Sample tasks

Framework contract for undertaking editing and media-related work for the EEA

1. Background information

The sample tasks outlined below aim to give the EEA an impression of the professional quality of the services offered by the contractor. There is one sample task for each lot. Service providers only need to carry out sample task/s for the lot/s for which they intend to put in an offer.

2. Sample task - Editing

Edit the enclosed excerpt of a draft report manuscript with a view of i) improving readability ii) ensuring good language quality iii) ensuring consistency with the EU's interinstitutional style guide http://publications.eu.int/code/en/en-000400.htm (see in particular sections three and four). The primary target group of the report is environmental specialists, though the text should be understandable to a non-expert audience as well. The first paragraphs have been edited to give an indication of what improvements are needed to the text. Please continue along the same lines with the remainder of the text.

Implementation of land and ecosystem accounts at the European Environment Agency

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ABSTRACT

The European Environment Agency has started the implementation of a programme of land use and ecosystem accounts, following the System of Environmental and Economic Accounts (SEEA) guidelines of the United Nations. The purpose is to progress with integrating information across the various ecosystem components of the environment and to support further assessments and modelling of these components and their interactions with economic and social developments.

This programme reflects the increasing demand for integration in Europe, both vertically through environmental thematic policies as well as horizontally across the sector policies that contribute most to environmental impacts. The construction of land and ecosystem accounts is now feasible for the main building blocks, due to continuous improvements in monitoring, collecting and processing data and progress with the development of statistical methods that facilitate data assimilation and integration.

The accounting framework that is currently being tested seeks to reflect the complexities of the real world, while maintaining simplicity, transparency and flexibility in the systemic approach and outcomes. The basic stocks of ecosystems (from wetlands and dry grasslands to rivers, forests and agro-systems) are linked to the specific flows of goods and services from these ecosystems as well as markers of ecosystem distress that results from the extraction of material beyond the renewal capacity or from land restructuring. The accounts are based on explicit spatial patterns provided by comprehensive land cover accounts that can be

upscaled/downscaled from the grid level (eg 1km²) to any type of administrative regions or ecosystem functioning zones (eg river basin catchments, coastal zones or bi- geographic areas).

Ecosystem goods and services are identified from the analysis of natural and land use functions. These goods and services are also spatially distributed consistently with the approach for the land accounts. Ecosystem accounts are open to monetary evaluations where they are relevant and possible on an ad hoc basis as well as at the macro scale by linking the stocks and flows of ecosystem goods and services to available socio-economic statistics from the System of National Accounts (SNA). The accounting framework is also open to practical solutions for filling in data and analytical gaps through the application of methods including spatial analysis, physical modelling, probability analysis, as well as to integrating heterogeneous data from existing and novel monitoring systems.

Land cover accounts have been produced for 23 countries in Europe and first results published in the 2005 state and outlooks environment report of the EEA[1]. Complete detailed results are publicly available from the web site of the EEA[2]. Work on land use and ecosystem accounts is currently ongoing and regular information on progress will be posted at the same web address.

Policy background

In early stages of environmental policies, specific directives have been elaborated for a large range of individual issues. Motivations where the protection of European citizens against air and water pollution, the regulation of waste flows, the protection of Nature and landscapes as well as the willingness of avoiding distortions in the economic competition due to uneven national emission standards. The full understanding of sustainability issues came then, leading to a redefinition of environmental strategies and the launch in 1998 of the integration process[3] with the joint objectives of streamlining the environmental legislation and improving the efficiency of policies.

One of the most remarkable achievements to date is the so-called Water Framework Directive built upon the concept of river basin management and targets of ecological quality of water bodies and the full recovery of costs of water protection and management.

Agri-environmental policies are also continuously moving towards more ecological integration. Initially foreseen as a way to support farmers' income in compensation to the progressive decline of subsidies to products, the so-called "second pillar" of the Common Agriculture Policy contained a set of targets beneficial to the rural landscape and the environment. In the recent years, programmes have been undertaken for defining, beyond individual measures, some ecological integrated perspectives, one of them being the so-called "high nature value farmland areas" where the maintenance of adequate cultivation practices (e.g. extensive grazing) is considered as the best way of maintaining the ecological potentials.

