



Danish Ministry of the Environment  
Environmental Protection Agency

# Assessment of potentials and limitations in valuation of externalities

With special focus on Environmental  
Profit and Loss

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Assessment of potentials and limitations in valuation of externalities

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# Foreword

This study was conducted by COWI on behalf of the Danish Environmental Protection Agency in December 2013 through January 2014. Doctorate candidate and CFO Munif Mohammed was included as a COWI sub-consultant. The study included both desk studies and workshops with the Danish Environmental Protection Agency.

The report's discussion and proposed initiatives to enhance the use of environmental profit and loss accounts (EP&L accounts) are, among others, based on bilateral discussion with major Danish companies and national and international institutions having an interest in developing and implementing methods for valuating environmental impacts at company level of production and consumption of goods and services.

In parallel with this project COWI met with representatives from various companies and public authorities to understand business needs when it comes to valuation of externalities. Due to confidentiality aspects findings are not specifically described in this report, but recommendations are in line with the findings. A detailed description of recommended initiatives is developed during February 2014.

# Conclusion and Summary

A relatively new trend in the way business considers and reports on the wider impacts of business activities is the application of monetary valuation of environmental impacts in the supply chain. The development of environmental profit and loss accounts (EP&L accounts) pioneered by companies such as PUMA constitute an important example of this trend.

The objective of our study has been to review the application of the EP&L approach using the companies PUMA and Novo Nordisk as case studies. It follows from the case studies, that monetary valuations of environmental impacts may provide a valuable overview of the societal footprint of the business upstream activities on human welfare and also that the EP&L is a powerful method of communicating and raising awareness on the environmental and societal cost of doing business. When carrying out studies of this kind, many internal and external stakeholders will surely gain insight and identify new problems requiring sustainable solutions.

The monetary valuation of externalities throughout the supply chain, which reflects a widening of economic analyses to cover the company level, can thus be very beneficial in itself.

Our main observation is that valuation of externalities is a matter of ambition and thus a choice of finding the right balance in the need for accuracy, cost and value of preparing the EP&L, all with the stakeholders' demands in mind.

Preparing an EP&L account can be a costly exercise. Thus, the EP&L in its present form is primarily for the very ambitious/large companies and even for them it is not necessarily considered realistic to prepare the EP&L annually, e.g. for internal or external reporting. Even though the EP&L has shown its value with respect to identifying the most critical impacts in a societal context and thereby as a useful decision basis. The EP&Ls examined in this survey were backwards looking, providing an 'as-is' status and is more focused on putting a price on the impact than identifying means for improvement to the benefit of the environment. In that case it is not easy to use the EP&L in strategic contexts such as strategic planning, deciding between different options or estimating the future value creating potential of changing the design, business model applied or production processes.

This leads us to conclude that the value of EP&L as a sustainability management framework is substantial. The approach could be enhanced by developing less data-intensive approaches and by enabling forward looking assessments.

In this report, we discuss the potentials of other approaches for valuating environmental impacts at company level. Approaches focusing on lower accuracy of both the impact assessment and the valuation methods are considered very interesting: If designed smart, they are considered attractive to more companies especially as they are less resource demanding in term of cost and specialist knowledge. Furthermore, standardized and simplified approaches may be applied for forward looking strategic purposes where less accuracy on e.g. the cost division on the different tiers may be accepted. Such a more simple, transparent and consistent approach may – for the very ambitious – be combined with more detailed approaches on specific issues of concern such as those used by PUMA and Novo Nordisk.

A line of initiatives to develop and test such new and easier applicable sustainability assessment approaches is proposed.

# 1. Introduction

## 1.1 Background

In 2013 the Danish Environmental Agency (DEPA) conducted a number of projects in order to describe the potentials and limitations associated with CSR reporting and monetary valuation of externalities. The projects were among others inspired by PUMAs Environmental Profit & Loss report from 2010 and the Novo Nordisk Environmental Profit & Loss (EP&L) report from 2013, where material environmental impacts throughout the value chain were assigned a monetary value<sup>1</sup>.

The projects included a study of the drivers in businesses in relation to CSR reporting, a screening of the possibilities of preparing and disseminating Environmental Profit & Loss (EP&L) reports in Danish businesses and – finally – the present assessment of the potentials and limitations of approaches for valuation of externalities – with a particular focus on EP&L.

COWI conducted the study on behalf of DEPA, and this report describes the results of the study.

## 1.2 Objective

The study objective was to:

- Screen approaches for monetary valuation of externalities that are used or have been used by companies and institutions in Denmark and internationally;
- Describe selected approaches with focus on identifying potentials and limitations in connection to using the methods in a business context;
- Propose overall initiatives that is expected to support the use of EP&L's in Danish companies.

In other words, the study aimed to qualify the decision-making base for businesses and public authorities with regard to valuation of externalities at corporate level and support the prioritization and direction of the future work on EP&L and other methods for valuation of externalities.

## 1.3 Overall approach

The overall approach consisted of a number of steps:

- Step 1: A review of the approaches used in Novo Nordisk EP&L and the PUMA's EP&L was carried out, thereby launching the screening of methods available
- Step 2: Selected additional business approaches to valuation of externalities were included in order to nuance the discussion of possible initiatives to enhance the use of EP&L's in Danish companies.

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<sup>1</sup> EP&L references used throughout the report:

- PUMA (2011): "PUMA's Environmental Profit and Loss Account for the year ended 31 December 2010"
- Novo Nordisk (2013): "Novo Nordisk's Environmental Profit and Loss Account", conducted by NIRAS A/S, Trucost PLC and 2.-0 LCA consultants
- Novo Nordisk (2013): "Methodology report for Novo Nordisk's Environmental Profit and Loss Account", conducted by NIRAS A/S, Trucost PLC and 2.-0 LCA consultants



- Step 3: The methods dealt with in the previous steps were analyzed and described focusing on potentials and limitations of approaches with a view to the use of these in companies with different reporting needs.
- Step 4: Preliminary findings were discussed across types of businesses and geographies in order to identify the key challenges and opportunities when valuating externalities at company level.
- Step 5: Final reporting.

#### 1.4 Terms and definitions

The key terms used in this study and their definition follow form Box 1 below.

<p><b>BOX 1: DEFINITION OF EXTERNALITIES, INTERNALISATION OF EXTERNALITIES AND VALUATION OF EXTERNALITIES</b></p>
<p><i>Externalities</i> refer to situations when the effects of production, consumption of goods and/or services imposes costs or benefits on others which are not reflected in the prices charged for the goods and services being provided (Khemani, R.S. and Shapiro, D.M (1993), "Glossary of Industrial Organisation Economics and Competition Law" Directorate for Finance, Fiscal and Enterprise Affairs, OECD</p> <p><i>Internalisation of externalities</i> refers to the situation when the costs of externalities are taken into internal cost of the business. This could be through state regulation such as taxes, subsidies, through pseudo-market or through markets mechanisms such as pricing of externalities.</p> <p><i>Valuation of externalities</i> refers to the process of putting a value on the cost and benefits of externalities qualitative, semi-quantitative or quantitative. A quantitative valuation may be monetary valuation.</p>

# 2. How Does Reporting Bring Value to a Business – With Special Focus on EP&L?

In this chapter we try to answer the above question. If voluntary reporting on valuation of environmental impacts are to be widely applied, it is paramount that it contributes to value creation for the individual company, taking into consideration the size of the company and, hence, its resources and impact on the environment.

## 2.1 What is the value of corporate reporting?

Generally speaking corporate reports – be it conventional annual reports, environmental reports, knowledge reports, CSR reports, integrated reports etc. – can be said to serve the purpose of providing transparency to informed decision making. Decision makers are in-house management and external stakeholders such as customers, investors, authorities, NGOs, and consumers – each having their specific information needs. There is a growing realisation for the need for integration of financial and non-financial reporting.

Reporting process is driven by specific information needs depending on companies, contexts and viewpoint of the user. Thus there are potentially huge differences from one reporting situation to another. As a consequence, there is no one-size-fits-all and there is no generally applicable best practice on reporting<sup>2</sup>.

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<sup>2</sup>Selected references on sustainability reporting:

- A renewed EU strategy 2011-2014 for Corporate Social Responsibility, European Commission, 2011
- Carbon Disclosure Project (CDP):- <https://www.cdproject.net/en-US/Pages/HomePage.aspx>
- Carrots and Sticks, Sustainability reporting policies worldwide – Today's best practise, tomorrow's trends; KPMG, Centre for Corporate Governance in Africa, Global Reporting Initiative, and UNEP, 2013
- Consultation draft of the international <IR> framework, Integrated reporting; The International Integrated Reporting Council, 2013
- Disclosure of non-financial information by companies; Kommissionen 2011
- Dow Jones Sustainability Indices, <http://www.sustainability-indices.com/sustainability-assessment/corporate-sustainability.jsp>
- Frequently Asked Questions on Corporate Sustainability Reporting - Tackling the big questions around the global corporate sustainability reporting agenda, UNEP, CDSB, GRI, 2013
- G4 Sustainability Reporting Guidelines, GRI, 2013
- Guide to Corporate Ecosystem Valuation – A framework for improving corporate decision-making, WBCSD ecosystem
- Proposal for a directive of the European Parliament and of the Council amending Council Directives 78/660/EEC and 83/349/EEC as regards disclosure of non-financial and diversity information by certain large companies and groups; European Commission, 2013
- PUMA's Environmental Profit and Loss Account for the Year ended 31 December 2010

## BOX 2: PARALLELS TO ANNUAL AND GREEN ACCOUNTS

Monetary valuation of externalities (EP&L) has a profoundly different perspective on business and businesses' environmental impacts compared to conventional business accounting.

Conventional financial or environmental accounts present figures directly related to business activities. Figures illustrate performance in isolation from environmental and social context. Such accounts – and in particular the financial accounts – have a well-defined and narrow scope, and are based on well-established accounting principles, concepts and methods supporting comparability over time and across companies. Purpose is relatively narrow and there is a well-defined audience.

EP&L accounts on the other hand consider the environmental and social context. They have broader scope and complexity is high as they typically consider the supply chain. EP&L accounting principles, concepts, and methods are emerging, but experience is still very low and applicability in general business context is still unclear.

What is decisive is that the EP&L approach establishes the link between business activities and environment/society in a language which is more in line with financial accounts. The monetized impact on human welfare creates a new kind of transparency – a new basis for making informed decisions.

## 2.2 Starting point

In relation to voluntary reporting, particularly CSR reporting, GRI, CPD and other environmental reporting going beyond explicit demands is generally published by larger companies. Small and medium-sized companies tend only to report if there are clear legal requirements or direct demands from customers. Even among big companies the reporters are in a minority. Recently The European Commission estimated that only about 2,500 out of 42,000 big companies in EU report on CSR. Worldwide about 6,000 organizations (including companies) have a registered profile in the Global Reporting Initiative (GRI) database associated to the sustainability reporting guidelines – about 100 reports from Denmark are found in the database. Close to 7,000 companies have signed the UN Global Compact and report in that context – out of these 295 are Danish. The number of companies reporting to Dow Jones Sustainability Index (DJSI) and/or Carbon Disclosure Project (CDP) is in the same range.

