

## **EVALUATION OF THE ENVIRONMENTAL IMPACT OF PRODUCTS**

**Draft report covering**

**Step 1: goal and scope definition, and**

**Step 2: evaluation of existing studies and consequences for methodology  
development**

**IPTS/ESTO project**

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## Table of contents

<b>1</b>	<b>INTRODUCTION .....</b>	<b>3</b>
<b>2</b>	<b>STEP 1: GOAL AND SCOPE DEFINITION .....</b>	<b>4</b>
2.1	OBJECTIVES OF THE STUDY .....	4
2.2	DETAILED GOAL AND SCOPE .....	4
<b>3</b>	<b>STEP 2: EVALUATION OF EXISTING RESEARCH AND CONSEQUENCES FOR METHODOLOGY DEVELOPMENT .....</b>	<b>6</b>
3.1	INTRODUCTION .....	6
3.2	REVIEW OF RESEARCH .....	6
3.2.1	<i>Selection</i> .....	6
3.2.2	<i>Aspects of evaluation</i> .....	8
3.2.3	<i>Short comparison of studies</i> .....	8
3.3	APPROACH FOR METHOD DEVELOPMENT .....	10
3.3.1	<i>The usefulness of existing and the need for new research</i> .....	10
3.3.2	<i>Key methodological choices for the new research part</i> .....	10
3.4	ELABORATION OF THE CEDA <sub>EU</sub> MODEL .....	14
3.4.1	<i>Developing CEDA<sub>EU</sub></i> .....	14
3.4.2	<i>Extending CEDA<sub>EU</sub> with use phase</i> .....	15
3.4.3	<i>Environmental impact assessment methods</i> .....	16
	<b>ANNEX 1: TIME TABLE .....</b>	<b>18</b>
	<b>ANNEX 2: LONG LIST OF STUDIES .....</b>	<b>19</b>
	<b>ANNEX 3: PARTICIPANTS EXPERT WORKSHOP, BRUSSELS, 6 MAY 2004</b>	

# 1 Introduction

In June 2003 the European Commission adopted a Communication on Integrated Product Policy (IPP)<sup>1</sup> aiming to improve the environmental performance of products and services throughout their life-cycles. Besides general measures to encourage a wide up-take of life-cycle thinking among all relevant stakeholders, the Commission has announced measures to address individual product groups. This includes the commitment to address products with the greatest potential for environmental improvement. As a first step towards identifying products with such improvement potentials, it is necessary to find out which are the products or product groups that have the greatest environmental impacts. On the initiative of the Institute for Prospective Technological Studies the European Science and Technology Observatory will execute this work. The following ESTO members participate in the study:

- the TNO-CML Centre for Chain Analysis (the Netherlands - Operating Agent/Project Manager)<sup>2</sup>,
- VITO, Belgium, and
- the Technical University of Denmark

The study consists of 5 main steps:

Step 1: Goal and scope definition

Step 2: Evaluation of existing research and consequences for methodology development

Step 3: Methodology development and refinement

Step 4: Application of the methodology and final reporting

Step 5: Participation in stakeholder consultations

This is an interim document that covers steps 1 and 2.

A first version of this document has been discussed at an expert workshop on May 6, 2004 (list of participants in Annex 3). After this, the document has been modified and updated to take into account the input from the workshop.

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<sup>1</sup> COM(2003) 302 final.

<sup>2</sup> This Centre consists of two TNO institutes (STB and MEP) and the Centre of Environmental Sciences of Leiden University.

## 2 Step 1: Goal and scope definition

### 2.1 Objectives of the study

The objective of the study is to identify the products or product groups that have the greatest environmental impact from a life-cycle perspective. This identification should allow the European Commission to select products that qualify for an assessment of their improvement potential and, depending on the outcome, for being addressed within the European IPP.<sup>3</sup>

The following boundary conditions apply:

- The study should cover EU-25
- The work should be based as much as possible on existing research
- The results need to be delivered before the end of 2004.

These objectives and boundary conditions were defined as project brief before the actual start of the study. The first task after the project start was to translate them into more concrete choices about goal and scope. This is described in the subsequent section.