Nature conservation has progressively moved from species protection towards a policy of habitats conservation, the "birds" directive of 1972 and the "habitats" directive of 1992 both merging in the NATURA2000 process, designated areas covering now 18% of the EU. In the current phase

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[1] European Environment Agency, 2005. *The European Environment State and Outlook 2005.* Copenhagen

[2] http://dataservice.eea.eu.int/dataservice/metadetails.asp?id=814

[3] The Cardiff Process is the name given to the process launched by European heads of state and government (The European Council) at their meeting in Cardiff, in June 1998, requiring different Council formations to integrate environmental considerations into their respective activities.

the reflections are developing towards a more systemic approach where the integrity and connectivity of the ecological network of designated areas as well as the interaction of these areas with their environment (the pressure by surrounding land use) are seen as keys of the success in halting biodiversity loss in Europe.

Another recent example is with the Environmental Liability Directive (ELD) adopted in April 2005. The ELD is as an attempt to apply the 'polluter pays principle' whereby polluters should clean-up the environmental damage that they cause. The directive aims to prevent and remedy environmental damage defined as damage to protected species and natural habitat. Ecosystem integrity and ecosystem services are fully considered in the assessment of damage and the choice of remedial actions.

As well, current reflections steered by the European Commission on the economics of biodiversity policy integrate the concepts of ecosystem, ecosystem services and resilience in their framing of the value of biodiversity and biodiversity losses.

Despite this positive evolution, the perspective is not all clear for European ecosystems. Urban sprawl is diffusing and impacting rural landscapes far beyond its developments. In the coastal zones of the Mediterranean and the Atlantic where this sprawl is important, farmers tend to reclaim the fields that they have sold for construction from natural land, making it the main source of consumption for urban sprawl. The continuous development of transport infrastructures, and its acceleration in the new EU countries increases the fragmentation of landscapes that normally should guarantee, altogether with rivers, some connectivity to the core areas of the ecological network. On the average less polluted than in the past, European rivers are highly fragmented by dams, which block the routes of migratory species and isolates spooning areas. Recent climate change has shown moves in the distribution areas of some species like butterflies, which may warn on ecosystem unwanted evolution. All subjects for which ecosystem based assessments can contribute in providing useful information for policy making.

Ecosystems and accounting

Ecosystem is certainly not a new concept in ecological economics and is present as well in environmental accounting since the very beginning of the formal developments that have lead to the SEEA 2003. Examples can be given in the work done in Canada [4], France[5], United Kingdom[6],

[4] Rapport, D. and A. Friend: 1979, Towards a comprehensive framework for environmental statistics: a stress-response approach. Statistics Canada Catalogue 11-510 (Minister of Supply and Services Canada, Ottawa).

[5] Commission interministérielle des comptes du patrimoine naturel, Les comptes du patrimoine naturel, Collections de l'INSEE, C137-138, Paris, 1986

[6] Haines-Young R. et alii, Countryside Survey 2000 - Accounting for Nature: assessing habitats in the UK countryside. DETR, 2000. ISBN 1 85112 460

Germany[7], Spain[8] as well as the pioneer work on land accounting initiated by UNECE[9] and continued by Eurostat[10].

Researches on land and ecosystem accounting have benefited from a large range of case studies at various scales and in various contexts, which have highlighted the correct concepts upon which ecosystem accounting should be based. These studies covered various aspects of ecosystem assessment from a scientific perspective to ecosystem management, including protection and restoration. They introduced concepts not all familiar to the national accounts community such as natural productivity and metabolism, functions, feedbacks, species patterns, spatial patterns, panarchy, health, resistance and resilience or ecosystem disturbance and stress.

However, ecosystem accounting sensu stricto has not been a high priority of environmental accounting at that time, even though the revision of the SEEA has lead to its explicit recognition and provided an important hook for further development[11]. Several reasons may explain this relative gap.