- 
- PUMA – First environmental profit and loss account, <http://about.puma.com/puma-completes-first-environmental-profit-and-loss-account-which-values-impacts-at-e-145-million/>
  - Reaching investors – Communicating value through ESG disclosures; GRI 2009
  - Redefining Materiality II; AccountAbility, 2013
  - Translating environmental, social and governance factors into sustainable business value, WBCSD and UNEP FI, 2010

Despite the relatively low number of companies reporting on CSR or environmental performance, these companies represent a significant amount of global assets/turnover.

### **2.3 Considering reporting form and target group**

Reports are made for management and employees in companies and for external stakeholders such as investors, customers, and consumers. A separate target group, not always highlighted by companies themselves, is the public authorities; companies want to increase its negotiation power vis-a-vis public authorities (and governments).

One single report may target a number of different stakeholders but reporting is increasingly tailor made for narrower target groups to meet their preferences regarding information, transparency and supporting the kinds of decisions they will make. Accordingly, reporting takes many forms:

- Companies' own reporting formats and reports;
- Companies reports based on standard frameworks and guidelines (such as GRI and UN Global Compact CoP);
- Investors' and analysts' (DJSI and other) questionnaires;
- Supplier to customer reporting databases (such as SEDEX);
- Product labelling for consumers.

Preferences or information needs of different target groups obviously depends on the situation as mentioned above. However, main concerns and needs of specific stakeholders are outline in broad terms below, mainly to indicate differences and similarities:

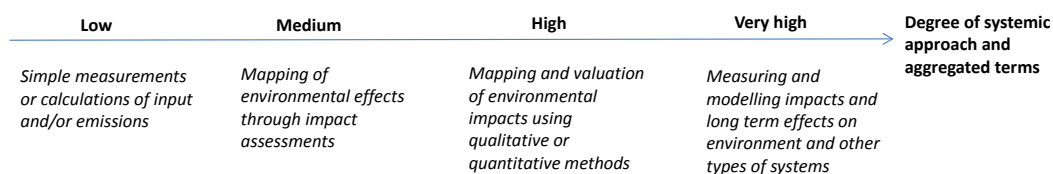
- Investors – comparing businesses and making decisions regarding companies as potential investment objects:
  - Valuation of the business in context – in the long term as well as the short term perspective – based on in-depth information on risks/opportunities associated to issues such as climate change, water scarcity, and social license to operate;
  - Evaluation of corporate governance and management capabilities, targets and strategies;
  - Evaluation of intangible assets.
- Suppliers, customers, consumers – making decisions regarding cooperation, and buying products:
  - Assessment of value creation, ethics and performance on specific topics;
  - Assessment of products in a lifecycle perspective.
- In-house management – making operational and strategic management decisions:
  - Understanding business in context – including competitive environment, sphere of influence and stakeholder landscapes;
  - Performance management, understanding what activities, efforts and impacts that are material to business and prioritization;
  - Giving insight and overview of the environmental impacts of the business activities;
  - Target group can comprise to different degree environmental and CSR departments but also finance, procurement, supply chain, production, and executive management.

### **2.4 Choosing reporting approach**

CSR and environmental reporting began about 20 years ago, still more companies make reports and the reporting as such has developed since. Among reporting companies there are trends towards changing approach to more advanced reporting:

1. From reporting emissions to reporting on impact – i.e. increasingly considering business context;
2. From reporting on the narrow scope to reporting on entire value chains – i.e. increasingly considering sphere of influence;
3. From separate reports towards integrated reports – i.e. increasingly considering business implications;
4. From backward looking to forward looking – i.e. from an accounting approach to a strategy and business development approach.

The EP&L accounts are in line with these developments – not least with regard to point one and two above. The evolution of reporting development over time is illustrated in the figure below. However, EP&L is still not integrated and still backward looking, which is in fact the typical approach to environmental reporting.



**FIGURE 1: TYPES OF MEASURING AND REPORTING APPROACHES**

Different approaches have different goals and may therefore be relevant and sufficient for different target groups depending on their needs. It is illustrated in Figure 1 above. As can be seen, from left to right there is an increasing holistic/systemic approach and aggregation of data; aggregation of data means using one and only one unit (e.g. a common monetary value across different systems and impacts). Thus, it is important to consider the continuum above when choosing the reporting approach that can fulfil the needs of a specific target group whether internal or external.

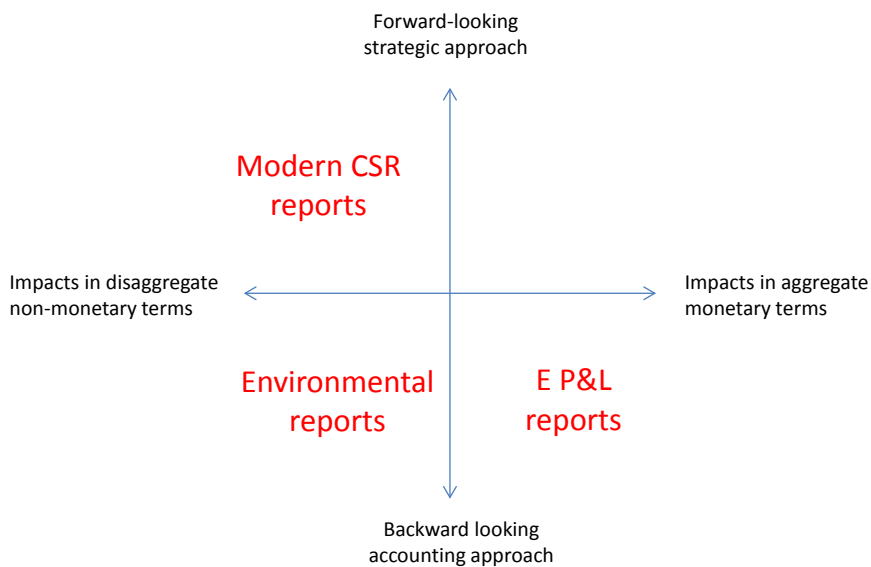
With regards to defining the reporting needs on valuation of externalities the WBCSD's report on corporate ecosystem valuation<sup>3</sup> provides a detailed guideline for deciding the ambition level and the choice of the specific approach (see supplementary explanation below).

The continuums are illustrated in the Figure 2 below. Given the characteristics of EP&L it is placed in the lower right corner. Conventional environmental reports are placed in the lower left corner. Advanced modern environmental and CSR-reports that are integrated, forward looking reports on impact along the value chains will be in the upper left corner.

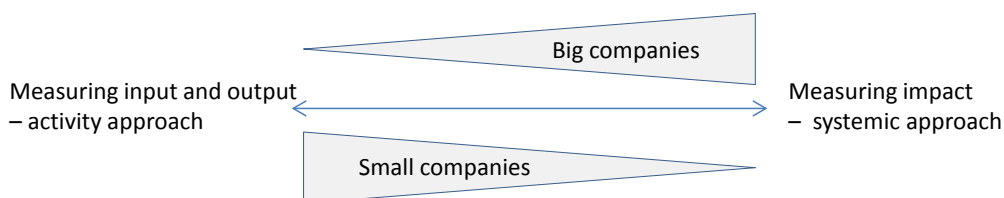
There is so far no type of reporting or reports that fall in the upper right corner. A report that would be focusing on how changes in business operations and supply chain management could reduce the negative environmental externalities is an example of a report type that could be in the upper right corner.

One could argue that forward looking report types belonging in the upper part of the model generally are more focused on optimizations to the benefit of business, environment, and society.

<sup>3</sup> Guide to Corporate Ecosystem Valuation – A framework for improving corporate decision-making, WBCSD 2011



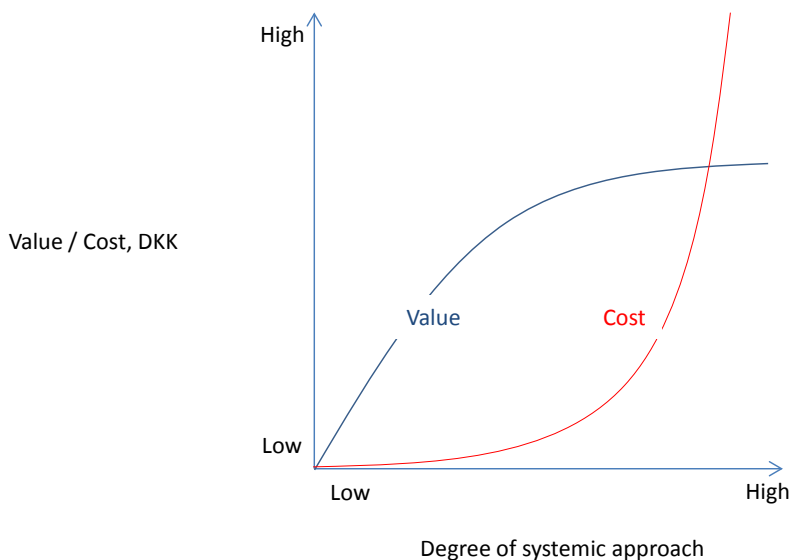
**FIGURE 2: TYPOLOGY OF ENVIRONMENTAL REPORTS**



**FIGURE 3: COMPANIES' CHOICE OF REPORTING APPROACH REFLECTS COMPANY SIZE**

As a rule of thumb, big companies favour a systemic approach to reporting, whereas small companies favour an activity approach. Unsurprisingly, big companies have the resources needed for a systemic approach highlighting their impact on environment (and society), which may be huge, whereas small companies tend to simply report on what they do. It is illustrated in Figure 3 above.

The use of an increased systemic approach is almost always equal to increased cost of reporting. Thus deciding the right approach to meet the stakeholder needs and finding the right balance between the burden of preparing the reporting and the value created by the reporting becomes essential. The cost-benefit relation is illustrated in the Figure 4 below.



**FIGURE 4: TRADE-OFF BETWEEN COSTS AND BENIFITS OF REPORTING**

A very interesting reporting approach is introduced by WBCSD in their guide on 'Corporate Ecosystem Valuation' (CEV). CEV was developed in response to the increasing focus on biodiversity loss and ecosystem values and furthermore responded to the recognition that serious risks to business, as well as significant opportunities are associated with biodiversity loss and ecosystem degradation. WBCSD saw a need for business to appropriately quantify and value its impacts on biodiversity and ecosystems, in order to manage risks and opportunities and to support sustainable development. The definition from WBCSD is: "Corporate Ecosystem Valuation (CEV) can be defined as a process to make better-informed business decisions by explicitly valuing both ecosystem degradation and the provided by ecosystem services."

A Corporate Ecosystem Valuation (CEV) process is valuing the 'impact side' and the 'dependency side' and it implies nine steps:

1. Define the business "aspect"
2. Establish the environmental baseline
3. Determine the physico-chemical changes
4. Determine the environmental changes
5. Assess the relative significance of ecosystem services affected
  
6. Monetize selected changes to ecosystem services
7. Identify internal and external benefits and costs
8. Compare benefits and/or costs
9. Apply sensitivity analysis

The CEV provide examples on how to use the steps 1 through 9 and these examples are mainly project or case oriented. Many big companies are already quite advanced regarding measuring and reporting on environmental performance. Accordingly the above steps 1 through 5 are close to fully covered by the current qualitative and quantitative approach. The steps 6 through 9 include the monetary valuation, and these steps are generally not yet mainstream. One of the major advantages of the CEV is that it highlights the need of a correct inventory of impacts on ecosystem services before monetizing the societal benefits and cost of business activities.

## 2.5 General steps in preparing an environmental report

In day-to-day business reporting companies and decision makers altogether need to make choices among reporting approaches. Important questions are:

- What should be measured and how?
- What standards/principles should be applied for handling data?
- How should information be reported?