### 2.2 Detailed goal and scope

The objectives of the project were translated into a specific goal and scope description of the project at a detailed level. The choices are presented below. They were agreed upon between the ESTO project team and the IPTS after discussion with Commission Services responsible for IPP:

- a) The study will focus on identifying the product groupings on the basis of their current life cycle environmental impacts ('hot spots'). They will be identified on the basis of the environmental impacts of the whole volume of the product used. The impact per Euro value will also be taken into account.
- b) The study will arrive at product groupings by dividing the EU final consumption into product aggregates at different levels of aggregation. The study will include the following levels (from high to low):
  1. Functional areas of consumption (e.g. Housing, Work, Personal Care, Recreation. Typical resolution: the total final consumption in society is divided in seven to ten elements)
  2. Consumption domains (e.g. transport that contributes to Work and Recreation. Typical resolution: the total final consumption in society is divided into 40 to 60 elements).
  3. Product groupings (e.g. the sub-division of the consumption domain 'transport' into 'car transport', 'passenger air transport', 'freight truck transport', etc.; typical resolution: the total final consumption in society is divided into several hundreds of elements).

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<sup>3</sup> This study hence does not seek to identify products or product groups for which *implementation of improvement options* is relatively easy. The aim is to identify the 'hot spots' with regard to environmental pressure, rather than to identify the 'low hanging fruits'. The improvement analysis is a step after this study.

The study will in principle not go down to the level of (4) more or less homogeneous product groups (e.g. middle-class diesel cars) or (5) even individual products (e.g. a specific diesel car). An analysis at these very detailed levels would hardly be of practical value at this stage of developing IPP, nor would it be feasible technically within this study.

- c) The study will include capital goods, and where possible will pay attention to specific materials such as, packaging and other intermediate products, despite the fact that they are not the primary cross-section in this study.
- d) The study will primarily focus on the EU's final consumption, and not on production for export
- e) Inventory/emission data of accession countries will be modelled on the basis of EU-15. For the accession countries, it can be assumed that in the next 10 years the most obsolete production technologies will disappear or be upgraded to a regular EU technology level. Otherwise the study might point to problem areas that will be solved anyway.
- f) A variety of impact assessment methods has to be used to overcome the inherent discussions about impact assessment methods. Examples of methods to be used are CML plus weighting, EPS, ExternE and Eco-indicator 1999.
- g) No impact categories must be excluded beforehand. The study must be very prudent with ranking on the basis of toxicity impacts, since scientific knowledge about this issue is limited

The goal and scope choices make clear that the method applied should be based on a system approach and elements of life cycle impact assessment. It should:

- allow identifying the products with a great environmental impact;
- be transparent;
- include assessing the degree of robustness of the results (i.e. its dependence of e.g. methodological choices with regard to impact assessment);

## **3 Step 2: Evaluation of existing research and consequences for methodology development**

### **3.1 Introduction**

As a second step in the study, a number of existing reports and tools for analysing the environmental impacts of products for environmental policy making were reviewed. A concise overall review of the studies is given in Section 3.2.

At this stage, the aim of reviewing the existing studies was to establish the state of art in the areas and to find the most suitable methodological approach for this study. The conclusions and consequences for method development are presented in chapter 3.3., covering both the exploitation of existing research results and complementary new research. A first outline of a methodology for the new research part is elaborated in chapter 3.4.

### **3.2 Review of research**

#### **3.2.1 Selection**

Annex 1 gives a long list of studies and tools that was considered for evaluation. Not all were seen as directly relevant. On the basis of the following criteria, the project team chose nine priority studies and tools for further evaluation. The selection criteria included:

- Comprehensiveness (i.e. in principle covering ‘society’ as a whole)
- Focusing on classifying products and aggregations thereof according to their life-cycle environmental impacts
- Focused on an EU country or the EU as a whole
- Covering a reasonable set of environmental problems
- Recently executed (particularly when more than one study was available of one country)
- In principle no more than one study from the same ‘school’ (the same or more or less similar author teams; also here in general the most recent study was selected).

On this basis, the following studies and tools were selected. Table 3.1 indicates the primary project partners responsible for the evaluation. A second partner from the project team has acted as ‘second reader’, which is indicated as well.