The first reason relates to the motivation of the largest community involved in the SEEA process: the national accountants eager at improving the national accounts. Their input has lead to important progress in relation to the analysis of actual monetary flows, of economic assets and their depletion as well as of the assessment on the use of natural resource and the emission of pollutants based on input-output analysis. It was the main responsibility of the national accountants to carry out these improvements and the work done so far is considerable. However, these developments, "close" to the core framework of the SNA are explicitly limited to what is directly compatible with this model, including the pre-eminence of the double-entry accounting principle and its spatial and temporal patterns. They reflect some important aspects of the relation of the economy to the environment but partly fail in considering essential aspects of its complexity, dynamics, impacts and feed-backs..

The second reason of the relatively low interest to ecosystem accounting relates to the period when environmental statistics have developed. This period is that of the fostering of command-and-control policies in response to high levels of pollution and environmental degradation resulting from industrial economy, intensive agriculture, urban sprawl and transport development. In such a context, many problems can be explained by linear models where a given pressure is the key variable and can be assigned to one or the other branch of the economy. Mitigating the pressure is a self-justified objective, environmental improvements being expected to come as an automatic result. Things start to be more complicated when, because of their achievements, the

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7 Seibel, S., Hoffmann-Kroll, R., Schäfer, D.: Land Use and biodiversity indicators from ecological area sampling - results of a pilot study in Germany, Statistical Journal of the United Nations ECE 14 (1997), IOS Press, p. 379 -395.

8 Naredo, J. M. and Parra, F. Eds. Tener en cuenta(s) la naturaleza (Bases para una contabilidad de los recursos naturales), in Hacia una ciencia de los recursos naturales, Siglo Veintiuno Editores, Madrid, 1993.

9 UNECE task force - Physical environmental accounting : Land use / land cover, nutrients and the environment – Etudes et travaux n°4, IFEN, Orléans 1995

10 See proceedings of the International Symposium on Integrated Environmental and Economic Accounting, March 5-8, 1996, Tokyo, Japan edited also in Uno K. and Bartelmus P. eds. Environmental Accounting in Theory and Practice. Dordrecht: Kluwer Academic Publishers. (1998) 450 pages.

11 UN, EC, IMF, WB, OECD: Integrated Environmental and Economic Accounting 2003, Chapter 8 Specific resource accounts, Section F Land and Ecosystem Accounts, pp. 372-389, Final draft, UNSD, 2003, to be issued as Series F, No.61, Rev.1 (ST/ESA/STAT/SER.F/61/Rev.1).

policies of first generation lead to less visibility of the causal chain. Environmental effects resulting in most cases of a set of pressures (and natural circumstances), the impact of individual pressures became more difficult to identify. At the same time, the marginal cost of rising environmental standards increasing strongly once the main objectives are achieved, demands came of justification of the cost-efficiency of policies. On the economic side, this situation favoured the promotion of economic instruments for supplementing or even replacing the traditional command-and-control tools. On the environmental side, the focus on the pressure side started to be balanced by more attention to the state of the environment and its impacts on the society.

The third reason relates to the knowledge necessary for producing ecosystem accounts at a level of completion similar to the economic national accounts while keeping the possibility of some down-scaling for meeting the needs of most policies. In the 80's, satellite images were still expensive, real time monitoring networks were an exception, databases software packages and geographical information systems were tools restricted to specialists. Therefore, time and space issues could not be addressed in an adequate way, in particular considering the meso scales, which are so important for knowledge as well as policy making. Things are changing fast nowadays and the technology is delivering huge amounts of data and possibilities of new developments.

The feeling that ecosystem approach is just sophistication may have resulted from these difficulties, with little usefulness as compared to the stronger data organized by or in connection with economic statistics. However, this partial vision of the information needed for decision making is not as realistic or robust as it seems. The local actors interacting with nature, farmers, foresters, water managers, urban planners… know that, who have to integrate the full range of the variables if they want to maximise their results and/or avoid shortcomings in the short or longer term. The same can be said for policy making in general which is a matter of trade-offs: *"The major drawback of most environmental sustainability indices is that they do not adequately address the economic or ecological significance of a change in the indices concerned. How much change is enough or too much? What are the economic, environmental and social implications of a change? Nor are substitution possibilities between different components made explicit. The imperative for policy makers is to explicitly show tradeoffs and for this they need an inclusive, integrated measure of change." (Brian Walker, 2005)*[12]. From an environmental accounting perspective, the integration advocated by B. Walker means continuing the development of ecosystem accounts and giving them a full place.