The different choices to be made in order to define the approach to be applied are illustrated in Figure 5 below. Choices have to be made with regard to intentions and type of report (the upper panel), and choices have to be made with regard to methods, data sets and standards (the lower panel). Please note that choices made in the lower panel need to match choices made in the upper panel.

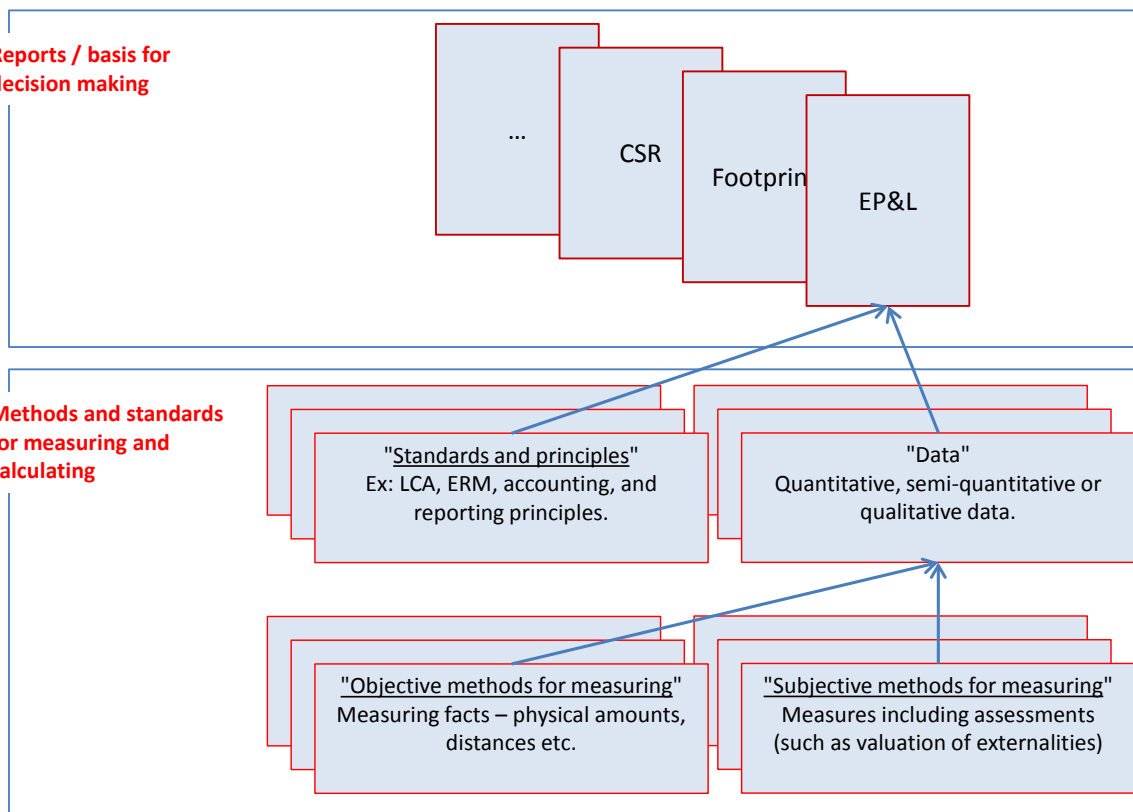


FIGURE 5: CHOICES ARE PLENTY AND INTERLINKED

When answering these questions several dilemmas emerge.

One dilemma is about scope and accuracy - about choosing the delimitation of the issues, features and links included. This is illustrated in Figure 6 using discharge of water as an example. It shows that delimitation A will result in one report, whereas delimitation B will result in another report.

A similar dilemma is about deciding which issues to focus on (e.g. 2 or 10 parameters within water discharge). Such considerations are linked to questions whether these data should be presented in a disaggregated or aggregated form, e.g. using a qualitative, semi-qualitative or a quantitative method and whether a common unit – e.g. a monetary unit - should be used. Thus reporting is about



balancing transparency, complexity, information need versus information overload, uncertainty, value and cost.

The earlier mentioned WBCSD report on Corporate Ecosystem Valuation gives valuable guidelines for discussing these dilemmas.

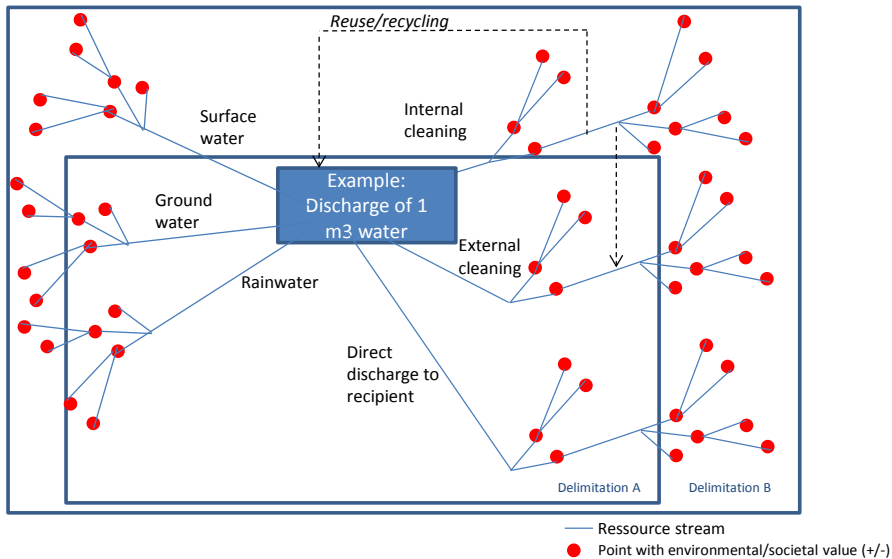


FIGURE 6: DELIMITATION MATTERS

## 2.6 Why prepare EP&Ls?

Externalities have been subject to intense economic valuation for several decades and lately also in relation to businesses. Cost of pollution is one well studied aspect, but also the role of environmental and natural resources in relation to business risk and opportunities have been scrutinized. One overview example is the TEEB for business from 2010 which was the outcome of work led by the UN Environment Programme.

The EP&L account is an expression of these developments. PUMA followed by Novo Nordisk put a society perspective on the environmental footprint in their supply chains. The approach not only focuses on own production and internal flows and costs, but also includes the supply chain and the economic cost to society of their activities. Thus, the approach aims at describing global impact of business activities delimited to selected environmental issues of concern upstream in supply chain – meaning not downstream use and disposal of products.

The level of ambition of these EP&L's is driven by internal as well as external stakeholders' demands to the reporting. The requirements of stakeholders and ambitions of PUMA and Novo Nordisk have determined the processes applied to valuating the externalities. A key question is: What level of detail and accuracy is needed to satisfy the business needs? In PUMA's application, the motivation was to "...understand the magnitude and importance of our impacts on the environment" as a basis for communication and actions. Novo Nordisk states that "...EP&L provides additional knowledge that will enable us to focus our efforts on the areas of our business that cause the largest environmental impacts".

The motivation behind in combination with methodological possibilities and the task of finding also by finding the right balance between cost and benefits of preparing the report defines what methods are used and how they are used.

## 2.7 Characteristics of EP&Ls

Basically, EP&L is an approach aimed at assessing and valuing companies' environmental impact throughout the supply chain. EP&L is not a specific well defined or standardized method, but rather an approach, which combines an inventory of (selected) environmental impacts throughout the supply chain with a monetary valuation of these impacts.

The EP&L approaches from PUMA and Novo Nordisk are similar in terms of chosen methods and dataset for preparing the environmental impact assessment and economic valuation.

Similar to other environmental reporting (as illustrated in Figure 5 above), the focus and quality of the EP&L is defined by a combination of:

1. Methods of measurement
2. Data
3. Standards/principles for preparing inventory and calculating monetary value.

As each of the three represent a number of specific dilemmas and choices, the form and content of an EP&L may differ significantly both within same industry (e.g. Adidas versus PUMA) and between sectors (e.g. PUMA versus Novo Nordisk).

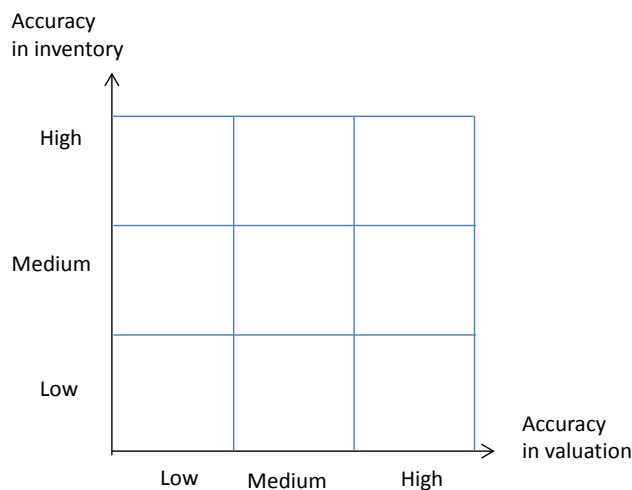
Preparing an EP&L will in practice follow a series of steps:

1. Selection of environmental impacts
2. Inventory of relevant environmental impacts
3. Valuation of environmental impacts.

All three steps are essential and will eventually define the quality of the value statement. Step 2 and 3 are within the main focus of this project.

Scope and accuracy are fundamental to the conclusions that can be drawn based on an EP&L. This is the case in all three steps. However, in the latter two, the accuracy and scope must be paralleled. This is to say that, e.g. high accuracy on the inventory side is a prerequisite for benefitting from putting effort into highly accurate valuations.

We argue that the PUMA and Novo Nordisk EP&Ls tend to have medium accuracy in both inventory and valuation. This is illustrated below and substantiated subsequently. As a consequence, it is possible to move valuation towards both higher (top right corner) and lower accuracy (bottom left corner) – the benefits of doing so are subject to discussion later in this report.



**FIGURE 7: METHODS WITH DIFFERENT ACCURACY**

**2.7.1 Establishing an environmental inventory**

It is essential to understand how the inventory of environmental impacts is generated, as the monetary valuation is based on this. The inventory of direct and indirect impacts can be established by using the following alternative methods, which may be more or less overlapping:

- **Low accuracy:** Input-output analysis, for example industry-specific data (as used in PUMAs case). Here the economic flow (direct and indirect spending) in the corporate supply chain is used as starting points in order to assess the overall environmental impact. By using this detail level it is possible to make very comprehensive studies, which e.g. covers entire value chains
- **Medium accuracy:** LCA analysis and LCA databases are used to estimate impacts throughout the company's supply chain, e.g. for a certain product
- **High accuracy:** Extensive and precise data on the "actual" impacts in the production and supply chain, achieved by direct measurements, e.g. for a specific production.

Each accuracy level has different properties, accuracy, advantages and disadvantages. The choice of method and accuracy will depend on the target group and corporate needs.

**TABLE 1: METHODS FOR MAKING ENVIRONMENTAL INVENTORIES ACCORDING TO LEVEL OF DETAIL**

<b>Methodological focus</b>	<b>Types of methods according to level of detail</b>		
	<b>Low accuracy</b>	<b>Medium accuracy</b>	<b>High accuracy</b>
<b>Environmental inventory</b>	Impacts based on generalized categories, e.g. industry or product. Example EP&L's based on EIO.	LCA or hybridized EIO/LCA	Operations data considering specific plants, suppliers etc.