**Table 3.1: Studies and tools reviewed**

Number	Reference	Short denomination
1	<i>Identifying key products for the federal product &amp; environment policy – Draft final report</i> , for Federal Services of Environment Department on Product Policy, Institut Wallon de Développement Économique et Social et d'Aménagement du Territoire ASBL/Vlaamse Instelling voor Technologisch Onderzoek, Namur/Mol, 2002.	Institut Wallon/Vito
2	<i>Study on external environmental effects related to the lifecycle of products and services – Final Report Version 2</i> , European Commission, Directorate General Environment, Directorate A – Sustainable Development and Policy support, BIO Intelligence Service/O2 France, Paris, 2003.	Bio/O2
3	Nijdam DS ; Wilting (2003): Environmental load due to private consumption; Milieudruk consumptie in beeld (RIVM rapport 7714040004), 78 p in Dutch. <a href="http://www.rivm.nl/bibliotheek/rapporten/771404004.pdf">http://www.rivm.nl/bibliotheek/rapporten/771404004.pdf</a>	RIVM
4	Rixt Kok, Henk-Jan Falkena, René Benders, Henri C. Moll and Klaas Jan Noorman (2003): Household metabolism in European countries and cities Comparing and evaluating the results of the cities Fredrikstad (Norway), Groningen (The Netherlands), Guildford (UK), and Stockholm (Sweden). Toolsust Deliverable No. 9 Center for Energy and Environmental Studies, University of Groningen. <a href="http://www.toolsust.org/documents/Toolsust-IntegrationWP2deliverable9final.pdf">http://www.toolsust.org/documents/Toolsust-IntegrationWP2deliverable9final.pdf</a> Norwegian report: <a href="http://www.toolsust.org/documents/ToolSust%20D-8%20Norway.pdf">http://www.toolsust.org/documents/ToolSust%20D-8%20Norway.pdf</a>	Toolsust
5	Dall O, Toft J, Andersen T T. (2002). Danske husholdningers miljøbelastning. København: Miljøstyrelsen. (Arbejdsrapport 13). <a href="http://www.mst.dk/udgiv/Publikationer/2002/87-7972-094-3/pdf/87-7972-095-1.PDF">http://www.mst.dk/udgiv/Publikationer/2002/87-7972-094-3/pdf/87-7972-095-1.PDF</a>	Dall/Toft
6	Weidema et al. 2004: Prioritisation within the integrated product policy. In preparation (available only by June 2004 and will be reviewed when available)	Weidema
7	<i>Environmental implications of resource use – insights from input-output analyses</i> , draft 21 October 2003, prepared by the European Topic Centre on Waste and Material flows (ETC WMF)	ETC-WMF
8	Cobas, E. Life Cycle Assessment Using Input-Output Analysis. Doctoral Dissertation, Carnegie Mellon University, Department of Civil and Environmental Engineering, Pittsburgh, PA, 1996.	Carnegie Mellon
9	CEDA 3.0 database. The CEDA 3.0 database is available at CML.	CEDA 3.0

### 3.2.2 Aspects of evaluation

With the results of the Goal and Scope step in mind, an evaluation format for reviewing the studies was developed. An example of the analysis for one study was elaborated. After that, each project partner reviewed his/her allocated studies, followed by a cross-check by another partner. The main elements in the evaluation were:

- Main characteristics (title, date, authors, main approach, etc.)
- Methodological approach and main results (goal, scope and system boundaries, aggregation level, data inventory, impact assessment)
- Main results/conclusions/product classifications,
- Evaluation of strengths/weaknesses of the study
- Relevance of the study for IPP in the EU (geographical relevance, product focus or not, aggregation level, and general acceptance of the method)

### 3.2.3 Short comparison of studies

For a full description and evaluation of each study and tools we refer to annexes to the final report. Here, we briefly review and compare the approaches in the different studies.

Table 3.2 gives an aggregated overview<sup>4</sup>. In methodological terms the existing studies broadly can be divided into two categories:

1. Bottom-up studies that extrapolate market-oriented LCA's to arrive at the environmental interventions associated with a certain commodity or service group. The VITO, Bio/O2 and Dall/Toft study fall in this category.
2. Top down studies, which use environmental extended Input-Output analysis to estimate the environmental interventions associated with the purchase of a certain amount of commodities or services. The ETC-WMF study, RIVM-study, Carnegie-Mellon tool and the CEDA 3.0 tool, fall in this category.

All bottom-up studies focus on household consumption only, whereas the top-down studies (except the RIVM study) cover the whole societal consumption. Most studies have a rather low resolution, and divide final (household) consumption into not more than about 50-70 consumption domains. (Results on more disaggregated levels are usually not regarded as robust.) Data sources depend very much on the type of study (top-down or bottom-up, geographical focus, etc.). Most studies use state of the art methods for Life cycle impact assessment to assess impacts (e.g. CML 2002, Eco-indicator '99). Exceptions are the Carnegie-Mellon Input-Output database, which still uses old characterisation factors for global warming potential and human toxicity, and Toolsust and Dall and Toft, who both use primary energy consumption as main indicator.