The understanding of the importance of assessing ecosystems in a sustainable development perspective has been popularized recently by the Millennium Ecosystem Assessment (MA). Beyond its intrinsic quality, the success of the MA is that it meets a range of growing concerns on the future of the planet, due in particular the conjunction of continuing depletion of biodiversity, new perception of the scarcity of the natural resources and climate change. The value of ecosystem goods and services, composed of natural resource for the economy stricto sensu (a marketed input) as well as "ecosystem input" (SEEA) or/and "support, regulating and cultural services" (MA), is now considered in the perspective of adaptation to climate change. Natural assets are no more mere inventories available for abstraction but potentials – a fixed capital – that might turn to be of vital importance in an uncertain context. Biodiversity is no more a stand alone issue – if it ever were – but one of the conditions for keeping the potentials of territories. Ecosystems and landscapes are places where conflicts in land use form and are solved.

[12] Walker, B., A Resilience Approach to Integrated Assessment, The Integrated Assessment Journal, Vol. 5, Iss. 1 (2005), Pp. 77–97

3. Sample task – Media related work

Produce a press release on the basis of the text below. The target group is the general public. The press release should not exceed 300 words. It is to be provided with a headline, and a caption for the enclosed image. See the press room section on the EEA website (http://org.eea.europa.eu/PR/Newsreleases) to get an indication of the general tone and profile of EEA press releases.

EEA Technical report No 5/2006

Paper and cardboard — recovery or disposal?

1 Executive summary

To provide a solid basis for policies and policy-making in the field of waste management, the environmental and economic impacts caused by different waste treatment options should be examined. In recent years, a large number of studies comparing recycling with recovery or final disposal have been published, which are based on life cycle assessment (LCA) and cost-benefit analysis (CBA). To the frustration of policy-makers, experts and, not least the public at large, the results from these studies often differ greatly, and are even sometimes directly conflicting. Therefore, it would be of value to evaluate the robustness of these studies and their conclusions, and to clarify the reasons why results apparently differ so much. This is the overall purpose of the present project. Studies using LCAs and CBAs for comparison of waste management options for paper and cardboard have been reviewed.

1.1 Background

The thematic strategy on the prevention and recycling of waste

The communication by the European Commission on the thematic strategy was inspired by a life cycle approach to resources management taking waste phase as its starting point. Following this approach, waste prevention and recycling are assumed to reduce the environmental impact of resource use by avoiding negative environmental impacts arising at all stages in the life cycle of products. These impacts include extraction and initial processing, transformation and manufacturing, consumption or use and, finally, waste management.

The communication argues that in some cases questions arise as to why specific materials are addressed in one waste stream but not in others. For example, while Community legislation requires the recycling of paper and cardboard from packaging, there is no analogous requirement for paper from other sources, such as office paper or newsprint. Paper from these sources is often as appropriate for recycling from both an economic and environmental point of view.

On this basis, the potential advantages of setting material-based recycling targets rather than product-based recycling targets should be examined. 'Paper and cardboard' is given as an example of a material to which such logic could be applied. The input to such target-setting could, for instance, be supported by information from both LCAs and

CBAs.

Instead of conducting further analysis, the European Commission requested the EEA and its Topic Centre on Waste and Material flow (now renamed the Topic Centre on Resource and Waste Management) to undertake two reviews of already existing studies in order to analyse whether any conclusions could be drawn on preferable waste management options for paper and cardboard. Thus, the present report has been prepared as an input to the process of elaborating the thematic strategy on the prevention and recycling of waste.

Objective

Two separate reviews have been carried out covering studies of alternative recovery and disposal options for paper and cardboard: one for LCAs and one for CBAs.

The objective has been to identify and subsequently to perform critical analysis of the LCA and CBA studies. The aim is also to identify and assess the system parameters and boundary assumptions that have been most decisive for the conclusions obtained in the studies analysed.

This approach has been chosen because there are many methodological issues involved in carrying out an LCA or CBA study; all of which can have a strong influence on the outcome of the study. Such methodological issues comprise, for example, the goal and scope of the study, definition of the system boundaries, weighting, environmental impact categories selected or monetary values chosen.

