input for construction of abatement cost curves. It is also needed as underlying data for the more comprehensive modelling work required to calculate the economy-wide effects of changing production patterns brought about by introducing emission abatement techniques on a large scale. As already discussed elsewhere in the report, the economy-wide modelling must be developed on a basis of hypotheses about rates and types of technical change and final consumption change, on a sector-by-sector and pollutant-by-pollutant basis. These hypotheses reflect knowledge about new technologies available or in prospect (process efficiency improvements, new products) and judgements about the responses of economic actors (firms, financial intermediaries and households) to the new technological opportunities, policy signals, and so on. In these behavioural respects also, a permanent interaction between researchers, statistical offices, policy-makers and a variety of producer and consumer stakeholders is a pre-requisite for quality and pertinence of work.