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<sup>4</sup> Table 3.2 was inspired by and in part copied from work done by Per H. Nielsen within the framework of the EIRES project, a parallel IPTS/ESTO project on resources.

**Table 3.2: Summary of the reviewed studies**

Main characteristics\Number		1	2	3	4	5	6	7	8	9
	<b>Short title</b>	<b>Institut Wallon/Vito</b>	<b>Bio/O2</b>	<b>RIVM</b>	<b>Toolsust</b>	<b>Dall/Toft</b>	<b>Weidema</b>	<b>ETC-WMF</b>	<b>Carnegie Mellon</b>	<b>CEDA 3.0</b>
	<b>Year of publication</b>	2002	2003	2003	2003	2002	2004	2004	2003	2004
	<b>Main approach</b>	Bottom-up	Bottom-up	Top-down	Hybrid	Bottom-up		Top-down	Top-down	Top-Down
<b>Methodological approach</b>							Study not yet finalised and to be included after finalisation			
	<b>System boundaries</b>	Functional approach to final household consumption in Belgium	Functional approach to final household consumption in Europe	Functional approach to final household consumption in Netherlands	Functional approach to final household consumption in four cities in GB, N, NL and S	Functional approach to final household consumption Denmark		Functional approach to final <b>total</b> consumption in EU-15	This is a description of a database and not a study. Functional approach to total US consumption possible	This is a description of a database and not a study. Functional approach to total US consumption possible
	<b>Aggregation level</b>									
	<b>Principle</b>	Functional, self-defined groups	Functional, self-defined groups	Functional, self-defined groups	Functional, self-defined groups building upon consumer expenditure statistics	Functional, self-defined groups		NACE /EPA classification	SIC	NACE/BEA classificatoin
	<b>Number of groups</b>	12 areas, 45 sub-areas, 120 product groupings, 290 products	13 product families, 34 sub-area's of consumption, ± 100 product groupings	7 function classes, 50 sub-classes	31-75 sectors, 14 product groups	800 products, 30 activities, 7 activity groups		27-57 product groups	481 product groupings	480 product groupings
	<b>Data</b>									
	<b>Consumption (year)</b>	2000	1999	1995	1990ies	2000	1995-2000	1997	1998	
	<b>Production (year)</b>	1995-2000	1990ties?	1995	mid 1990ies	Early 1990ies	1995-2000	1997	1998-2002	
	<b>Production (technology)</b>	Country of origin	West European	Present	West European	West European	Germany	US	US	
	<b>Impact assessment</b>	Characterisation and LCIA	LCIA, and characterisation	LCIA	Energy	Combined	LCIA	LCIA	LCIA	
	<b>Indicators (environment)</b>	GWP, AC, POCP, COD, waste, heavy metals, eutrophication, etc.	GWP, ODP, AC, POCP, TOX (4), YOLL etc.	GWP, AC, POCP, Noise, NP	Primary energy consumption	Primary energy Waste	GWP, AC, POCP, waste	GWP, Toxicity (TLV), plus economic valuation	Impact assessment according to CML 2001, Eco-indicator '99, and EPS	
	<b>Indicators (resources/ other)</b>	Material intensity (5), Energy intensity (3), water intensity (1)	Depletion of non renewable resources (internalisation) external costs (6)	Land use, wood, water, fish	Primary energy consumption	Primary energy resources added together	TMR, primary energy, land use	Probably absent	Impact assessment according to CML 2001, Eco-indicator '99, and EPS	
<b>Main results</b>										
	<b>Sources of the greatest environmental impacts</b>	Building structure Building occupancy Transportation Information technologies and paper Packaging	Transport Building occupancy Food products Water supply MSW management Packaging Civil work	Food Housing Leisure	Fuels, heat and electricity Food Recreation and transportation	Food Transportation Housing	Construction Food and agricultural products Metal products (motor vehicles, basic metals and machinery) Electricity, gas, steam and hot water supply Chemicals and chemical products	This is a description of a database and not a study. Impacts can be calculated at each level of aggregation above the 481 product groupings but are not directly available	This is a description of a database and not a study. Impacts can be calculated at each level of aggregation above the 480 product groupings but are not directly available	
<b>Relevance for IPP</b>										
	<b>Geographic area</b>	Belgium	EU-15	Netherlands	NL, N, GB, S	Denmark	EU-15 based on German data	US	US	
	<b>Product focus ?</b>	Broad selection of products	Products/services	Final household consumption	Household metabolism	Household consumption	Final consumption	Final consumption US	Final consumption US	

At the high level of aggregation that forms the common denominator for the studies, there is little disagreement about the most important functional areas of consumption from an environmental perspective. Food, transport, and housing (or similar consumption domains) are always at the top of the lists. However, per Euro spent, the ranking of consumption categories according to environmental impact is quite different.