The role of decision support tools

A wide spectrum of tools can be used to support decisions in the environmental field; two of the most discussed are LCAs and CBAs. These tools have different areas of applicability, different advantages and disadvantages, and their suitability depends on the type of problem to be assessed. LCA is based on natural science while CBA is based on welfare economics. Thus, even though LCA and CBA pursue the same goal of comparing waste management alternatives, they cannot answer the same question. LCA expresses environmental impacts, whereas CBA expresses economic impacts.

An important difference between LCAs and CBAs is the degree to which the methods have been standardised. Although CBAs have existed as a tool for decades, no standard has been developed to ensure a uniform application. In contrast, between 1997 and 2000 the International Standardisation Organisation (ISO) published a series of standards which now serve as a guideline for conducting LCAs. As a result, CBAs are considerably more heterogeneous than LCAs in terms of the choice of system boundary and methodology.

None of the tools should serve as the sole basis for a decision, since individually they are not able to bring forward all relevant aspects of a proposed project. Instead of being considered as competing, LCA and CBA should be seen as complementary.

1.2 Summary of the LCA review

Scope

A total of nine LCA case studies, containing 73 scenarios, have been selected from a thorough literature search. The selected studies are primarily LCAs including different management options for waste paper and cardboard.

The nine studies have been selected on the basis of a combination of selection criteria defining their quality and comprehensiveness. These criteria include: compliance with international LCA methodology standards, the perspective adopted by the study (company/society), the time frame (longterm/short-term), the year of the study and the type of paper/cardboard.

The impact categories for the environmental assessment of paper systems used in this review, representing the scope of categories contained in the analysed LCAs, are:

- energy use (or generation);
- resource consumption;
- energy-related impacts (e.g. acidification, greenhouse effect);
- toxicity (of emissions);
- waste generation;
- wastewater.

The analysis encountered some difficulties of a nontechnical nature. Legislative differences were one area of difficulty. For example, some of the residues from incineration (gypsum, slag and ashes) are currently characterised and registered as waste in the EU Member States, whereas they are classified as by-products in some countries outside the EU. When such differences exist, there is a question of comparativeness. Can the waste generation of two systems from two different countries be compared?

Methodology-related issues

The paper system is complex. The life cycle of paper is characterised by a number of system parameters and system boundary assumptions that not all LCAs include. These parameters and assumptions should cover all essential activities/processes in the technosphere affected by the choice. These parameters include secondary services such as generation of energy from wood residues and paper incineration, forestry services and parallel services provided by the existing waste management systems. LCAs should, as far as possible, include such services in order to describe correctly the environmental impacts occurring when choosing one alternative over the other. These parameters and assumptions are needed to ensure that the systems to be compared are actually fully comparable.

The LCA review has included a systematic exploration of the key system boundary criteria that can have an influence on the result of a life cycle assessment of paper. This exploration has resulted in the identification of 15 key assumptions that cover the three paper cycle system areas of: raw materials and forestry, paper production and disposal/ recovery. The key assumptions are presented in the box below.

Results of the reviewed studies

The results of the 73 scenarios have been classified and presented as a function of the 15

key assumptions identified. The outcome of the individual LCA studies largely depends on the choices made in some of these assumptions; the most important being connected to the geographical conditions of the region analysed.

Nevertheless, the results from the nine LCA studies, produced in different geographical areas and including in different degrees the key assumptions mentioned, all indicate that recycling results in less overall environmental impacts than both landfilling and incineration. These geographical differences are not large enough to result in incineration or landfilling being more favourable. The result is clear in the comparison of recycling versus landfilling, and less pronounced, but also clear, in the than recycling from an environmental point of view. comparison of recycling versus incineration. However, no such case has been found in the LCA studies reviewed. It is theoretically possible that geographical regions exist, where incineration may be a better alternative

15 key system boundary parameters

1. Is the alternative use of land/wood included?
2. Is the saved wood used for energy production?
3. Is wood considered a scarce resource?
4. Which is the marginal energy source for the electricity used in virgin paper production?
5. Which is the marginal energy source for the heat (steam) used in virgin paper production?
6. Which is the marginal energy source for the electricity used in recycled paper production?
7. Which is the marginal energy source for the heat (steam) used in recycled paper production?
8. Is the energy export from virgin paper production included?
9. Which is the main alternative to recycling: incineration or landfilling?
10. Are the emissions from paper landfilling included?
11. Does the thermal energy produced from incineration substitute other sources?
12. Does the electricity produced from incineration substitute electricity from the grid?
13. Are the alternative uses of incineration and landfilling capacity included?
14. In which ratio does recycled paper substitute virgin paper?
15. Is the handling of rejects and de-inking waste from paper recovery?

