PART II:

DEFINITIONS OF TERMS AND SYMBOLS

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Contents of Part II

1. DEFINITIONS OF TERMS

These definitions should enable discussions in the SETAC Working Group on Impact Assessment. This document could be regarded as a language glossary. It is not the aim to exclude some impact assessment methods proposed within other frameworks by choosing inadequate definitions, but some definitions focus only on the present SETAC approach.

abiotic resource
Object that can be extracted from the environment to serve as an input for the product system, and that is distinguished from a biotic resource by its non-living nature. Examples of resources that are generally considered to be abiotic are mineral ores, fossil fuels and water.

areas for protection (safeguard subject)
Broad social values with respect to the environmental policy (e.g., human health, ecological health, biodiversity, intergenerational material welfare, aesthetic values).

biotic resource
Object that can be extracted from the environment to serve as an input for the product system, and that is distinguished from an abiotic resource by its living nature. Examples of resources that are generally considered to be biotic are (parts of) animals and (parts of) plants.
Note: although fossil fuels originate from biotic resources, they are generally regarded as abiotic. The distinction between abiotic and biotic resources is not really sharp.

characterisation
Second element within impact assessment succeeding the classification element and preceding valuation, in which analysis/quantification, and aggregation of the impacts within the chosen impact categories takes place. This element results in impact scores of the impact score profile.

> Step in which analysis/quantification, and where possible, aggregation of the impacts within the given impact categories takes place. The outcome of this step may be referred to as the impact profile [Consoli *et al.*, 1993; page 24].
>
> The analysis and estimation of the magnitude of impacts on the ecological health, human health, or resource depletion for each of the stressor categories, derived through application of specific impact assessment tools [Fava *et al.*, 1993].
>
> Step of the LCA in which analysis/quantification, and where possible, aggregation of the impacts within the given impact categories takes place [Lox, 1994].
>
> Substep of the LCA Impact Assessment in which the classified inventory parameters are processed into a common unit characterising the impact category, and where possible, aggregated [ISO/SC5, 1994].

characterisation factor (exposure factor, effect factor, exposure-effect factor, equivalency factor)
A factor which expresses the contribution of a unit environmental intervention (such as the atmospheric emission of 1 kg CFC-11) to the chosen impact categories (such as global warming and ozone depletion).
Note: The term characterisation factor should only be used within the framework of LCA for the quantification of linkage between the inventory table and the impact score profile. Exposure factors include only exposure aspects of the environmental interventions (e.g., persistency, intake), effect factors (or, more appropriately, impact factors) only include the sensitivity of the chosen receptors for environmental interventions (e.g., toxicity), and exposure-effect factors (or impact factors) include information about both exposure and effect (or impact) (e.g., GWP). Characterisation factor is the more general name for these different kinds of factors. The word factor implies the assumption that a linear relation exists between intervention and effect (or impact).

Factor used to normalise endpoints within impact categories during the characterisation step of an impact assessment. For example, if cancer was the chosen endpoint for environmental releases to air, air releases are converted into a single measure of relative cancer risk [Fava *et al.*, 1993; modified].

classification
First element within impact assessment, which attributes the environmental interventions listed in the inventory table to a number of selected impact categories.
Note: environmental interventions contributing to more than one impact category are listed more than once.
Note: the selection of relevant impact categories can be made either in the classification prior to the attribution, of course in line with the goal and scope definition of the study under consideration, or it can be made in the goal and scope definition itself. The current tendency in ISO is to split these two elements into two distinct steps: definition and classification.

Step in which the data from the inventory table are grouped together into a number of impact categories ¼ impacts are to be included on the general protection areas of resources, human health and ecological health [Consoli *et al.*, 1993, page 23].

The process of assignment and initial aggregation of data from inventory studies to relatively homogenous stressor categories (e.g., greenhouse gases or ozone depletion compounds) within the larger impact categories (i.e., human and ecological health, and resource depletion) [Fava *et al.*, 1993].

The step in LCA where all relevant input and output streams are classified according to which type of impact categories they are contributing to [Norwegian Standards Organisation, 1993].

Substep of the LCA IA in which all input and output flows of the system are assigned to one or more impact categories representing an environmental effect [Bache, 1995].

environment
Entire surroundings and conditions in which individuals, populations and organisations operate and interrelate. The surroundings include air, water, land, natural resources, flora, fauna and humans and extends from within an organisation's location to the global system [ISO/SC6, 1994].

environmental index
Resulting score representing the perceived harmfulness of a product to the environment, obtained by quantitative weighting as a result of the valuation element.

environmental intervention (environmental flow, environmental burden, stressor, elementary flow)
Exchange between the anthroposphere (the 'economy') and the environment including resource use, emissions to air, water, or soil.
Flow from the environment to a process or vice versa: resources emissions etc. [Heijungs *et al.*, 1992] Any change to the environment which permanently or temporarily, results in loss of natural resources or deterioration in the natural quality of air, water or soil [Bache, 1995].

goal and scope definition
Activity that initiates an LCA, defining its purpose, boundaries, limitations, main lines and procedures.

The first component of a life cycle assessment in which the functional unit is specified and the product group is delineated [Heijungs *et al.*, 1992].

The first component of a life cycle assessment which consists of a definition of the purpose of the study, its scope, establishing the functional unit and a procedure for quality assurance of the results [Consoli *et al*, 1993, page 13; Heijungs *et al.*, 1992].

goal definition
Part of the goal definition and scoping element of the LCA process leading to an unambiguous statement of the reason for carrying out the LCA, the intended use(s) of the results, the intended audience, the initial data quality goals and the type of initial review process to be employed (if any) [ISO/SC5, 1994].

impact vs. effect
Most of the environmental problems treated in present characterisation methods are quantified on the level of environmental impacts (e.g., ozone formation, H_+ deposition, ozone depletion, rise of radiate forcing etc.). Environmental effects are the chosen endpoints within these impact chains (e.g., reduced human health, reduced growth of crop, dying of plants, reduced biodiversity etc.). This means that all steps in the cause effect chain are impacts while effects are the chosen endpoints.

Note: the choice of endpoints may be made different by different people, hence a phenomenon that is an impact for one person may be the endpoint effect for another person.

The potential effect on health, environment or resource situation from input and output streams from a product system [Norwegian Standards Organisation, 1993].
A change in the environment and the associated consequences for both humans and other ecosystem components caused directly by the activities of product or service development and production . Impacts include secondary and tertiary consequences with direct upstream links to primary changes to the environmental system [Canadian Standards Association, 1994].

impact
The consequences on human health, for the well-being of flora and fauna or for the future availability of natural resources, attributable to the input and output streams of a system [ISO/SC5, 1994].
Change to the environment, whether adverse or beneficial, wholly or partially resulting from activities, products and services of an organisation [Bache, 1995].

effect
A specific change in human health, in an eco-system or the global resource situation as a consequence of a specific impact [Bache, 1995].

impact assessment (life cycle impact assessment)
Quantitative and/or qualitative process to characterise and assess the effects of the environmental interventions identified in the inventory table. The impact assessment component consists in principle of the following three or four elements: classification, characterisation, (normalisation,) and valuation.

Impact assessment is a technical, quantitative, and/or qualitative process to characterise and assess the effects of the environmental burdens identified in the inventory component. The impact assessment component consists of the following three steps: classification, characterisation, and valuation [Consoli *et al.*, 1993, page 23].

The element of the LCA process aimed at a technical, quantitative and qualitative classification, characterisation, and valuation of the magnitude and significance of environmental impacts based on information to the inventory analysis [Bache, 1995].

impact category (problem type, environmental problem, environmental theme)
Chosen level in the cause-effect chain of the considered environmental effect type, relating somehow to the areas for protection. The impact score profile gives the impact scores for the impact categories.

A defined type of health, environmental or resource impact [Norwegian Standards Organisation, 1993].

impact score
Contribution of a product system to one impact category.

Total contribution to a given impact category from a specific product system [Norwegian Standards Organisation, 1993].

impact score profile (environmental profile)
List of impact scores for all impact categories.
Note: if the sub-step of normalisation is done in the characterisation this is called the normalised impact score profile.

inventory table
List of environmental entities added to and taken from the environment (environmental interventions) through economic actions which are directly caused by processes within a product system. It is the main result of the inventory analysis.

normalisation
An optional element within impact assessment which is relating all impact scores of a functional unit in the impact score profile to a reference situation. The reference situation may differ per impact category, and is the contribution of a certain region in a certain period of time to the problem type at hand. Normalisation results in a normalised impact score profile which consists of normalised impact scores.

The characterisation step may be concluded by normalising the aggregated data per impact category in relation to the actual magnitude of the impacts within this category in some given area. The reason for doing this is to increase the comparability of the data from the different impact categories and thus to create a more sound basis for the next step, the valuation [Consoli *et al.*, 1993, page 24].
Calculation of all input and output flows to a system unit in relation to the reference flow and the functional unit of the product [Norwegian Standards Organisation, 1993].

valuation
Last element within impact assessment following the characterisation/normalisation element, in which the results of the characterisation/normalisation, in particular the (normalised) impact scores, are weighted against each other in a quantitative and/or qualitative way in order to be able to make the impact information more decision-friendly. This is an element which necessarily involves qualitative or quantitative valuations which are not only based on natural sciences. For instance political and/or ethical values can be used in this element. The valuation can result in an environmental index.

The step in LCA where the total contribution from a given product system to all relevant categories are calculated [Norwegian Standards Organisation, 1993].

The fourth component of a life cycle assessment in which different product systems are assessed in comparison with each other, or in which potential environmental effects of different kinds are compared [Heijungs *et al.*, 1992]

Substep of the impact assessment element of the LCA process in which the results of the characterisation are compared. It may involve the interpretation, further aggregation, weighting and ranking of data [ISO/SC5, 1994].

Step in which the data of the different specific impact categories are weighted so that they can be compared among themselves [Consoli *et al.*, 1993, page 24].

The assignment of relative values or weights to different impacts and their integration across impact categories to allow decision makers to assimilate and consider the full range of relevant impacts across impact categories.

Use of formal valuation methods should make this process explicit and collective, rather than one based on implicit, individual value judgements [Fava *et al.*, 1993].

valuation factor
Factor in the valuation element transforming the impact score profile in an environmental index.

Sources
Several letters and comments by Göran Finnveden (IVL), Rolf Frischknecht (ETH), Allan A. Jensen (DK teknik), Michael Hauschild (DTU), Erwin Lindeijer (IVAM), José Potting (NW&S) and Helias A. Udo de Haes (CML) are an important background for these definitions.
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2. DEFINITIONS OF SYMBOLS

Below is a list of symbols to be preferred when dealing with equations in the impact assessment. We have tried to find symbols which are a compromise between different requirements:
- the symbols should be as far as possible self-evident (e.g. not G or q for the environmental index)
- the symbols should be sufficiently distinct (e.g. not s for stressor and S for score)
- the symbols should not be exotic (e.g. not ξ)

quantity	symbol	arguments
environmental intervention	M	reserve I for index; also not S (stressor) because S for impact score; M suggests mass, which is most often the case
characterisation factor	Q	C could suggest concentration; Q suggests a bit the TEQ and other equivalents
impact score	S	is more descriptive than I
actual extent in a certain period in a certain area	A	
normalisation factor	$1/A$	reserve N for normalised score; do we need a separate symbol?
normalised impact score	N	distinct enough from unnormalised score S, but not too distinct
valuation factor	W	this is the factor in the weigh(t)ing sub-step of the valuation step, so the societal, monetary or distance to target factor; the normalisation factor is not part of it
target value	T	this might be any target impact value, not a target intervention
interimpact factor	R	suggests the relativity of this factor
environmental index	X	is more descriptive than I

Often, different interventions or different impact categories must be denoted. This may be done by attaching small print subscripts *i* for different interventions and *j* for different impact categories to the above symbols. Thus the characterisation procedure amounts to:

$$S_j = \sum_i Q_{ji} x M_i$$

the normalisation to:

$$N_j = \frac{S_j}{A_j}$$

and the valuation to:

$$X = \sum_j W_j x N_j$$

for valuation methods which need normalisation, and

$$X = \sum_j W_j x S_j$$

for valuation methods which do not need normalisation. The valuation factor could consist of actual values, target values and/or intrinisic or monetary values:

$$W_j = \frac{A_j}{T_j}$$

for a plain distance-to-target valuation,

$$W_j = R_j$$

for a purely societal or monatery valuation, and

$$W_j = R_j x \frac{A_j}{T_j}$$

for a combination thereof. The normalisation factor is constructed from measured or predicted environmental interventions in a certain period in a certain area

$$A_j = \sum_i Q_{ji} x \Phi_i$$

where Φ_i represents the actual flow of intervention *i* in the chosen area in the chosen time period.