### **3.3 Approach for method development**

#### **3.3.1 The usefulness of existing and the need for new research**

The review of existing studies shows quite robust results at the level of functional areas of consumption and to some extent also at the level of consumption domains. Their geographical scope is, however, not identical to EU-25. They usually have certain methodological limitations, and they hardly provide useful results at the level of product groupings. The preferred methodological approach for this study is therefore to combine the exploitation of results of existing research studies with complementary new research in the following way.

First, the results of existing research are used to develop in a systematic way a classification of 1.) functional areas of consumption and 2.) consumption domains according to

- the importance of their environmental impacts
- the degree of robustness of the results, and
- possibly some other criteria (e.g. which phases of the life-cycle are responsible for main environmental impacts).

Then a coherent new analysis is carried out that allows consolidating the results at the levels of functional areas of consumption and consumption domains, and refines the classification by analyzing as far as possible the environmental impacts at the level of product groupings. The resulting degree of robustness of the results will be clearly qualified at the different levels.

Such an approach allows taking full advantage of the state of research and knowledge about which products have the greatest environmental impacts, and to develop it further in key areas to close existing knowledge gaps.

Systematic and transparent methodologies will be developed for both consolidating the existing research results and for the new research in the next project step. Concerning the new research key methodological considerations have already been presented and discussed at an expert workshop on May 6, 2004<sup>5</sup>. The following sections present the key choices that will guide the methodology development for the new research part of the study.

#### **3.3.2 Key methodological choices for the new research part**

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<sup>5</sup> Annex 3 lists the participants of this expert workshop.

### ***Bottom-up or top-down?***

Both types of approaches have their advantages and disadvantages. With regard to bottom-up studies, which take existing LCAs as a basis, the following advantages and disadvantages can be discerned:

#### Advantages

- Availability of LCI databases that allow covering (Western) Europe is quite good.
- The bottom-up studies can be designed relatively easily in a way that allows include the full life cycle of products (production phase, use phase and disposal phase).

#### Disadvantages

- The numerous product LCAs to be used are likely to be of very different quality, leading to important inconsistencies between the way how product groupings are evaluated.
- Extrapolating results of individual LCAs to different product groupings is difficult and subjective.
- The product LCAs make use of cut-offs, leading to an incomplete view of environmental impacts.
- Regular updates are very difficult to realise; in principle then the underlying LCAs would need to be redone.
- The approach is very laborious and it is unlikely that a meaningful study reaching the level of resolution of product groupings desired can be performed in a reasonable time.

The advantages and disadvantages of top-down studies (including using NAMEAs), that are based on existing Input-Output databases, can be characterised as follows<sup>6</sup>:

#### Advantages

- The full inventory (without cut-offs) for the production phase of the commodity or service is taken into account.
- Environmental interventions of goods and services produced within an economy are assessed consistently.
- If existing Input-Output databases can be used, this greatly facilitates the work with regard to data inventory.
- In principle Input-Output databases can be relatively easily updated.
- There are tools for top-down analysis that allow achieving the desired resolution at product grouping level (e.g. 500+ product groupings in the case of the CEDA 3.0 and the Carnegie-Mellon tools).

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<sup>6</sup> Note that the Carnegie Mellon tool and CEDA 3.0 tool are not specific studies but were developed as tool to assess the environmental interventions associated with the purchase of goods and services in general. Later on these tools have been used in several studies with different purposes among which integrated product policy. In contrast, the ETC-WMF study and RIVM study used environmental extended input-output analysis (NAMEA) for use in integrated product policy.