Life cycle assessment (LCA) technique[1]

Life cycle assessment is a 'cradle-to-grave' approach for assessing the environmental impact of a single product or system. An ideal LCA should include all stages in the product life cycle from the gathering of raw materials for production through to the point where all waste materials and emissions are returned to the earth (or air or water). The total cumulative environmental impacts resulting from the product can thus be estimated by summing the environmental impacts from each element of the total system.
The LCA process consists of four components:

- Goal Definition and Scoping — the objective and audience of the LCA are identified. A functional unit is defined which describes the basic function of the product, process or activity (e.g. disposal of 1kg of waste paper). Quality requirements are defined for input data, and finally boundaries of the system to be studied are set (i.e. which unit processes and subsystems should be included in the total assessment).

- Inventory Analysis — the identification of all raw inputs and outputs into and from the system, i.e. inputs such as energy, water and materials usage and outputs such as air emissions, solid waste disposal, wastewater discharge.

- Impact Assessment — the inputs and outputs into the full system as listed in the Inventory, are further reduced to a number of key impact categories. These might include global warming effect, ozone depletion, human toxicity, ecological toxicity, non-renewable resource use etc. Each impact category will have a set unit, usually equating to the impact of a standard emission e.g. greenhouse gas effect might be given in units of 'tonne CO_2 equivalent'.

- Interpretation — The results of the inventory and/or impact assessment stages are interpreted in order to identify the better performing product among a number of alternatives assessed. A clear understanding of the uncertainties inherent in the results is necessary for this element. The interpretation stage is the most subjective element of an LCA since it often requires decisions to be made on the relative importance of various impact categories.

1) ISO standards for LCA up to the impact assessment stage were published in 1997.

It is also interesting to observe that the results in certain environmental impact categories are more unambiguous than in others with respect to the choice made in the key assumptions. 'Energy use', 'Energy-related impacts' and 'Wastewater' results are clearer than 'Resource consumption' and 'Waste generation' results.

The results obtained refute one of the hypotheses motivating the present study, namely that the results of existing paper LCA studies are very different. Generally, the LCA studies analysed, which were selected from existing literature on the basis of a set of quality criteria, arrive at similar results. Some differences are observed, however. These differences are not found primarily to be due to actual differences in the environmental impacts from the paper systems studied, but rather to differences in the way the LCA methodology is applied. This is especially the case with the definition of the paper system and its boundaries. The differences observed in some of the studies, therefore, are not believed to be the result of conscious methodological choices.

1.3 Summary of the CBA review

Scope

A total of nine studies containing 41 scenarios are included in the review: seven cost-benefit-type studies on paper; one cost-benefit-type study on municipal waste, where

paper is a separate waste fraction; and one life cycle assessment, where the externalities have been subject to monetary valuation. Only two studies were conducted for direct policy support, while the rest have focussed on contributing to the policy debate.

The hypothesis assumed from the outset of the review was that a lot of cost-benefit analyses exist on paper and that it would be possible to gain some general insight from these studies. Surprisingly, the literature inventory only identified a few studies that can be characterised as cost-benefit-type studies on paper, cardboard and paper packaging.

For this reason, a pragmatic selection took place. Studies were selected which included an economic and environmental assessment of alternative treatment options. These studies were transparent in terms of the assumptions and results achieved, and focused on paper/cardboard packaging rather than packaging in general. Moreover, they were European. The studies were all published in the nine-year period of 1994–2002.

The review does not allow conclusions to be made as to the optimal socio-economic level of recycling, incineration or landfilling. Such conclusions are highly dependent on case-specific conditions such as paper type, treatment capacity, transportation distance and prices. Furthermore, the studies do not cover these issues in sufficient detail.

