Feasibility of environmental product information based on life cycle thinking

Niels Jungbluth N.[1*], Sybille Büsser, Matthias Stucki, Rolf Frischknecht

[1] ESU-services Ltd., Kanzleistrasse 4, CH-8610 Uster, T. +41 44 940 6132, www.esu-services.ch

[*] jungbluth@esu-services.ch

Abstract In the recent past there were many initiatives for showing the carbon footprint or other environmental impacts on consumer products. An important sector of application is the food sector. After initial enthusiasm about the usefulness of such approaches, difficulties occur which are already partly known to LCA practitioners. A feasibility study investigated the possibilities for such information in detail. The presentation evaluates different approaches for providing environmental information on products based on LCA. It shows the main challenges for meaningful information that should direct consumer decisions. The study highlights the differences between the uses of LCA or carbon footprint for this purpose compared to the normal application. A special issue of environmental information on products is the consideration of the use and end-of-life phase, which might be important, but cannot be foreseen and only partly be influenced by the producer. Furthermore, one has to decide about the level of decision making addressed by the approach and thus about the functional unit for which information can be shown. The presentation shows that the idea of environmental product information is welcomed. But, there are many obstacles for putting this into practice, which make it questionable if environmental information on products really can direct consumer behaviour into a more sustainable direction.

Keywords: consumer products, environmental product information, environmental product declaration, carbon footprint

1 Goal and scope

In the recent past there were several initiatives for showing the carbon footprint or other environmental impacts on consumer products. An important sector of

application is the food sector. After initial enthusiasm about the usefulness of such approaches, difficulties occur which are already partly known to LCA practitioners. We evaluated the possibilities for such environmental product information (EPI) in detail within a feasibility study. This study shows the main challenges for meaningful information on products [1].

2 Challenges for environmental product information

Within the feasibility study several challenges have been identified for EPI. Some of them are described in the following sub-chapters. Here we make also some recommendations how these challenges can best be addressed.

2.1 Levels of decision making addressed

In Table 1 different levels of decision-making (DML) are shown [2]. A consumer can decide to shift money from one field of need (e.g. mobility, nourishing) to another. This might be environmentally relevant if one spends, for example, less on travelling, but more on eating in an organic-food restaurant. Within the need field of nourishing one can decide, for example, to eat mainly in fast-food restaurants or to consume only vegetarian food. Closely related is the level of decision among different product groups (vegetables, meat). In one product group (e.g. meat), one can choose to buy more pork or more beef. Purchasing decisions within one product category (e.g. cabbage) with different products (e.g. cauliflower, red cabbage, etc.) are also possible e.g. depending on the availability of certain products. Often the choices among variants of a product (e.g. organic or conventionally grown carrots) are addressed by consumers. If the decision has been made for one product, there is still a possibly relevant choice, e.g. for a certain packaging. The consumer can also decide about the processing (e.g. cooling, cooking) of a product in the household. All levels of decision-making are relevant for the overall environmental impacts of individual consumption patterns.
The higher levels of decision-making are quite often more relevant for behavioural changes and reduction of total environmental impacts than the lower DML. With regard to environmental product information, it has to be clearly defined which level of decision-making should be mainly supported with the information. Due to the necessary setting of system boundaries it will not be possible to find one methodology and approach that can be used to address all levels of decision making at the same time. We recommend to address higher levels of decision-

making at the first step of EPI and to refine the approach to lower levels at a later point of time.

Tab. 1 Levels of environmental decision-making for different actors in the food chain and appropriate method for an analysis of these decisions.

Level of decision making (DML)		Example
9	All need fields	Mobility, nourishing, ...
8	One need field	Home cooking, restaurant, …
7	Product groups	Vegetables, meat, ...
6	One product group	Beef, pork, poultry, …
5	Product category	Cabbage, salad, ...
4	Variants of a product	Organic, conventional
3	One product	Types of packaging, ...
2	Processing	Cooking, cooling, …
1	Pre-product and additives	Cleaning agents, …

2.2 Inclusion of the use phase

A special issue of environmental product information is the consideration of the use and end-of-life phase. Therefore different approaches are applied today. The problem of considering the use phase is elaborated in Figure 1 for different degrees of influence. Grey boxes stand for products, which are bought by the consumer. Black boxes describe consumer behaviour in the use phase.

Now the question is what to include in the use phase of a certain product. In the first stage it seems to be necessary, to include for washing powder and washing machine also the inputs of electricity and the discharge of effluents in a life cycle evaluation. On the other side, it does not seem necessary to include washing in the use phase of electricity, because electricity can be used in quite different ways and the individual product does not have a direct influence on this.

Washing is an important aspect in the life cycle of clothing. Thus again also inputs of buying washing powder, washing machine and electricity have to be considered if one wants to label the environmental impacts of different types of textiles over the full life cycle. If one has to decide between different types of sport courses, clothing might have some importance in the use phase of this service again. Thus, diving and playing tennis can only be compared if the necessary equipment is included in an analysis. This means that there are influences from products like washing powder.

In general it is difficult to forecast during the provision of the product what really happens in the use phase (or end-of-life phase). This limits the possibility of

showing these impacts in the environmental product information. A second implication is the double counting of environmental impacts if the use phase is included. This forecloses the calculation of the total environmental balance of consumer.

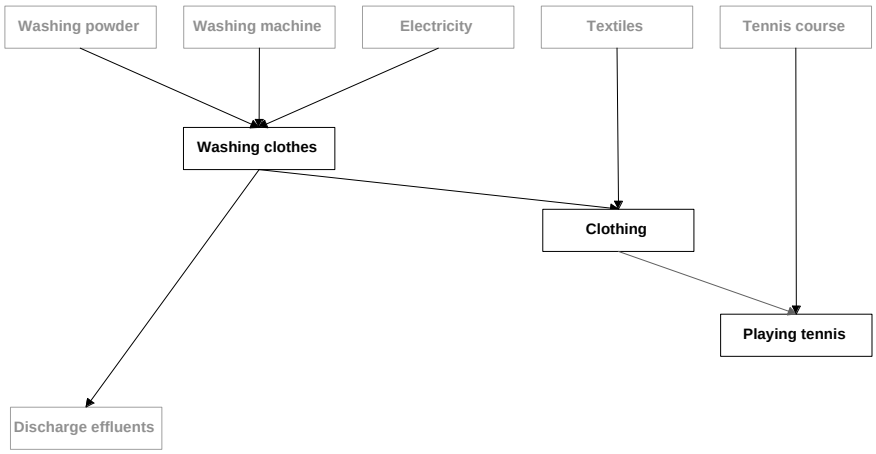

Fig. 1: Different degrees of influence in the use phase

We recommend showing environmental information for the product in the basket / at the shop and exclude the use phase for most EPI. Direct emissions from the combustion or application of the product (e.g. fuels, detergents, pharmaceuticals, etc.) should be included in this calculation because they are not covered elsewhere. Different waste treatment options are tackled as an own service and EPI can be shown for it directly. The full life cycle impacts can be analysed by consumer organisations as soon as information for all relevant products used by the consumer to fulfil a specific need, are available.

For all energy using products with a plug or a tank, information regarding the use phase can be shown additionally to the information about the product at the shop. For example for a car, the environmental information stating the total impacts of its production should be supplemented with additional information showing the impacts of driving one kilometre with the car. This additional information would include the production of the fuel and the emissions due to burning it. The exact evaluations have to be made within the development of PCR (product category rules) for specific product groups.

With the approach “at the basket”, it is possible to provide information directly for the amount of product purchased. Producers might agree within PCR on a functional unit for which information is shown additionally. This might be the case for products such as washing powder, where the “amount used for an average washing” would be an appropriate functional unit.

2.3 Life cycle impact assessment and indicators

Different methods for characterisation of environmental impacts and calculation of single score indicators have been analysed and compared in the study. Each of the methods has different features and underlying assumptions. In order to provide one single environmental score to the consumer it is necessary to perform a weighting between different types of environmental impacts. It was found that the methods cannot be ranked absolutely, but only in view of goals set by the decision-maker.

We recommend using the ecological scarcity 2006 method in the environmental product information applied in Switzerland [3]. The method is specifically designed to represent the assessment of environmental problems from the Swiss perspective. It covers many environmental problems and the method can be adapted to cover further environmental topics (e.g. more regionalized assessment of water use, noise, and other environmental issues which are decided on the political agenda). The method is suitable for all types of products and can be used on a regional or national level.

We see some improvement options, for instance regarding the assessment of pesticides or regarding the inclusion of effects on biodiversity due to land transformation, in particular due to clear cutting of primary forests.

Nevertheless, also other LCIA methods might be used. ReCiPe is considered as the second best option for application in Switzerland, but so far, there is not much experience with this method [4]. The evaluation of nuclear energy might be seen as shortcoming from a Swiss perspective because relevant aspects of final disposal of nuclear wastes are not considered within ReCiPe. The weighting in ReCiPe leads in many cases to similar results as in a carbon footprint analysis.

Impact 2002+ and Eco-indicator 99 (H,A) can be considered as somewhat obsolete because basic models have been revised within the ReCiPe method. Impact 2002+ does not provide factors for the weighting step. Thus it cannot be used in environmental product information as long as there is no commonly agreed procedure for weighting.

2.4 Communication of results with a Swiss Environmental Time Unit (SETU)

Communication of LCA results in a very simplified form is another issue of consideration. For consumers it is quite difficult to understand units of environmental indicators such as eco-points or kg CO2-eq. Therefore easier to

understand units have been looked for [5]. We recommend using time as a reference unit. Time is one of the few things that everyone is experienced with and of which all people have the same annual budget, regardless of their income or any other social differences.

We normalize a Swiss target for the environmental burden per person and year with the time in one year (365 days, 8760 hours, 526 thousand minutes, 32 million seconds). This allows the consumer to easily assess the burden of a product in relation to his or her annual budget or in relation to the real time for which they may benefit of the specific product. We call the units eco-years, eco-hours, eco-minutes, etc.

Table 2 shows the environmental impacts of some product examples. A return flight Zurich - New York takes about 24 eco-days of the annual budget against real time duration of half a day. The manufacture of a T-Shirt is equivalent to about seven eco-hours. Buying a new car takes 4000 eco-hours, but the consumer might depreciate these over 8-10 years of usage. Car driving of 10’000 km costs 1'460 eco-hours, but with an average speed of 50 km/h only 200 hours of real time. The column to the right shows the equivalent time of the product consumed. Car driving for instance is equivalent to two entire months.

Tab. 2 Conceptual example of SETU of consumer products calculated from cradle to basket

Product	Ecological scarcity	Ecological Time	Usage time estimation	Budget indicator	Ecological Time
	eco-points	eco-hours	hours	eco-hours/a	
Annual budget	12'000'000	8760:00:00	8760:00:00	100.00%	365d 0h 0` 0``
Spinach, deep frozen, 1 kg	3'000	2:11:24	0:30:00	0.0250%	0d 2h 11` 24``
T-Shirt, cotton	12'400	9:03:07	1600:00:00	0.1033%	0d 9h 3` 7``
Car, VW Golf	6'370'000	4650:06:00	2000:00:00	53.0833%	193d 18h 6` 0``
Car driving, 10'000 km	2'320'000	1693:36:00	200:00:00	19.3333%	70d 13h 36` 0``
Mineral water, 1 litre	200	0:08:46	0:10:00	0.0017%	0d 0h 8` 46``
Flight, New York, 12'600 km	920'696	672:06:28	13:00:00	7.6725%	28d 0h 6` 28``
Electricity, 1 kWh	340	0:14:54	10:00:00	0.0028%	0d 0h 14` 54``

eco-hours provided in hours : minutes : seconds
last column provided in days. hours, minutes, seconds

This approach could also be used if the ecological scarcity method is developed with a regional focus larger than Switzerland. The idea can also be applied for other indicators with clear defined targets, e.g. global warming potential and one tonne of CO2-eq per capita and year. However, it cannot be used within regions, which did not develop explicit targets for the level of environmental impacts that should be achieved.

3 Conclusions & outlook

Within this study, we investigated the feasibility to develop environmental product information. The focus of research was Switzerland, but we also considered the ongoing developments in several other countries.

An EPI may help consumers to consider environmental impacts of products during their buying decisions. Many methodological restrictions have to be considered while developing a comprehensive approach. It seems to be necessary to simplify the approach and thus not to fulfil all possible goals at the very beginning.

We consider the method of life cycle assessment, the ecoinvent life cycle inventory database and the present ecoinvent methodology developed for the investigation of life cycle inventory data as a good starting point for an EPI.

We recommend choosing a comprehensive environmental indicator that already considers several relevant environmental aspects and which can be further developed with increasing scientific knowledge or new political targets. This helps to avoid burden shifting and to prevent reducing one environmental impact at the expense of others. Therefore, we would propose to use the Swiss ecological scarcity method as an indicator.

We recommend showing EPI for the product as it is provided to the consumer. Direct emissions in the use phase must be considered with the product that is burned or used up. This is mainly important for fuels, solvents, detergents and pharmaceutical products that are emitted into air or water.

In all cases where products have a plug or tank (meaning they are directly using energy), this should be supplemented with information on the use phase. Product category rules (PCR) will help to ensure the comparability of the use-phase EPI for a certain type of product.

In any case, clear procedures and guidelines are necessary as a first step when developing such an approach. The development process should be led by a national authority or an independent organisation.

In a second step, pilot-LCA studies have to be carried out for several types of consumer products. The generic data should be published and be collected in one central database. As long as more specific information is not available these generic results will be used for the EPI. The pilot-LCA studies shall also identify hot spots in the life cycle and develop product specific rules that have to be followed by later LCA studies for products by specific producers. The pilot-LCA and investigated data need to be peer-reviewed independently.

In a third step, case specific LCA can be calculated following the overall generic guidelines and the specific recommendations of the pilot-LCA. If single producers or associations do not agree with case specific recommendations producer associations can provide recommendations for changing certain rules.

Several similar initiatives with similar goals are ongoing in different countries. Most of these initiatives focus on the carbon footprint. Different standardisation organisations try to harmonize these developments regarding the carbon footprint of products. Now it seems to be difficult to achieve a global agreement on a rather detailed level. We consider it even more difficult to get an international agreement on one LCIA methods (such as the ecological scarcity) as a basis for the EPI.

The discussion in the report of several methodological and conceptual issues revealed that it would be impossible to develop an approach that can fulfil all goals one can think of. The following Table 3 summarizes the main conflicts in the development of a final concept.

Tab. 3 Overview on conflicting decisions to be made in the development of a final concept for environmental product information. Our recommended choices are marked in blue

		Goal and Scope										LCI		LCIA								Communication		
Criterion demanded for good EPI	Choices to be made	DML 1	DML 2	DML 3	DML 4	DML 5	DML 6	DML 7	DML 8	DML 9	Develop PCR	at shop	full life cycle	Impacts per unit	Impacts per function	Quantitative results	Qualitative results	carbon footprint	ecological footprint	ecological scarcity 2006	ReCiPe	Indicator result	Ecological currency	Ecological time
Allows a fair comparison of single products		.	.	+	+	+	+	.	-	-	+	-	+	-	+	+	-	.	.	+	+	.	.	.
Allows a good guidance for sustainable consumption		-	-	-	.	.	+	+	+	+	.	+	+	+	-	.	+	+	+	+	-	.	.	+
Includes all relevant aspects in the full life cycle		-	-	+	+	+	.	-	-	-	+	-	+	-	+	+	.	+	+	+	+	.	.	.
Low uncertainties of judgements		+	+	.	.	.	.	+	+	+	+	+	-	+	-	-	-	+	-	+	+	-	-	+
Inclusion of several environmental impacts		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	-	.	+	+	+	+	+
Approach is transparent for consumer		.	.	.	.	+	+	+	+	+	.	+	-	+	-	+	-	+	-	+	+	.	.	+
Low workload		-	-	-	-	-	.	.	+	+	+	+	.	+	.	-	+	+	+	-	-	.	.	.
Add up of impacts is possible (life cycle, household, national)		-	-	+	+	+	+	+	+	+	-	+	-	+	-	+	-	+	+	+	+	+	+	+
One approach is possible for all products		-	-	-	-	-	-	+	+	+	-	+	-	+	-	+	-	+	+	.	.	-	+	+
Worldwide accepted as a method		-	-	.	+	+	.	.	.	.	.	.	.	+	+	.	.	+	+	-	-	+	-	-
Information on traded products is valid		.	.	+	+	+	-	-	-	-	.	+	-	+	-	+	.	+	+	-	+	+	.	.
Communication is understandable		-	-	+	+	+	+	+	+	+	+	+	-	+	+	.	+	+	+	+	.	-	.	+
Value judgements are separated		.	.	.	.	.	.	.	.	.	+	+	.	+	-	+	.	-	-	+	-	.	-	-
Criterion can be fulfilled	+																							
Criterion difficult to be fulfilled	-																							
Neutral concerning criterion or unsure	.																							

The left side describes the criteria that should be fulfilled by a concept of environmental product information. The different columns stand for certain methodological choices that have to be made while developing the approach. Red fields highlight conflicts between a criterion and a methodological choice.

One choice is for example the system boundary for the information “at shop” or “full life cycle”. The first will allow a summation of several purchases to a total figure, while the second would allow a fair comparison of individual products with a given function.

4 References

[1] 1. Jungbluth, N., et al., Feasibility study for environmental product information based on life cycle approaches, 2011, ESU-services GmbH, im Auftrag des Bundesamtes für Umwelt (BAFU): Uster, CH. p. 220p.

[2] 2. Jungbluth, N., Environmental Consequences of Food Consumption: A Modular Life Cycle Assessment to Evaluate Product Characteristics. Int J LCA, 2000. 5(3): p. 143-144.

[3] 3. Frischknecht, R., R. Steiner, and N. Jungbluth, The Ecological Scarcity Method - Eco-Factors 2006: A method for impact assessment in LCA, 2009, Federal Office for the Environment FOEN: Zürich und Bern.

[4] 4. Goedkoop, M., et al., ReCiPe 2008 - A life cycle impact assessment method which comprises harmonised category indicators at the midpoint and the endpoint level. First edition. Report I: Characterisation, 2009: NL.

[5] 5. Känzig, J. and A. Hauser, Darlegung der Umweltbelastung - True and Fair View und Umweltbelastungszeiten, 2009, Präsentation 29. Juni 2009, BAFU, Bern.

5 Acknowledgements

We thank the Swiss Federal Office for the Environment for financing the feasibility study for environmental product information based on life cycle approaches. Nevertheless, this article presents our personal viewpoint.