*Disadvantages*

- Considerable extra efforts are needed to take into account the environmental interventions associated with the use phase, because this is not yet included in the available analytical tools.
- Similarly, considerable extra efforts are needed to take into account management services for households as this is not yet provided by existing tools. (However environmental interventions associated with waste management services needed during the production phase of the product or service are already part of the input-output based tools.)
- None of available studies or tools has been prepared for the EU-25 as such. The Carnegie-Mellon tool and CEDA 3.0 tool cover the US economy and the ETC-WMF study builds on the IOA tables of Germany. The RIVM study primarily covers the Netherlands, while the Danish and Swedish studies have similar focus on national consumption.
- The IOA tools all date back to the 1990's, with CEDA using the most recent IO tables now available.

Given the goal and scope chosen, and on the basis of the arguments above, the a top-down approach using Input-Output based tools turns out more suitable for this project because:

- The bottom up studies are not available to the degree required (limited number of LCAs, with different methods).
- The bottom up studies remain too close to specific products and even more specific variants thereof.
- The bottom up studies available use different methods for establishing environmental consequences and hence are not fully comparable.
- The top down studies are in principle most relevant for a clear and consistent survey;
- Existing Input-Output studies in principle allow reaching the desired level of resolution within the time frame of the study.

***Which Input-Output model should be the basis?***

As mentioned above, (environmental) Input-Output tables have not been established yet at the level of EU-15 or EU-25. Building a totally new and dedicated Input-Output table is a major multi-year effort that is out of reach for this study, which has to base itself on existing Input-Output studies, or a combination thereof. As indicated already in 3.2 and 3.3., the existing Input-Output studies tend to have quite different geographical scopes, divisions into final product groups, and divisions into industry sectors. It would be rather arduous to combine the underlying databases used in the different studies/tools. The best strategy hence is to choose the most suitable available Input-Output model as a basis, and adjust it for use in this study.

Of the four Input-Output studies/tools reviewed (see section 3.3.2), the ETC-WMF and the RIVM method have too high levels of aggregation; represent a small part of EU 25 only; have a relatively large share of imports and hence miss relevant EU sector data in their national tables; and/or incorporate a limited number of environmental

interventions<sup>7</sup>. Both the CEDA 3.0 and Carnegie-Mellon tool build on the most recent IOA tables of the US and can provide answers on the same level of aggregation (about 500 goods and services) which seems sufficient for integrated product policy. Both tools make, generally speaking, use of the same databases on environmental interventions which are rich in detail. From a practical point of view it is important to know how environmental interventions and industry categories have been coupled which is often not a straightforward exercise as described in the section on the CEDA 3.0 tool. The coupling of environmental intervention and industry categories has not been described very well for the Carnegie-Mellon study. In general the Carnegie-Mellon study has not been described in very much detail. In contrast, for the CEDA 3.0 tool all basic data is available, together with a detailed description of the data transformations. Furthermore, the CEDA tool is more flexible than the Carnegie Mellon study, as the impact assessment methods including those developed under the EU projects are readily applied with CEDA.

In conclusion, it was decided to use an adjusted CEDA 3.0 tool (CEDA<sub>EU</sub>) as a basis in the EIPRO project, for the most detailed level of analysis. Important adjustments will be made to adapt it to the EU situation, both in terms of adjusting the IO table to the European economic structure and in terms of the overall level of resource use and emissions, which will be European data. Even if this will not be fully equivalent to using a genuine European environmental Input-Output model (which is currently not available), it is the preferred solution. The advantage lies in the detailed nature of CEDA<sub>EU</sub> as compared to the more aggregated nature of the tables available in Europe, for only small parts of the EU25. The Danish project on product policy (of which first outcomes have just become available) for example is partly based on specific Danish process data; partly on Danish Input-Output data with environmental extensions; and partly on the detailed Input-Output data from CEDA. The uncertainty analysis on the results indicates that the uncertainty involved in using the more aggregated (Danish) data is higher than when using the more detailed technology characteristics of the US data (Weidema, SETAC-Europe Conference, Prague, 20 April 2004).

The need for adaptations is alleviated by the fact that technology differences are diminishing in those sectors that are characterised by globalisation. It can be assumed that there is technological similarity in many sectors. However, adjustments of the technology characteristics will be made in a number of sectors, where this is important. Alternatively, the available European technology tables will be used to force the US data into the actual European technology structure, using the more aggregated European tables for that purpose. A survey of options in this respect will be made.

The final demand structure in CEDA will be fully adjusted to that of the EU25.

More details on transforming CEDA 3.0 to CEDA<sub>EU</sub> are presented in following sections, namely in section 3.4.1:

- Adjustment of sector structure to the European situation.
- Using EU25 household and government consumption data.
- Adjusting the environmental interventions to the European situation.

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<sup>7</sup> This, incidentally, is also the case for other Input-Output tables available from other EU countries which were not reviewed in this study.

and in section 3.4.2:

- Add the expenditures on consumption categories of the EU
- Add the environmental interventions in the use phase of household consumption of the EU25, including post use waste management.

Basing our work directly on a detailed (regionalised) EU25 table would clearly have been preferred. Such a data source cannot become available on short notice, as it requires a fundamental realignment of European data gathering and modelling<sup>8</sup>.

As CEDA 3.0 is not linked to specific environmental impact assessment methods but supports a large number of these, a further choice on such methods is required, and indicated below in section 3.4.3.

### **3.4 Elaboration of the CEDA<sub>EU</sub> model**

#### **3.4.1 Developing CEDA<sub>EU</sub>**

In principle, for CEDA<sub>EU</sub> to represent emissions and industry inter-relationships in the EU, three types of data in CEDA 3.0 need to be adjusted.

There are no fundamental reasons why the difference between the technology structures of EU and the US should be large. Main differences seem to be related more to the pattern of final demand than to the underlying technology structure as captured by the Input-Output technology matrix. However, there are some areas where adjustments will be needed, especially concerning the interrelationships between energy transformation sectors and other industry sectors and inputs into agricultural production. The contribution of different energy transformation industries (nuclear power plants, coal fired power plants, etc.) to total electricity generation might not deviate very much in the US and EU-25. This will be checked and if considerably different, the energy mix (ie: the input and output ratios) will be adjusted in the IOA tables. Inputs into agricultural production in the form of fertiliser is probably lower in the US than in the EU-25 and should be adjusted. Following this line of adaptation, intermediate production and distribution of other goods and services between industry sectors is assumed to be the same in the US and EU-25. A more fundamental adjustment might be possible, adapting the technological relationships between industry sectors in a general way only, using data on the European technology structure as are available at a more aggregate level. This option will be investigated as prime choice. The demand vector (how much of a certain commodity or service is produced by an industry with respect to other commodities or services) will of course differ between the US and the average European final demand pattern. This final demand vector therefore has to be adjusted to the European situation.

There are two options for adjusting the environmental intervention data. As a first option, it could be assumed that the environmental interventions associated with the production of goods and services need not be adjusted for the largest part, on the assumption that most technologies are of a global nature with global firms competitively engaged in their implementation. Only where markets are not global or

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<sup>8</sup> Following, the US, Japan now also has produced a detailed Input-Output table with broad environmental extensions, making the lack of data in Europe even more pertinent.

where nature differs systematically, as to some extent for agricultural production, the sectoral emissions would be adapted, as for fertiliser input and application of pesticides. This also holds for energy use where tax patterns differ fundamentally, see above for the possible adjustments indicated there. Some further adjustment may be made in the emission pattern of car transport. A second option is to adjust the total emissions generated in the model to the overall European emission volumes for which data is available. The overall volume is distributed over the sectors using the available European tables for aggregate structure and the detailed US tables for the underlying detailed patterns.

Perhaps in some sectors technology being used in the new member states is currently not at the level of West-European industry. However, it is expected that the new member states, by complying to EU (environmental) regulations and adjusting to European market requirements will within a few years attain the same level of technology. Targeting integrated product policy towards products and technologies that are already being phased out does not seem useful. Therefore the assumption that the new member states can be modelled as if being at the same level of production technology in Western-Europe seems reasonable and practical within this project.

### 3.4.2 Extending $CEDA_{EU}$ with use phase

The IO framework can be extended with the use phase and with post-use waste management and recycling activities. This can partly be done by connecting the IOA output to so-called consumption tables. In the consumption tables, all commodities & services needed for the fulfilment of specific functions within society are given. In principle all functions, at a certain level of aggregation, needed within society are listed.

Final demand in principle covers three categories: household expenditure, government expenditure and exports. Exports may be specified, but this specification has limited value in the context of IPP. Government expenditure will be specified in terms of European demand. The use activities of government expenditure, like related to maintenance of and exercise with military equipment, will not be specified in this study, where the prime focus lies with household consumption.

The relevant household consumption tables could be taken either from the Eurostat consumer expenditure survey or from the RIVM study, or might be developed specifically in this study. Practical problems that arise in the use of consumption tables are:

- How to connect the output from the IOA tool with the consumption table in practical sense: different level of aggregation, different classification systems, etc. This does not seem to be a very big problem because standard classifications have been developed to some extent.
- How to incorporate waste management & recycling in the post-consumer disposal phase. Waste management and recycling after the use-phase can likely only be incorporated in a very standardized way, distinguishing between a few technical options, related to recycling, incineration and land fill. For that purpose, the product volumes are to be transformed into mass volumes, and the mass volumes distributed over the disposal phase techniques.

A further problem with the consumption tables is that they do not tabulate the environmental interventions associated with the consumption of the goods and services. For example, the emission of pollutants while driving the car are not taken into account. This is a serious omission which needs to be amended. We propose to use information on the energy use of households for cooking, driving, etc. for correction of this data gap. There are some environmental interventions in the use phase which are not covered like:

- Emission of VOC's when applying paint in households;
- Application of pesticides in households & private gardens: There are no data on the application of pesticides for private use in the EU-25. However total sales of pesticides is known.
- Application of fertiliser in private households: We will look into options to take this into account if relevant. Beware that total application in agriculture for the EU situation has been taken into account.
- etc.

However for most of the environmental interventions in the use-phase, except energy use, the contribution is small with respect to those in the production phase, and diminishing under the influence of the EU VOC Directive and similar legislation in the US.

We propose to link household emissions in the use phase to a most disaggregated level possible, in contrast to most consumption studies available now. Eg, an aggregation to 'households' is possible. We will stick however to the level of 'household heating' primarily, allowing for later aggregation of several household elements to the 'household' level. If aggregating directly, the detailed level cannot be made available any more; that information than has not been produced.

### 3.4.3 Environmental impact assessment methods

The result of the consumption analysis first is in terms of the large number of environmental interventions on which data is available. For interpreting these, their environmental impacts will be given using several impact assessment methods. These can roughly be grouped into midpoint methods and endpoint methods. Midpoint methods specify potential effects on environmental problem themes like global warming, ozone layer depletion, acidification and human toxicity. Endpoint methods specify effects in terms which are more directly amenable to evaluation, like human health (eg WHO DALYs) and biodiversity (RIVM PAFs). At an aggregate level, most methods show similar results and hence can be combined without further choices between them. However, at the intended level of detail, specific products may deviate from this general pattern and an overall view then is difficult to obtain. In that case, we propose to use the CML2001 method as the reference midpoint method. and the EcoIndicator'99. as the reference endpoint method. Results will then be compared to the several other methods available. For both methods a further aggregation step into a single score is possible, with weighting sets as are practically available. This step may be applied tentatively, if wished so, as technically it is a very simple operation, leading to a single environmental score per product.

Some interpretations of results are contentious. E.g., the toxicity of different substances may be viewed differently. By clearly stating so, and by indicating an interpretation with several available methods, such unavoidable ambiguities in scientific knowledge will be resolved. A number of environmental aspects are not fit yet for inclusion in the current analysis, like the risks from genetically modified organisms. Such unavoidable omissions will be stated.

## Annex 1: Time table

Step	Name task	Start date	Detailed end date
1	Goal and scope definition	<i>Week 0-3</i>	End: 13 February
	Discussion		5 February
	Finalising evaluation format		13 February
2	Evaluation of existing studies	<i>Week 3-Week 13</i>	End: 23 April
	Study selection		Finalised 20 Feb
	Study evaluation		Finalised 20 March
	Review of study evaluation and developing outline for methodologies		Finalised 15 April
	Comments IPTS on former point		Comments given well before 22 April Included in document 22 April
	Workshop to discuss results with experts and stakeholders	<i>Around Week 15</i>	6 May
	Project team meeting		7 May
3	Methodology development and refinement	<i>Week 17-Week 28</i>	Start: 15 May End: 31 July
	Workshop to discuss results with experts and stakeholders	<i>Around Week 30</i>	2 September
	Project team meeting		3 September
4	Method application and final reporting	<i>Week 32-Week 47</i>	
5	Participation in stakeholder consultation and revision	<i>Week 48 – Week 61</i>	

## Annex 2: Long list of studies

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## **Annex 3: Participants expert workshop, Brussels, 6 May 2004**

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### **Commission**

- Julio Cardoso (DG Enterprise)
- Orsolya Csorba (DG Environment)
- Robert Goodschild (DG Environment)
- Luis Delgado (DG Joint Research Centre – IPTS; chair)
- Peter Eder (DG Joint Research Centre – IPTS)