Methodology-related issues

Four guidelines on CBAs from European countries and international organisations have been used to identify six basic CBA steps which form the reference point. A set of criteria was defined on the basis of these steps, and together with the system boundary issues identified in the LCA review, has been used as the basis for the CBA review.

None of the reviewed studies fully applies the basic steps for conducting a CBA. In particular, discounting is avoided in seven of the eight CBA-like studies. One study does not include the monetary valuation but lists environmental and economic conclusions separately.

Few studies have included a description of the 15 key system boundary criteria from the LCA review. Only two of the nine CBA studies include half or more of the 15 system boundary criteria, while the remainder of the studies includes less that half. The limited coverage of the life cycle of paper in the reviewed CBA studies is also illustrated by the number of externalities, or emissions, included in the studies. They vary from 2 to 28 whereas more than half of the studies include around 10 externality parameters.

The parameters that are most decisive for the conclusions of the reviewed studies are:

- time cost;
- waste paper price;
- total external costs;
- system boundary.

The time cost represents the value of private households time spent on sorting and transporting waste paper to recycling facilities. Households are assumed to spend between 15 and 30 minutes per week on this activity. The high cost of this activity turns out to be decisive for the conclusion in three of the five scenarios considering this issue.

The waste paper price typically represents the economic benefit of the recycling activity. However, the market price for waste paper fluctuates considerably, which is why it is a source of uncertainty in a cost-benefit analysis.

In some studies, the total external costs influence the conclusions due to their significantly high values compared with other costs. Unfortunately, the environmental assessment in most of the studies is poorly described. Therefore, it is not possible to specify which the essential environmental parameters are. Nevertheless, it is clear that most of the studies include the traditional air emission parameters from energy production (incineration).

Although the review does not lead to any firm conclusion regarding the choice of system boundary, this choice is still perceived to influence the outcome of a study. The review shows that there are large variations in the system boundaries and the degree to which different elements of the paper system are included. By excluding the upstream elements such as 'avoided virgin paper processing', the potential benefits of recycling are excluded. Moreover, the review shows that the system boundary in the environmental assessment and the economic assessments of a study are not always the same.

Results of the studies reviewed

In the review, 18 conclusions are reported from the nine studies. The number of conclusions is higher than the number of studies because some studies analyse either several waste paper fractions or the sources of collection or they apply more valuation methods for estimating the external cost. More than half of the conclusions find that recycling is the preferred waste management option. Incineration and/or landfill are preferred in the remaining studies and scenarios. If the time cost is excluded, the preference for recycling becomes more explicit.

The nine studies differ extensively with regard to both system boundaries and methodology for assessing the environmental and economic impacts. Due to the limited number of studies and too few studies including the same parameters or applying the same system boundary, it is not possible to draw conclusions concerning a preferable option of waste paper management.

The present review concludes that there is room for improvement in the methodology currently used in waste paper CBAs , regarding improved transparency, improved economic methodology to derive prices, and the use of a more consistent system boundary. There is a need for supplying CBA analysts with more thorough guidance on how to conduct system analysis in connection with cost-benefit studies. Inspiration could, for instance, be found in LCA guidelines.

1.4 Overall conclusion, LCA and CBA reviews

The LCA review concludes that the majority of LCAs indicate that recycling of paper has lower environmental impacts than the alternative options of landfill and incineration. The result is very clear

Cost benefit analysis (CBA) technique

Cost Benefit Analysis is a decision-support tool which helps decision makers to develop policies providing the highest environmental benefits at the lowest overall cost to society. The CBA method attempts to place a monetary value on the environmental and social impacts of a policy, and add them to its commercial costs. The combined 'present value' cost to society can then be equated with the combined cost of an alternative policy.

Six basic CBA steps can be identified:

1. Formulation of the problem/definition of the CBA
2. Description of consequences (scope definition)
3. Monetary valuation
4. Discounting
5. Evaluation (net present value (NPV) and conclusion)
6. Evaluation of uncertainty

The scope of a CBA study is potentially much greater than that of an LCA study which only compares environmental impacts. An ideal CBA would include a full LCA up to the impact assessment stage, as just one element of the scope. No international standards exist for the CBA technique. in the comparison of recycling with landfilling, and less pronounced, but still clear, in the comparison of recycling with incineration.