*Note: EIO is Environmentally Extended Input-Output Tables*

### 2.7.2 Establishing a valuation method

Methods for valuating externalities have different focus and different accuracy. Values for converting an impact into a monetary cost or profit (prices) are often produced by specialists either as research or as direct input into public policy making. Typically, businesses will reuse values from the literature and not undertake own primary studies. Valuation studies initiated by businesses apply available knowledge to study a specific context.

The process of finding, adjusting or creating values that suit the context varies in terms of ease-of-use, delimitation and accuracy. Thus, there is significant difference in the resource demand that is required by the company to choose the value to apply any given externality. The level of accuracy is fundamental to the process of valuation:

- Low accuracy: General values (unadjusted values that do not consider e.g. geographical differences)
- Medium accuracy: Semi-specific approach (general experiences relevant to industry, e.g. combined with specific data)
- High accuracy: Specific approach (specific data in relation to e.g. geographical location, processes (e.g. characteristics of waste water of specific plant and vulnerability of surroundings).

The choice of method will - like for the methods for environmental impact inventory - among other factors depend on the target group and the company's needs and resources: Different stakeholders have different areas of focus, which requires different approaches to the estimation of environmental effects as well as valuation.

**TABLE 2: METHODS FOR VALUATION ACCORDING TO LEVEL OF DETAIL**

<b>Methodological focus</b>	<b>Types of methods according to level of detail</b>		
	<b>Low accuracy</b>	<b>Medium accuracy</b>	<b>High accuracy</b>
<b>Economic valuation</b>	Values from literature with no adjustment or geographic detailing.	Attention is given to adjusting literature values (secondary studies) according to geography. Example: benefit transfer	Local setting and vulnerability is accounted for via dedicated valuation (primary studies)  Also global GHG based on social cost of carbon

# 3. Impact Assessments Used in EP&L Cases

In this chapter a description of the environmental impacts assessments as applied by PUMA and Novo Nordisk is presented. The overall results of the two EP&Ls are summarized in Appendix 1. Particular attention is paid the following:

- Scope of the environmental impact assessment
- The level of ambition and methods applied
- Environmentally Extended Input-Output (EIO) method
- Alternatives to the EP&L approach and EIO method.

The valuation methodology applied in the two case studies is dealt with in Chapter 4.

## 3.1 Scope

Scope of environmental impact assessment is understood as the amount of information collected and used in as basis for the environmental impact assessment. Thus scoping follows the chosen delimitation of the issues to be included in the EP&L, as discussed in Chapter 2.

Resources flow to businesses via their supply chain and onwards as market products or emissions, waste etc. Defining scope is defining how much and which parts of your environmental footprint you would like to capture: Are all inputs across entire supply chain considered? Are the lifecycle of your marketed products included? Basically, delimitation and scope of information directs your attention and defines your possibilities for future action based on the information.

In terms of scope, the two cases studied in this report operate with environmental impacts of own production and different tiers within the supply chain. No attention is given to impact of products when marketed and used by consumers. Hence, scope has been defined as “cradle to gate”. The EP&L approach as such does not generally imply this scope definition. It would be possible to include the use and disposal phases as well.

The different scoping in the PUMA and the Novo Nordisk EP&L follows from Table 3 below, and the type of impact and units applied are presented in Appendix 2.

**TABLE 3: SUPPLY CHAINS OF PUMA AND NOVO NORDISK**

<b>Supply chain</b>	<b>PUMA</b>	<b>Novo Nordisk</b>
Own production	Offices, shops, warehouses, business travel, logistics and IT	Pharmaceuticals production, production of devices, filling, assembly and packaging
Tier 1	Shoe manufacturing, apparel manufacturing, accessory and manufacturing	Production equipment, clinical and laboratory services, transportation services, IT and office supplies.
Tier 2	Outsole production, insole production, textile embroidery and cutting, adhesive and paint production	Processing of raw materials, for example transforming oil into plastic granulates, corn into glucose, and by milling starch into syrup
Tier 3	Leather tanning, petroleum refining, cotton weaving and dyeing	Extraction of raw materials or cultivation of farm crops
Tier 4	Cattle rearing, rubber plantations, cotton farming, petroleum production and other material production	n/a

### **3.2 Ambitions and methods**

The reporting of the two cases present only in general terms the methods that they have applied to the environmental impacts of the supply chain. Neither PUMA nor Novo Nordisk describes their approach at a level of detail, which directly would allow to others to copy and reuse part of the data in other EP&Ls. Some of the specific tools that have been applied to develop the EP&L are not within normal business competencies which would require business to hire of new staff or consultants. Nevertheless, it could be considered that the EP&L reports have sufficient value to inspire other companies to undertake this endeavour.

Below, we give an overview of the ambitions and methods of the two case applications.

As supply chains differ, so does EP&L. However in these two case studies they remain similar and in terms of processes for assessing environmental impacts they are very similar. Direct operations data (environmental inventory) is available at different points in the supply chain. In addition, the EP&L for Novo Nordisk contains a methodological exercise for assessing environmental impacts of glucose production in France.

The table below provides an overview of methods applied to establish environmental impacts through the supply chains. For own production and some suppliers specific operations data is available which can be subject to economic valuation more or less directly. For other supplies, specific data is not readily available; thus, general assessments are made on the basis of EIO tables.

**TABLE 4: LEVEL OF DETAIL IN METHODS USED FOR ENVIRONMENTAL IMPACT ASSESSMENT**

Supply chain	Types of methods according to level of detail			Method applied
	General	Semi specific	Specific	
PUMA				
Own production				Operations data
Tier 1				Operations data and EIO
Tier 2				EIO
Tier 3				EIO
Tier 4				EIO
Novo Nordisk				
Own production				Operations data
Tier 1				EIO
Tier 2				Operations data
Tier 3				EIO

### 3.3 EIO

The environmental impacts included in the EP&L cases are to a large extent quantified using EIO tables. As the term indicates the method builds on environmental additions to economic input-output tables that are produced by statistical bureaus in most countries to map economic flows as part of the national accounts. Input-output tables capture the monetary movements between industries and sectors and the economic dependency among industries through flows of goods and services. The environmental extended input-output tables describes how much energy, water and emissions that a particular industry use or causes based both on its direct emissions and those coming from all the industries that supply input (raw materials and intermediate products) to this particular industry.

EIO methods assess environmental impacts through supply chains by combining economic flows and environmental data. This combination of information makes it possible to calculate the emissions per Euro spend for each industry and - accordingly - to quantify the environmental impacts through a generalized supply chain for a business within a given industry by using the transaction patterns between industries.

An example: a business in the "brewery industry" buys inputs at a cost of three EURO. One EURO is spent in the "sugar industry", one in the "barley industry" and one in the "bottle industry". The EIO contains information that makes it possible to interpret what direct emissions one EURO of activity produces in each of the sectors and so forth. The spendings are then related to impacts on the environment and finally converted to associated societal benefits and cost. The completeness of the included environmental impacts is thus decisive to the resulting cost and benefits.

According to Novo Nordisk's methodology report, the EIO methods are consistent with emission calculations in Life Cycle Assessments (LCAs). The obvious difference between them is that the links between activities are measured in monetary term rather physical units such as kg or kWh.

### **3.3.1 EIO potentials**

The main potentials and benefit of using EIO for impact assessments - which are most probably also the motivation for using the methods in the EP&L cases - are listed below:

- EIO provides much information at rather low cost;
- It takes advantage of the plentiful and somewhat consistent data available from input-output tables in national accounts;
- It can address global impacts and map a complicated network of suppliers in a supply chain;
- It is applicable to almost all industries enabling a consistent use of information across business and industries;
- The EIO approach means that in principle all impacts caused by a given company will be captured compared with an LCA approach (see further discussion in Section 3.4 on Alternatives).

### **3.3.2 EIO limitations**

The challenges with regards to EIO are to a large extent related to the quality and detailing of the available data. The limitations of the EIO method include:

- The EIO assumes that all activities are on industry average. This means that a business' suppliers are assumed typical within their industry with average level of environmental footprint. Thus suppliers doing better than average e.g. through greener business models, or suppliers performing below average or at an unacceptable level will not necessarily stand out in the EP&L accounts.
- Impacts on the environment are complex to map and basically calls for extended specialist knowledge. The included environmental impacts is decisive to the resulting cost and benefits and thus call for a high level of completeness, accuracy and transparency.
- The Novo Nordisk operates with basically two geographies - Denmark/Europe and the World - with some detailing. Thus, no distinguishing is made between a supplier based in Brazil and Indonesia, i.e. the same impact is assumed.
- The reliance on general average data makes it almost impossible to track environmental developments from one year to the next. Changing levels of expenditures will of course impact the EP&L account, but environmental improvements in a given supply chain may not be visible. This is due to the fact that the effect of the improvements may vanish in the total industry average. Thus when using EIO in an EP&L the company's environmental improvements in the supply chain will not necessarily give detectable accounting improvements. In the cases, IO data from 2002 and 2003 are used.

### **3.3.3 An example: Glucose - A major input to Novo Nordisk**

One attempt at moving from a general to a more specific level is made for glucose in the Novo Nordisk case.

Glucose is Novo Nordisk's the largest purchase category, and attempts were made to assess the environmental impact using so-called hybridization which incorporates LCA data into the EIO. The purpose of this is to increase level of detail on a selected impact category.



Glucose is used extensively in Novo Nordisk's production with France as the major sourcing country. The EIO where hybridized with LCA data for the EcoInvent database<sup>4</sup> on life cycle assessments. The level of detail was therefore extended from information based on a general EIO category – flour<sup>5</sup> - to glucose specific data from a LCA study comprising the two main processes of glucose production: wet-milling and syrup conversion which converts corn to starch and in turn syrup.

The LCA database provided details on inputs and by-products of glucose production, which in turn were assessed using the EIO setup. The specific information on consumption of e.g. energy and corn were modelled based on the EIO flows of "Electricity, steam and hot water" and "grain crops", respectively.

The Novo Nordisk methodology report depicts the detailing for "flour" to "glucose production in France" as illustrated below. The box itself shows the modifications made based on the LCA database whereas the flows outside the box are modelled in the EIO. In total, the figure shows the hybridization of LCA data and EIO.

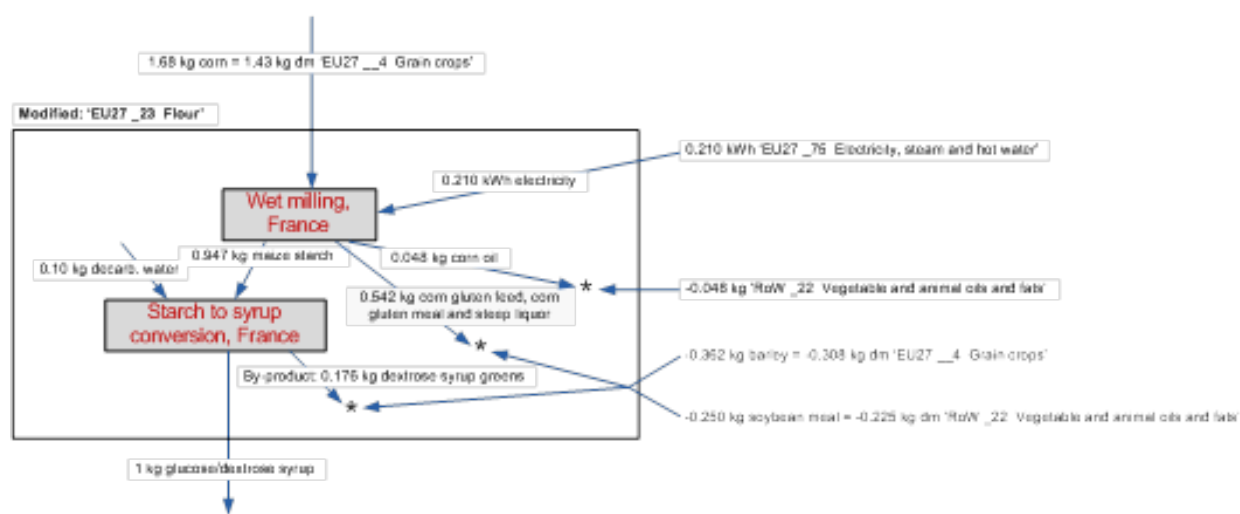


FIGURE 8: GLUCOSE IMPACTS BASED ON HYBRIDIZATION OF LCA DATABASE AND EIO

This exercise increases the quality of information greatly as European or worldwide average impacts of flour production is replaced by average French impacts of glucose production.

### 3.4 Alternatives

The main alternative to the approaches applied in the PUMA and Novo Nordisk cases is to do more specific assessment of the material flows at different supply chain tiers. In principle the alternatives to the EIO method is LCA and specific data collection and assessment of suppliers.

The LCA is using physical units for the material flow which on one hand allows for more detailed assessments but also requires delineation in how comprehensively the supply chain is covered. As any product uses a large number of inputs and each input again uses a number of inputs, only the main material flows are included in the LCA. Hence, the LCA approach can be disaggregated and detailed for selected material and process but not comprehensive in its coverage of the supply chain.

<sup>4</sup> Ecoinvent is a university based LCA database that provides scientific data consisting of several thousand industrial life cycle inventory datasets ([www.ecoinvent.ch](http://www.ecoinvent.ch)).

<sup>5</sup> This category is also used if no additional information is available. Thus, if no glucose specific data is available, the EIO flour category is used as best estimate. One example where general data is applied is for production capital (machinery and buildings).

Specific assessments of emissions and other impacts from suppliers provide the most accurate assessment of the impacts, but the large resource needed will limit the extent of such direct assessment. As discussed in chapter 2 is the key trade-off between accuracy and resources needed for the assessment.

For both the EIO and the LCA methods, the accuracy depends on which data bases that are available regarding the level of disaggregation (also by regional differences) and how updated they are.

Nothing prevents the three approaches to be combined which can increase the accuracy without increasing the costs of the assessment too much.

It should be noted that the difficulty of doing LCA so that they be reproduced and compared across companies etc. has been one important motivation for the EU initiative on product environmental footprint (PEF)<sup>6</sup>. This initiative is aimed at providing more standardisation on how to do LCAs at product category level. This will increase the comparability while at the same time reduce the effort needed to do the assessments.

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<sup>6</sup> See for example: 2013/179/EU Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations.

# 4. Economic Valuation Used in EP&L Cases

This chapter presents the valuation methodology applied by PUMA and Novo Nordisk. An overview of the valuation methods used is provided in Appendix 3.

By way of introduction an overview of the valuation categories used is provided, followed by a description of value transfer and an overview of possible alternatives to the EP&L. Value transfer constitutes an overall method applied in economic valuation. Focus is on the two cases.

## 4.1 Valuation categories

An overview of methodological categories within valuation is provided in the box below whereas an overview of how the valuation is applied in the EP&L cases of PUMA and Novo Nordisk is provided in Appendix 1.

The valuation literature includes a substantial number of studies that address economic value of environment, pollution, natural resources, etc. These studies vary from being context specific to being meta-studies that provide an overview over a number of other studies. In addition, they vary in methods and theories applied.

In general, the EP&L cases of PUMA and Novo Nordisk use a similar method for economic valuation which is summarized in the diagram below.

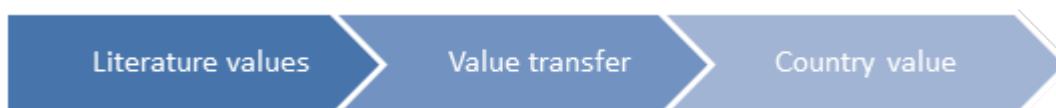


FIGURE 9: ILLUSTRATION OF THE TYPICAL METHOD FOR ECONOMIC VALUATION

This is what we refer to as a semi-specific method for economic valuation, as the method is not based on specific data from a primary study that estimate the cost of an environmental impact on a given location. Efforts are made to adjust literature values that originate in one context in order to reflect the country in which the environmental impact occurs. In spite of variations in method detailing, this is the general method across types of impacts.

The exemption being greenhouse gas emissions, where a universal unit value is applied reflecting the global nature of GHG emissions. In other words, the consequences of GHG emissions are equivalent no matter the location of activity – the same price applies globally and no further detailing is feasible. Thus, in spite of the general nature of the cost of greenhouse gas emissions, the value is grouped as "specific" (cf. table 5) with regards to level of detail, as no greater accuracy can be attained<sup>7</sup>. Also, for glucose the Novo Nordisk EP&L use specific French valuation studies (the detailing of environmental inventory and impact assessment for glucose was described above).

<sup>7</sup> The consequences of climate change and the conducted studies themselves involve much uncertainty, but this does not alter the specific nature of the value's level of detail

### BOX3: VALUATION CATEGORIES

Monetary valuation of externalities may be done by using several different methods. Below is a categorization of the methods. The categories distinguish methods on whether they adopt market prices, prices and value calculated with the use of market prices or stated valuation of those affected (population) directly of environmental impact. EP&L may consider all methods. The PUMA and Novo Nordisk each apply different valuation methods.

#### Overview of methodological categories of primary valuation

Category	Method
Direct market valuation	(Adjusted) market prices Production function methods
Indirect market valuation	Damage cost avoided Replacement cost Factor income Travel cost method Hedonic pricing
Stated preferences	Contingent valuation Discrete choice experiments

Source: De Groot et al., 2002<sup>8</sup>.

Advantages and disadvantages of these methods depend on what type of externality that is being valued. Valuation of externalities is generally a challenge. However, it is an ever evolving field and many improvements have been made. The basic methods for valuing externalities are still the same but experience increases with practical application, which also means that more and more specific studies are available in literature.

#### Overview of uncertainties, data and application of categories of valuation methods

Category	Uncertainty and data	Applications
Direct market valuation	Limited uncertainty and requirements for data	Relatively few externalities where this category is applicable
Indirect market valuation	Moderate uncertainty and moderate to high requirements for data	Methods can to a large extent be applied to valuation of resource use (e.g. water resources)
Stated preferences	High uncertainty and moderate to high requirements for data	Can in principle be applied to all kinds of externalities

Note: A more comprehensive overview of valuation methods and their requirements and (dis-/advantages) can be found in e.g. Global Nature Fund (2014): "How Companies Value their Natural Capital".

Source: COWI.

A set of databases provide valuation studies, including:

- Environmental economic unit prices for emissions (Danish Centre for Environment and Energy, Report no. 783, 2010) and transport economic unit prices (Danish Technical University and COWI)
- EVRI (Environmental Valuation Reference Inventory)
- ENVALUE
- RED (Review of Externality Data)
- BeTa–Benefits Table
- NMDB (New Zealand)
- ValueBase (Sverige)

<sup>8</sup> De Groot et al. (2002). A typology for the classification, description, and valuation of ecosystem functions, goods and services.

Specific studies are not applied to the EP&L cases as the authors of the cases do not conduct primary studies that reflect the specific characteristics of e.g. a given plant, the inputs, emissions and technology being used nor the vulnerability of its surroundings. Neither does the authors link to primary literature which has investigated economic value of environmental impacts in a country or at a location. We therefore term the method semi-specific due to the fact that efforts are made to adjust for country specific conditions.

A semi-specific level of detail makes it possible to partly adjust for geographical variations and provides a set of economic values at a fairly low costs and with a consistent set up from country to country.

**TABLE 5: THE LEVEL OF AMBITION OF BOTH PUMA AND NOVO NORDISK'S ECONOMIC VALUATION**

Type of Environmental Impact	Types of methods according to level of detail		
	General	Semi-specific	Specific
Water use			
Greenhouse gas emissions			
Land use conversion			
Other air pollution			
Waste			

#### 4.2 Overall method applied: Value transfer

Value transfer – in literature also often called benefit transfer – where values from one study site are transferred to a different policy or case site is common in environmental valuation. This allows for taking advantage of the vast knowledge available in the literature. Value benefit is much less resource demanding than undertaking a costly primary study. The disadvantage could be that local and regional conditions are not taken fully into account and increasing the inaccuracy of the estimate based on the transferred value. It is always a trade-off between cost effective knowledge reuse and increased uncertainties. As a consequence, Navrud (2007)<sup>9</sup> suggests limiting international value transfer to countries that are relatively equal in terms of in-kind income and institutional settings, as these intangible measures cannot be captured by e.g. currency conversion.

Value transfer can be done more or less comprehensive. Defining a value function which describes how the value depends on one or more parameters and using the value function to make the estimate should in principle allow for higher accuracy compared to just applying a unit value. According to Navrud (2007)<sup>10</sup>, function transfer is theoretically superior to unit transfer, as more information on site characteristics can be taken into consideration. But when testing for validity of the unit- and benefit function transfer, the method does not perform better. It is argued that the relatively poor performance is due to the problem of omitted variables, resulting in a lowered explanatory power, making them insufficient for the transfer. Unit transfer, on the other

<sup>9</sup> Navrud, S. (2007). Practical tools for value transfer in Denmark - guidelines and an example, Danish Ministry of the Environment, Environmental Protection Agency. Working Report No. 28: pp 1-58.

<sup>10</sup> Ibid.

hand, "...is recommended as the simplest and most transparent way of transfer..." according to Navrud (2007)<sup>11</sup>.

The approach in the two EP&L cases has been to apply benefit function transfers. For example, the Novo Nordisk methodology report describes a three step approach to determine country specific environmental cost of air pollution:

1. Literature screening of valuation studies. The studies are used to calculate averages for a number of different impacts for each pollutant (e.g. the number of cases of chronic bronchitis per ton of particulate emissions). These impact functions are, in turn, scaled to case site (e.g. population density for health impacts).
2. It appears that market prices on country level are used for the valuation of impacts on goods that are traded on markets such as crops and timber.
3. For non-market elements such as health impact, values are based on averages from the valuation literature. These values are then adjusted to the specific location based on PPP-ratio<sup>12</sup> between study country and case country<sup>13</sup>. For health effects, the literature was basis for creating health costs function which links health to GDP per capita.

On an overall level, the approach used for country specific valuation of water usage is similar. The PUMA assessment is based on the assumption that when a company use water the availability of water for all other users and uses are reduced. They distinguish between the direct use (water supplied for drinking water, irrigation and industrial uses) and indirect use for ecosystem services. The valuation then considers only the indirect use and the effect on ecosystem service provision. By reviewing studies that have valued ecosystem services a value function has been estimated linking the value of water with the degree of scarcity. The valuation of local water use (at national level) is then estimated by firstly establishing the level of scarcity and then adjusting the resulting value by PPP ratios.

### **4.3 Alternatives**

As it is the case for the impact assessment described in the previous section, the main issue is the trade-off between precision/accuracy and the resources needed for the analysis.

For the valuation part it is less a question of choosing between fundamentally different approaches than a question of the specific application of main approach – the value transfer.

As the uncertainty of the resulting EP&L is a function of the uncertainty on both environmental impact assessment and the valuation of the included environmental impacts, the choice of valuation method should be made with that in mind. Assuming that the assessment of the impact and the assessment of the unit values are independent the overall level of uncertainty will be more or less similar to the most uncertain component.

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<sup>11</sup> Ibid.

<sup>12</sup> Purchasing power parity (PPP) is a way to determine the relative value of different currencies focussing on purchasing power. In other words, the concept compares the cost in USD/Euro to purchase a basket of goods in different countries, which is done in order to avoid misleading international comparisons based only on currency exchange rates.

Theories that invoke purchasing power parity assume that in some circumstances (for example, as a long-run tendency) it would cost exactly the same number of, say, US dollars to buy euros and then to use the proceeds to buy a market basket of goods as it would cost to use those dollars directly in purchasing the market basket of goods.

<sup>13</sup> And adjusting for time gap between year of original study and now by means of e.g. consumer price indices.

The two EP&L have illustrated that valuations are available and compared to the resources of mapping the supply chain and estimating the resulting environmental impacts in physical terms, the valuation part is relative easy to undertake.

The appropriate level of detail has to reflect the geographical scope of the environmental impact, e.g.:

- Global impact: greenhouse gasses
- Regional impact: air pollution
- Local impact: water consumption.

Global values are surely applicable to greenhouse gases. For regional impacts such as air pollution it more questionable to use international standard values if no regional estimates can be found. For example values in the format of a unit cost per tons of emissions can be found for Europe. Value transfer to regions where the air quality is worse and the population exposure much higher could risk underestimating the value. On the other hand, the value of the end-point health effects might be lower due to lower price and cost levels.

In the case of textile production in Bangladesh, transferring values based on country specific level of water scarcity, does not reflect the fact that water might be plentiful, but clean water of high quality may not. Thus, for local impacts one has to be aware of the complications of using "one size fits all" although semi-specific adjustments are made. This is especially the situation, when two locations or suppliers are compared. Semi-specific methods may hide differences in costs of environmental impacts.

In some cases, primary studies for given locations can be identified in the literature. However, it will not be possible to assure consistency from location to location due to the very random availability of studies performed and presented in the literature. While semi-specific methods – value transfer methods– can vary much they do offer some consistency in study that has to grasp the many impacts and locations in a global supply chain.

As a methodological exercise in the Novo Nordisk case, Danish unit values and guidelines are applied to some extent as well. This can be termed "general" in our differentiation of methods according to level of detail, as no further specification is made. Environmental costs elicited in Denmark differ substantially from environmental cost in other countries and continents and cannot be used straightforward when dealing with global supply chains.

The main factor to decrease the costs to business is making more valuation available and by establishing internationally agreed unit values. There are companies and research institutions that supply commercial tools where they have collected and assessed the available valuations. This will also make it cheaper for companies compared to undertaking assessments on their own. And it is similar to any other purchase of goods or services where such purchase is more cost-effective than building the competences in-house.

The PUMA authors conclude that, "the location of emissions or resource use is significant because the ensuing environmental impacts depend on geographical location and context. However, while the precise location of Tier 1 suppliers was known, for many other suppliers only national level locations were available. As a result, the valuation approaches employed in the EP&L generate national level averages for specific environmental impacts. Making decisions at a local level may require additional research and analysis."

The table below shows a list of alternative business initiatives addressing the economics of externalities. In addition a number of individual businesses have undertaken valuation activities although there are not always made public. Examples include<sup>14</sup>:

- Chemical industry: AkzoNobel, Syngenta and Cook Composites and Polymers
- Utility industry: EDP (Portugal), Eskom, SA Water and Veolia Environment
- Natural resource industry: Eni, Rio tinto, Holcim, Lafarge and Weyerhaeuser.

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<sup>14</sup> Global Nature Fund (2014): "How Companies Value their Natural Capital – Taking stock and looking forward", draft, [www.globalnature.org](http://www.globalnature.org)



**TABLE 6: BUSINESS INITIATIVES WITHIN VALUATION OF EXTERNALITIES**

<b>Name</b>	<b>Objective</b>	<b>Further info</b>
Natural Capital Coalition (formerly TEEB for Business Coalition)	Platform of initiatives. Development of methods for the evaluation of natural and social capital. Development of open-source database	<a href="http://www.teebforbusiness.org">www.teebforbusiness.org</a>
World Business Council for Sustainable Development (WBCSD)	Development of the “Guide for Corporate Ecosystem Valuation”, a framework for integrating natural capital into business operations	<a href="http://www.wbcsd.org">www.wbcsd.org</a>
B-TEAM	More sustainable economy in general, including accounting for the “real” costs in particular.	<a href="http://www.bteam.org">www.bteam.org</a>
Dow Chemical Company and The Nature Conservancy	Development of tools, methods and models that aim at helping companies to integrate the economic value of nature in their strategies, goals and decision making.  Very site-specific and decision-oriented approach.	<a href="http://www.nature.org/about-us/working-with-companies/companies-we-work-with/dow/working-with-dow-chemical-company.xml">www.nature.org/about-us/working-with-companies/companies-we-work-with/dow/working-with-dow-chemical-company.xml</a>
Corporate EcoForum	Building an open-source enterprise platform to exchange experience and best practices.	<a href="http://www.corporateecoforum.com/valuingnaturalcapital">www.corporateecoforum.com/valuingnaturalcapital</a>
Cambridge Natural Capital Leaders Platform	Development of a framework for the assessment of externalities. Centers on support for the practical implementation. Recently published guide-lines for the agriculture.	<a href="http://www.cpsl.cam.ac.uk/Business-Platforms/Natural-Capital-Leaders-Platform.aspx">www.cpsl.cam.ac.uk/Business-Platforms/Natural-Capital-Leaders-Platform.aspx</a>
The True Price Foundation	- Development and testing of a methodology for the detection of social and environmental costs - Supporting companies in calculating these costs - Awareness-raising among the population	<a href="http://www.thetrueprice.org">www.thetrueprice.org</a>
Natural Capital Declaration (UNEP FI)	Initiative of the financial industry with the aim of more consistently taking into account natural capital in financial products and services and to integrate them into accounting, disclosure and reporting.	<a href="http://www.naturalcapitaldeclaration.org">www.naturalcapitaldeclaration.org</a>

Source: Global Nature Fund (2014): "How Companies Value their Natural Capital – Talking stock and looking forward", draft, [www.globalnature.org](http://www.globalnature.org)".

# 5. Discussion on the potentials and limitations of EP&Ls to business

We share the view that monetary valuation of externalities makes a valuable and very powerful basis for communicating the link between business and society both to internal management and external stakeholders, such as shareholders, consumers, suppliers, employees and authorities. In the following sections the major potentials and limitations of EP&Ls from a business view point are discussed.

## 5.1 Balancing overall cost & benefit of EP&L

The process of preparing an EP&L is very resource demanding and thus appeal mostly to the larger, sustainability sensitive, and ambitious companies. Valuation of full supply chain externalities is no simple task: It will require careful methodological consideration, data sourcing challenges, interpretation of previous studies and wide-ranging expertise not commonly found in businesses. Accordingly, cost & benefits from the EP&L have to be carefully assessed. In this assessment the following issues may be included in the discussion:

Achieved benefits of an EP&L:

- Identification of risks and opportunities in the supply chain
- Powerful communicative value to both internal management and external stakeholders
- Identifying overall potentials to reduce environmental costs in the supply chain

Resulting costs of an EP&L:

- Cost of external consultants and experts in the preparation of the EP&L
- High internal cost of management time
- Require detailed inventory on environmental impacts
- Cost of revision

In the box below different types of EP&L approaches are listed to illustrate that the EP&L approach may have different focus and thus may fulfil different stakeholders needs.

#### BOX 4: BUSINESS SCOPE IN FOCUS

This report discusses the potentials and limitations to businesses distinguishing between different stakeholder needs.

The EP&L cases have a "corporate incl. supply chain" focus, but as outlined in the table other scoping options exist.

Scope	Comparison to "corporate incl. supply chain" focus
Industry incl. supply chain	Less accurate but adjustments could be made to correct for characteristics of specific business providing overview
Corporate incl. supply chain	Not applicable
Corporate	More accurate and oriented towards internal decision making, but less comprehensive and less "true & fair"
Project (could include selected suppliers)	More accurate and oriented towards internal decision making, but no oversight of full environmental impact
Product incl. supply chain	Same accuracy and most probably same level of effort necessary

Different scopes have different requirements in terms of efforts and ability to satisfy different stakeholder needs.

#### Using the knowledge from published EP&L as a starting point for changing strategy

When taking a high level look at the findings in the EP&Ls of companies it is seen that the conclusions in many ways are similar:

- The majority of the costs are often generated in the lower tiers of the supply chain
- The environmental costs are often related to production of raw materials and agricultural products
- The major issues of concern are often related to water, greenhouse gasses and land use.

This is in line with experiences from conventional environmental reporting. As more EP&L's are published it would be interesting to compare the environmental net cost with the financial performance in order to have a brief estimate of the environmental cost level for different sectors and business. In the 2 cases examined in this report the environmental cost is in an order of magnitude similar to the yearly EBIT.

These findings may provide a valuable starting point in the businesses as to what areas to include. It will support the discussion of improvement opportunities when it comes to environmental cost of impacts. This also indicates that more generic EP&L's focusing on specific raw materials, processes and products may be valuable for companies as input for the discussion.

#### 5.2 Value of EP&L as a basis for decision-making

The challenge with regards to using EP&L approaches for decision-support is that the information basis primarily captures the environmental cost of the business' activities and does not show the benefits to society. For the approach to be more supportive in business decision making it has to be

focused on the environmental issues of material strategic importance and the scope has to match the strategic needs. Furthermore the account should clearly state both the benefits and the cost separately, in order for the business to be able to enhance activities that result in societal benefits. The starting point of this approach would require management of a given company to identify the key strategic value drivers of the business and how the business can use its expertise to create value for society. This idea is similar to the 'Creating Shared Value' concept that has been very well articulated by Porter and Kramer <sup>15</sup>. In contrast to the concept of Creating Shared Value, the EP&L is a broad assessment of cost impact of the company on the environment and is not directly linked to the strategy of business. It typically accounts for the net cost side of the EP&L and does not state the benefits (profit) to society of the company's products and services. This lack of balance compromises the value of the EP&L to be a basis for decision support. Further in our view the value of the EP&L as a decision-making tool is limited due to:

- The EP&L is an assessment of historical cost in the current supply chain structure of the company. In this sense the EP&L is backward looking
- The EP&L is to a large extent based on input-output data and is thus representing the industry average more than the actual business practises implemented in the supply chain. Thus the current EP&L approach provide relatively static data and does not provide timely information nor necessarily company specific data to support decision making. At the moment there are no cost effective alternatives to input-output data
- There are no agreed standards and guidelines, which are needed in order to ensure that the EP&L's are including relevant environmental impacts and right cost and benefits of these impacts to society.
- The EP&L and FP&L are different in nature and therefore not directly compatible
- The company is not fully in control over its supply chain and can only hope to influence its most immediate suppliers

### **5.3 Balancing profit and loss**

It is noteworthy that the EP&Ls that are publically available or have been presented verbally by e.g. Otto Group are to a high degree focusing on the environmental losses –not the benefits - of their activities and only upstream in supply chain. It is reasonable to presume that the products and services that the businesses provide could have environmental and social benefits. However these benefits (profits) are not given much attention in the EP&L accounts. From a business decision making point of view it is essential that both profits and losses are given attention though a discussion of the trade-offs between the two, e.g. as the profitable activities may be indicators showing where the business should increase focus in the future. As examples: The societal and human profits of providing good running shoes in terms of better health and wellbeing of the user and thus less expenses on welfare, and the practice of disposal of shoes and degradability of materials may open up discussions of how to re-design both the shoe and the business model.

This highlights the need of having more holistic and nuanced discussions of the overall trade-offs of profits and losses following different strategic decisions and developing tools that enables including profit and loss in all aspects of capital.

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<sup>15</sup> Porter, M. and Kramer, M. (2011), "Creating Shared Value: how to reinvent capitalism - and unleash a wave innovation and growth", Harvard Business Review, Vol.89, No.2, pp.62-77

#### **5.4 Stakeholder engagement in the creation and communication of the EP&L**

As discussed in chapter 2 reporting using valuation of externalities in the supply chain should be aligned with the needs of the stakeholders and provide a transparent and fair and true picture of the business performance.

Transparency could easily be compromised because EP&L to a large extent is based on high level expert data, and the preparation may therefore be seen by the stakeholders as a 'black box'. This may jeopardizes the perception of being fair and true and isolate the stakeholders from discussing the approach and results, and could result in limited sharing of ideas and opinions, and inhibit the collaborative learning to empower more stakeholders.

#### **5.5 Added value of EP&L in the business reporting context**

The value of EP&L can be further enhanced if it is integrated – in terms of connectivity and common context - in the existing reporting done by the company.

Enhanced management commentary on how the business response to the information in the EP&L would greatly enhance the added value of EP&L. Thereby the business show stakeholders how business impacts and value creation will be better managed. In our view the added value of the EP&L should be improved by management commentary, and linking it to corporate reports - financial accounts, CSR reports, environmental reports etc. – to guide stakeholders. It is important to adequately show business implications of EP&L as a starting point for strategic discussions.

# 6. Framing initiatives to promote the use of EP&Ls

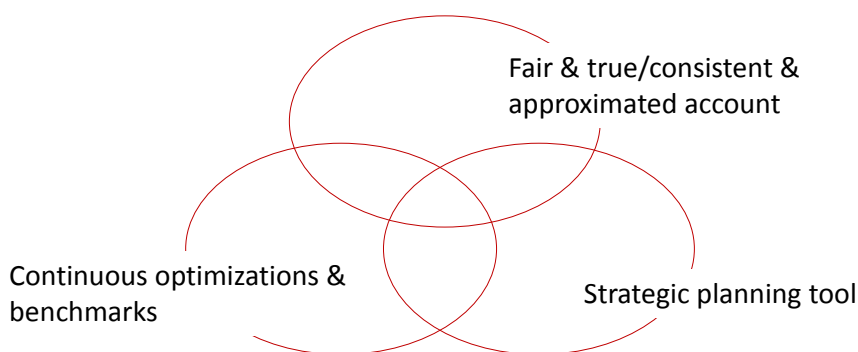
## 6.1 Potential way forward

As discussed in the previous chapters there is no doubt that EP&Ls similar to the EP&Ls produced by Novo Nordisk and PUMA give value to businesses. It is therefore recommended EP&L accounts are further developed. This development should focus on both standardizing the EP&L and over time including social and human capital and both up- and downstream activities. In this way a holistic account may be produced including profit and losses on all types of capital.

As described earlier EP&Ls similar to the PUMA and Novo Nordisk EP&Ls may not appeal to smaller or less ambitious companies. This calls for a supplementary approach designed to support small to medium size companies. Furthermore in our view a backwards looking accounts in general does not necessarily drive the needed sustainable change and improvement. This calls for a forward looking approach that is focused on driving change.

Therefore it is recommended that both companies and institutions - in parallel to the development and standardization of the full EP&L accounts - focus on developing tools that may support a change orientated sustainability dialogue and decision making in companies, between companies and between companies and institutions. It is of course a prerequisite that relevant authorities and institutions drive the process of valuating ecosystem services.

Such a parallel approach should preferably fulfil the characteristics presented in figure 10. Using this illustration one could argue that the PUMA and Novo Nordisk EP&L approaches are focusing more on the top circle with an emphasis on comprehensiveness in both impact assessment and valuation. To make alternative approaches attractive as a strategic decision basis and relevant to both smaller and bigger companies, it is important that the approach is fairly easy to use. No doubt that some comprehensiveness will be lost, but on the other hand more companies could be included in the discussion and accounting of environmental profits and loss. Thus alternative approaches should focus in the lower circles in order to be easier to use thereby appealing to most companies. Furthermore the new approach should be designed in such a way that it may be extended to other types of capital and both up- and downstream activities.



**FIGURE 10: ILLUSTRATION OF THE OVERALL CHARACTERISTICS OF A NEW MORE APPLICABLE EP&L APPROACH**

In our view, the new approach should focus on especially:

- Providing easily achievable valuations of ecosystems services and valuation of impacts on these for a range of companies' activities
- Capturing both the individual company's changes in performance and the company's benchmark compared to e.g. industry averages
- Providing a strategic planning decision basis that allows the company to examine the impact of its future actions at a product, project, business unit, country or total company level
- Enables capturing both up- and downstream profits and loss and other types of capital.

## 6.2 Building blocks

Thus we recommend that the following initiatives are supported to increase the use of EP&Ls as drivers for improvements:

1. **Get broadly applicable data for common use:** Develop and share applicable EP&Ls for specific materials, products and processes to be used as input in EP&L dialogues, screenings and EP&L accounts
2. **Facilitate dialogues on the environmental trade-off of decisions:** Develop dialogue tools that provide ranges of environmental profits and loss for different types of business activities.
3. **Include environmental profit and loss in the strategic planning:** Approach for including the EP&L into a balance sheet of the company as basis for strategic decisions
4. **Enhancing and Standardizing the business EP&L accounting approach.**

The 4 suggested initiatives to some degree also represent the natural steps to be used by companies with increasing ambitions, leading them from 'how can we use generic EP&Ls to check the robustness of our business?' to 'how can we understand and create value for our business from managing all types of capitals?'. The initiatives may be developed and implemented individually and preferable with inclusion of both companies and their stakeholders to ensure that the right and needed changes are in focus when designing the tools.

Initiative 1-3 are described briefly below.

### 6.2.1 Broadly applicable EP&Ls to get an understanding of environmental impacts

It is suggested that broadly applicable EP&Ls are produced for extraction/production of raw materials, products and processes in order to provide a better business understanding of the potential sources of impact on the environment. The objective of this step is to identify the key activities that result in the major environmental losses. These broadly applicable EP&Ls are thus important inputs to the business when - among others – identifying major risk and opportunities, designing products and services, deciding sourcing and re-shaping the business model.

### **6.2.2 Using a dialogue tools to enhance greener choices and highlight trade-offs**

Achieving a sustainable business increasingly calls for including sustainability issues in the daily discussions in the business. There is a general understanding that reports and accounts do not seem to drive the change by itself. Therefore we suggest that a dialogue tools is developed focusing on showing the trade-offs now and in the future following different business choices, e.g. the choice of different types of transportation of goods, different types of energy or different places for building a production plant. The tool should be based on the broadly applicable EP&Ls and thus focus on a high level screening of impacts on environment and society following the use of different resources and processes. The tools should provide data for issues with the greatest environmental and social potential that at the same time are strategic to the value creation ability of the business.

### **6.2.3 Using valuation of externalities for different scenarios to drive change**

It is our view that the next evolution in business reporting taking the valuation of externalities further needs to be a change to also including the appraisal of the company's social asset<sup>16</sup>. The social asset is the company's net benefit to society. The size of the social asset would depend on the societal valuation of the business considering the balance between positive and negative impacts from the company.

The thinking behind introducing the social asset is to value businesswise that local and national communities provide infrastructure, social support and an educated work force to the companies. The global community grants the permission to use these environmental amenities. Most of these scarce resources are provided to the company free of or at low cost and, as a result, are not recorded anywhere in the financial accounts of the firm. The value of these amenities may be defined as part of the company's social asset.

The social asset is highly correlated to the well established CSR concept of 'license to operate'. Social – and in this case environmental - assets are assets given by society to the company. Managing assets now and in the future are the focus of a business balance sheet. Therefore it is recommended to develop an approach where the environmental impacts of different scenarios business decisions on the social assets are included in a balance sheet. By using a balance sheet approach the improvement or depreciation of the asset may be calculated for different operational and strategic business decisions.

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<sup>16</sup> Mohammed, M. & Muff, K. (2013), "The SEE Framework: Creating Social, Environmental and Economic Value in a Resource-Constrained World – a conceptual model", Working Paper, Business School Lausanne



## Appendix 1: Examples of results of EP&L

The two EP&L cases present similar methodologies. Below, we outline examples of how the cases

The EP&L cases reveal that own production accounts for a very low share of total externalities. This is not surprising due to the high level of globalization and sourcing of the two case businesses' supply chains. Production of raw material inputs is rather heavy in terms of externalities for both supply chains (PUMA – tier 4: 57% and Novo Nordisk – tier 3: 39 %).

The externalities resulting from PUMA's business cost the global society Euro 145 million (2010) compared to Novo Nordisk's Euro 223 million (2011).

Cost of greenhouse gas emissions account for 33 % of PUMA's external impact and 77 % of Novo Nordisk's, respectively. For PUMA, water and land use cause 33% and 25% of external costs.

**TABLE 1-1. EXTERNALITIES TOTAL AND DEVIDED BY TYPE OF IMPACT, METHODOLOGICAL LEVEL OF DETAIL AND SUPPLY CHAIN**

Results		PUMA	Novo Nordisk
Net earnings, mio. euro (year)		202 (2010) <sup>1</sup>	2.297 (2011) <sup>2</sup>
Total external costs, mio. euro (year)		145 (2010)	223 (2011)
Environmental impacts	Greenhouse gas	33%	77 %
	Water	33%	15%
	Land use	25%	(only assessed for glucose)
	Other air pollution	7%	8%
	Waste	2%	-
Supply chain	Own production	6%	13%
	Tier 1	9%	36%
	Tier 2	9%	12%
	Tier 3	19%	39%
	Tier 4	57%	-
Types of methods for environmental impact assessment	General	88%	75%
	Semi specific		
	Specific	12%	25%
Types of methods for economic valuation <sup>3</sup>	General		
	Semi-specific	67%	25%
	Specific	33%	75%

<sup>1</sup> PUMA Annual report 2010

<sup>2</sup> Adopted from Novo Nordisk Annual report 2011

<sup>3</sup> Specific valuations are taken to be proportion of cost of greenhouse gas emissions compared to total external costs whereas semi-specific are costs of non-climate change impacts.

#### **BOX1-1: COUNTING ENVIRONMENTAL CALORIES**

The CEO of PUMA, Mr Zeitz, has expressed his vision for EP&L as a way of guiding consumers through the environmental noise of a very complex market\*. Monetized externalities can be put on a shoe box the same way as information of nutritional value is given on cereal boxes. Given such "environmental calories" consumers can in principle compare products one on one.

The results from the EP&L cases could, in fact, be used to providing such information to consumers of PUMA apparel and Novo Nordisk pharmaceuticals. However, much standardization is necessary before consistent, transparent and comparable information can be produced. PUMA aims at establishing a EP&L club, which could be a step towards not only businesses working with external cost of activities but also towards standardized processes. Nutritional contents for foods and beverages can be tested in laboratories; which will never be the case of environmental externalities in highly complex supply chains.

\*Source: <http://www.ethicalcorp.com/communications-reporting/analysis-puma%E2%80%99s-epl-accounts-be-reckoned>

## Appendix 2: Units used in the EP&L of PUMA and Novo Nordisk

Type of Environmental Impact	PUMA	Novo Nordisk
Water consumption	Volume of water used (cubic meters of direct water consumption)	m <sup>3</sup>
Greenhouse gas emissions	Tonnes of GHG emissions	Energy use data was disclosed in giga joules (GJ), kgCO <sub>2</sub> e
Other air pollutants		kgSO <sub>2</sub> , NMVOC, NH <sub>3</sub> , PM <sub>2.5</sub> (< 2,5 µm) and NO <sub>x</sub>
Land Use Change	Tonnes of particulates, ammonia, sulphur dioxide, nitrogen oxide, volatile organic compounds (VOCs) and carbon monoxide. Converted from fuel consumption data using the latest fuel conversion factors from the International Energy Agency	Occupation (ha yr). Only applied for glucose

### Appendix 3: Valuation Methods Applied

The two EP&L cases present similar methodologies. Below, we outline examples of how the cases deal with valuation of the impacts in question. A comprehensive description can be found in the Novo Nordisk methodology report, which - however - is not a "recipe" for performing such analyses.

#### Greenhouse gasses

Climate change effects are global and therefore easy to monetize based directly on literature. The two cases use values of "EUR 66 t/CO<sub>2</sub>e" and "US\$113 per tonne", respectively. Sources are well-known publications that build on decades worth of valuation literature:

- Tol (2009): "The Economic Effects of Climate Change"
- Stern Review on the Economics of Climate Change (2006)

These sources suffer from major uncertainties, but will serve as reference documents for any business assessing cost of its climate impact.

#### Water use

The Novo Nordisk report state that "extensive review of the available water valuation literature adjusted for local incomes and water scarcity water scarcity and each of the water environmental services. water scarcity has been calculated at a country level using the Aquastat database" this is followed by PPP adjustments. The mathematical relationship between water scarcity (i.e. freshwater withdrawal as a percentage of total renewable resources) and economic value of water for different ecosystem services is illustrated below. A given country can – according to water scarcity – be inserted in the function succeeded by adjustments for purchasing power.

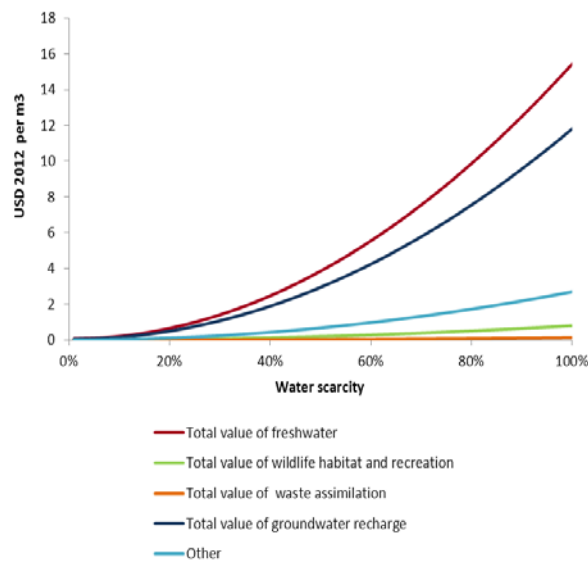


FIGURE 3-1. THE RELATIONSHIP BETWEEN VALUE OF WATER AND WATER SCARCITY

#### Air pollution

The process of attain economic value of air pollutions in the Novo Nordisk case in described by the following elements:

1. "Literature reviews were carried out for each pollutant to derive the average level of each type of effect associated with a tonne of that pollutant (e.g. the reduction in crop yield from a tonne of nitrogen oxide emission)."

2. "Where necessary, these averages were then adjusted based on relevant local factors (e.g. purchasing power parity for willingness to pay analyses, population density for health impacts)."
3. "... function transfer for air pollution is to scale the number of effect end points from the literature based on the receptor density. Therefore the number of effect end points per tonne is adjusted based on relevant factors (e.g. population density for health impacts, crop ratios for crop effects)."

The authors argue that "Disaggregating data from studies enables more effects than might have been included in each particular study. It also enables a disaggregation of the costs of the effects (e.g. health costs) from the number of effects and applies its own costs, based on further detailed reviews of valuation literature. Isolating individual effects, and then adjusting each effect based on relevant factors, provides a more robust estimate of the total environmental damage cost than, for example simply adjusting a total damage cost for Purchasing Power Parity (PPP), as is carried out in some studies. Taking this approach of disaggregation derives the most indicative costs for the effects of air pollution emissions of a company's operations and supply chain and enables each effect to be adjusted and valued appropriately."

The figure below illustrates the different impacts on ecosystem services and how they are adjusted.

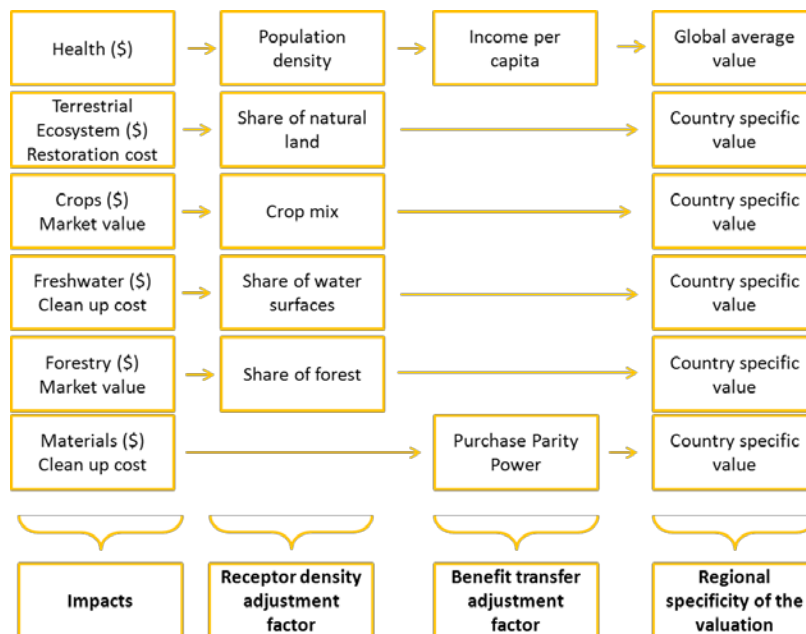


FIGURE 3-2. ADJUSTMENT OF COSTS OF AIR POLLUTION

### Waste

One cost of waste is related to greenhouse gasses (see above). In addition the PUMA report describes that "A leachate scale was developed based on best and worst case scenarios from the literature. Leachate costs were then derived based on the quality of waste management in each country in PUMA's value chain (using the percentage of waste going to a formal disposal method as a proxy for waste management quality). Disamenity effects are principally non-market effects and hedonic pricing methods<sup>17</sup> are commonly used in the literature to infer the associated external costs. Average disamenity costs were derived from the literature and adjusted for different countries at purchasing power parity. The cost of Polychlorinated-p-Dibenzodioxins and Polychlorinated Dibenzofuransas well as heavy metal emissions was derived from the 2009 EU study "Waste Management Externalities in EU25".

### Land use

The PUMA authors note, that "valuation studies were performed recently and consider the cost of losing an additional hectare 'today'. However, the land that PUMA's production occupies was converted at some time in the past, when natural areas were more abundant. The values from existing studies have therefore been adjusted to take into account the fact that ecosystem value (per hectare) increases as the extent of remaining natural areas diminishes. PUMA makes the conservative assumption that ecosystem value is directly proportional to scarcity of the given ecosystem (rather than increasing more rapidly as scarcity increases which would give a lower average value over time). An average value over time (for each ecoregion in each country) is developed based on this assumption"

In the Novo Nordisk application, land use changes is valued for glucose only. The most common non-urban/-cultivated ecosystem in France is temperate forest. Hence, the authors "...compare the value of one hectare of corn cultivated in France to the value of one hectare of French forest." A set of specific French studies are used in order to list the different values of one hectare of corn and forest, respectively. The values applied are listed in the table.

**TABEL 3-1: VALUE OF LAND USE CHANGE FOR FRENCH COST PRODUCTION COMPARED TO TEMPERATE FOREST**

<b>Euros 2011 per ha</b>		<b>Temperate French forest</b>	<b>Corn cultivated in France</b>
Direct, use value	Provisioning services	2.56	
Direct, non-use value	Recreational activities	2,940.18	22.87
Indirect	Carbon sequestration	6,457.50	321.62
Indirect	Pollination	304.74	15.24
Total		9,702.42	359.72
Net loss		9,342.70	

### Other methodological aspects

A set of other assumptions are used in the economic valuation of environmental costs. This includes the discount rate. PUMA describes that approach to discounting of future damage due to greenhouse gas emissions to present value as follows:

"PUMA opted to use a social discount rate (SDR). The SDR comprises two elements – the 'Pure Rate of Time Preference' (PRTP) and assumptions on future economic growth. The PRTP selected by PUMA is 0%, based on the philosophy that no generation should prioritize its welfare over another's. The approach averages future economic growth in the studies which disclose it. The overall SDR applied in the analysis was 3.4%. Normalising SCC estimates in 2010 USD: As well as adjusting for price inflation, older SCC estimates were increased by 3% per annum to account for growth in the SCC as a result of the increased stock of GHGs in the atmosphere (the mid-point of the IPCC's 2-4% range)."



## **Assessment of potentials and limitations in valuation of externalities**

With special focus on Environmental Profit and Loss

The objective of this study is to review the application of the EP&L approach using the companies PUMA and Novo Nordisk as case studies. It follows from the case studies, that monetary valuations of environmental impacts may provide a valuable overview of the societal footprint of the business upstream activities on human welfare and also that the EP&L is a powerful method of communicating and raising awareness on the environmental and societal cost of doing business. When carrying out studies of this kind, many internal and external stakeholders will surely gain insight and identify new problems requiring sustainable solutions.

Preparing an EP&L account can be a costly exercise. Thus, the EP&L in its present form is primarily for the very ambitious/large companies and even for them it is not necessarily considered realistic to prepare the EP&L annually, e.g. for internal or external reporting. Even though the EP&L has shown its value with respect to identifying the most critical impacts in a societal context and thereby as a useful decision basis. The EP&Ls examined in this survey were backwards looking, providing an 'as-is' status and is more focused on putting a price on the impact than identifying means for improvement to the benefit of the environment. In that case it is not easy to use the EP&L in strategic contexts such as strategic planning, deciding between different options or estimating the future value creating potential of changing the design, business model applied or production processes.

This leads us to conclude that the value of EP&L as a sustainability management framework is substantial. The approach could be enhanced by developing less data-intensive and less costly approaches and by enabling forward looking assessments. A line of initiatives to develop and test such new and easier applicable sustainability assessment approaches is proposed.



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