The CBA review concludes that in little more than half of the CBAs, paper recycling has higher socioeconomic benefits than other management options. In the remainder of the studies, the socio-economic benefits of incineration, landfill or other options are higher than those gained from recycling. It is often said that CBAs are generally favourable to other waste management options than recycling. However due to the heterogeneity of the methodologies used in the reviewed CBAs, it is not possible to confirm or to reject this statement.

These conclusions should be interpreted having in mind the potential and limitations of the LCA and CBA methodologies. Both methodologies involve a series of assumptions enabling the comparison of two or more waste paper treatment options which otherwise would not be comparable. The paper system is complex. It has been found that the necessary assumptions made about the definition of the system borders and the choices about which indirect effects (e.g. energy production from incineration of paper) are included or excluded from the system are decisive for the outcome of an LCA or CBA.

With LCAs, the existence of an internationally agreed procedure, including the requirement of transparency in the calculations, allows the identification of those

assumptions most important for the outcome. The CBA methodology has so far not reached such a level of international agreement about the stages to be followed. Moreover, most studies are not transparent. Therefore, it has not been possible to identify the most relevant background assumptions and their possible correlation with the outcome of the CBA studies. This study has shown, however, that some of the important assumptions concern system analysis and system boundaries definitions.

Drawing from the experience of this review, it seems necessary to further develop CBA guidelines. This would greatly help policy-makers to take informed decisions based on results deriving from this tool.

Use of the results for policy support

One of the objectives of this review is to inform European policy-makers as to whether the individual LCA and CBA studies on this topic gave conclusions pointing in the same direction. It has been shown that there is a clear answer from LCAs, but not from CBAs. A clear answer is, however, not sufficient for a direct transfer to policy-making. When using LCAs and CBAs for decision-making, three main issues should be considered:

a) loss of available information; b) differences in geographical scope; c) the ability to use national studies — especially

CBAs — for supranational policy-making.

Ad a) When considering the decision-support value of CBAs and LCAs, it becomes evident that much qualitative information exists and has to be interpreted. Only a proportion of this information can be quantified, and only a proportion of the quantified information can be ascribed either a monetary value (CBA) or an environmental impact category (LCA). An information pyramid illustrates this process where the information available is selected and structured in a form suitable for decision-making support.

Source: Adapted from Hjerp *et al.* 2005.

LCA and CBA methodologies are two of the best available decision support tools, but it still has to be borne in mind that they operate with imperfect information.

Ad b) Concerning geographical scope, while the CBA is undertaken most often at regional or national level, it is often the ambition of an LCA to address environmental issues on a global scale. The environmental assessment of an LCA typically has a broader scope, and even impacts that may take place outside the country are accounted. This serves to illustrate the difference between the two approaches. However, in the reviewed CBAs the environmental assessment often takes a broader scope than the national one.

Ad c) Even if several national CBAs show a clear, common answer, it is important to point out that policy-makers should be cautious in extrapolating the conclusions to supranational policy objectives. Any CBA on waste paper is conducted using a geographical reference, for example, a locality, region or State. Specific information from these areas is used as input to the studies, and as a result their conclusions are tailored to support policies and targets of that area.

As most CBAs are national in scope, they analyse which waste management alternative option provides the socio-economically preferable solution within the national boundaries. When the system boundary is national, the CBA describes the costs and benefits within the national border. Consequences beyond the border are either ignored or not directly part of the costs and benefits. CBAs typically provide information about the costs and benefits of marginal effects on the market covered by the system investigated. Thus, the sum of national marginal changes within the EU may not necessarily be equal to a beneficial marginal change at EU level. In other words, making the same policy initiatives at European level based on national CBAs can lead to substantial effects on the market, such as changes in prices and market structures. These may not necessarily be socially beneficial in the long run. Due to the broader scope, LCAs, in particular, are more immune to such a generalisation of results when addressing environmental issues at regional or global levels.

Taking all the three issues into account, it is important that policy-makers who intend to use of LCAs and CBAs in decision making are aware of and take into account both the advantages and the possible problems and limitations of these tool.

Image for press release: