Chapter 7
Goal Definition

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Abstract The goal definitionis the first phase of an LCA and determines the purpose of a study in detail. This chapter teaches how to perform the six aspects of a goal definition: (1) Intended applications of the results, (2) Limitations due to methodological choices, (3) Decision context and reasons for carrying out the study, (4) Target audience, (5) Comparative studies to be disclosed to the public and (6) Commissioner of the study and other influential actors. The instructions address both the conduct and reporting of a goal definition and are largely based on the ILCD guidance document (EC-JRC in European Commission—Joint Research Centre—Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook—General Guide for Life Cycle Assessment —Detailed Guidance. Publications Office of the European Union, Luxembourg 2010).

Learning Objectives
After studying this chapter, the reader should be able to:

- Define the goal of any LCA study.
- Explain the six goal aspects and their relevance for the subsequent LCA phases.

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7.1 Introduction

The goal definitionis the first phase of any LCA. Here, the purpose of the study is elaborately defined and described. This greatly influences the LCA because decisions made in later LCA phases (Chaps. 8–12) must be consistent with the goal definition. The influence may also go the other way, for example, if unforeseen data limitations in the inventory analysis (Chap. 9) necessitate a revision of the goal definition. Such a revision is an example of the iterative nature of LCA (see Chap. 6).

The goal definition based on the ISO standard requirements generally contains six aspects:

1. Intended applications of the results
2. Limitations due to methodological choices
3. Decision context and reasons for carrying out the study
4. Target audience
5. Comparative studies to be disclosed to the public
6. Commissioner of the study and other influential actors.

Each aspect must be considered when performing an LCA. Aspects 1 and 3 are central for *doing* an LCA because they have pervasive influence on decisions made in later LCA phases. On the other hand, aspects 2, 4, 5 and 6 mainly relate to *communicating the results* of an LCA. For these aspects, we further refer to Chaps. 13, 37–39, which provide specific guidance on and examples of the reporting and reviewing of LCA results.

7.2 Intended Applications of the Results

All LCAs involve studying one or more product systems and this can be used in several applications, such as

- Comparing environmental impacts of specific goods or services.
- Identifying the parts of a product system that contribute most to its environmental impact (i.e. “hot spot identification”, focusing in product development).
- Evaluating improvement potentials from changes in product designs(analysis and ‘what-if’ scenarios in eco-design).
- Documenting the environmental performance of products (e.g. in marketing using environmental product declarations or other types of product environmental footprints).
- Developing criteria for an eco-label.
- Developing policies that consider environmental aspects.

It is important to determine the intended application(s) of the LCA results at the onset, because it influences later phases of an LCA, such as the drawing of system boundaries (Chap. 8), sourcing of inventory data (Chap. 9) and interpretation of

results (Chap. 12). Often, several separate applications are intended in a study. For example, the intended applications of the results of the illustrative case on window frames in Chap. 39 were both to benchmark a new window design against three windows already on the market and to identify hot spots in the life cycle of the compared windows with the aim of guiding future impact reduction efforts.

7.3 Limitations Due to Methodological Choices

This aspect can be seen as a critical reflection of what the LCA results can and cannot be used for. If a study only covers climate change (often referred to as a "carbon footprint" study) it is, for example, important to stress that results cannot be used to claim a general environmental superiority of a studied product or conclude anything about its overall "environmental friendliness". Also, if a comparative study disregards one or more life cycle stages, it is important to stress how that limits the interpretation of results. For example, a study comparing the production of 1 tonne aluminum to the production of 1 tonne steel from mining to ingot cannot be used to identify the environmentally soundest material for use in a car, because the density difference of the two metals leads to differences in the amount of metal used for the car body and differences in the car mileage (fuel consumption per kilometre), causing different environmental impacts in the use stage and finally also in the disposal stage. In the illustrative window frame case study (Chap. 39) a stated limitation of the study was that a site-generic LCIA approach was taken in spite of impacts being concentrated around Scandinavia, where the natural environments, for some impact categories, do not correspond to the global average (e.g. Scandinavian soils show a higher sensitivity to depositions of acidifying compounds). Note that the limitations stated here should only relate to the choices made in the goal and scope phases of an LCA (this chapter and Chap. 8). These choices all relate to the *planning* and *use* of an LCA. On the contrary, choices made during the inventory and impact assessment phases of an LCA (Chaps. 9 and 10) relate to *unforeseen constraints and assumptions* (for example with respect to data availability) and must be documented at a later point in an LCA report, for example, in the inventory analysis part (Chap. 9) or in the interpretation part of a report (see Chap. 12).

7.4 Decision Context and Reasons for Carrying Out the Study

This is an important aspect of the goal definition because it strongly influences the appropriate elaboration of a life cycle inventory (Chap. 9). First, the reasons for carrying out a study must be understood. The reasons should be clearly connected

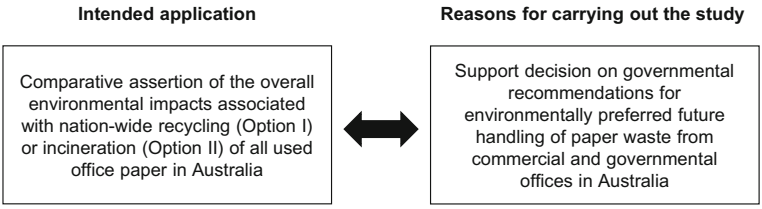

Fig. 7.1 Example of reasons for carrying out a study in continuation of the intended application

to the intended application of results (Sect. 7.2) and specifically address drivers and motivations with respect to decision-making. Figure 7.1 provides an example of reasons for carrying out a study in continuation of the intended applications.

Note that there is some ambiguity about the differences between "Intended application" and "Reasons for carrying out the study" in the ILCD guideline. As a rule of thumb the former should describe *what* a study does, while the latter should address *why* a study is made. The reasons for carrying out at study help understanding its decision context. In the example shown in Fig. 7.1 the study is motivated by a need for decision supporton governmental recommendations of paper waste handling. This means that the results and recommendations of the study can be expected to lead to changes in the analysed system. These changes may, in turn, lead to so-called "structural changes" in other systems that the studied product system interacts with. A structural change occurs when a change in one product system has such a large influence on the demand for a good or a service that it leads to new equipment being installed (increase in production capacity) or existing equipment being prematurely taken out of use (decrease in production capacity). As a rule of thumb, structural changes can be assumed to take place if the analysed decision leads to an additional demand or supply of a product that exceed the average percentage of annual replacement of total capacity (100% divided by the average equipment lifetime in years, e.g. 20). Structural changes result in qualitative and quantitative differences of industries and this must be considered in the inventory modelling (Chap. 9). In combination the above considerations help identify three different decision context situations and any LCA should be classified into one of these as part of the goal definition. Box 7.1 presents these three decision contexts and Fig. 7.2 presents a decision tree for how to determine the correct decision context of an LCA study.

Box 7.1 The Three Types of Decision Contexts
Situation A (Micro-level decision support): The study results are intended used to support a decision, but the small scale of the studied product system means that regardless the decision made, it will not cause structural changes in the systems that the studied product system interacts with. Many studies that intend to compare individual product systems, identify hotspots within these (see Sect. 7.2) or document the environmental performance of a product

in the form of an environmental product declaration fall into this decision context. The decision support of the LCA study may lead to limited changes in other systems, e.g. a reduced demand for electricity, but the changes are not of a structural nature, e.g. no electricity production equipment will be prematurely taken out of use.

Situation B (Meso/macro-level decision support): The study results are intended used to support a decision, and the scale of the studied product system is such that the decisions that are made are expected to cause structural changes in one or more processes of the systems that the studied product system interacts with. An example of a study that would be classified as belonging to this type of decision context is a study intended as decision support for policy development on potential nationwide substitution of diesel derived from oil with biodiesel for private cars. Such a decision will lead to structural changes in the biodiesel industry in the form of new equipment being installed to respond to the substantially increased demand for biofuels.

Situation C (Accounting): The study is not to be used to support decisions and is of a purely descriptive nature. It is documenting what has already happened, or what will happen due to a decision that has already been taken. Therefore, the presence of the LCA study will not lead to changes (small or structural) on other systems. Interactions with other systems (whether taking place in the past or in the future), e.g. through energy generated from waste incineration, can either be included in the product system model (**Situation C1**) or considered partially in the LCA through allocation (see Chap. 8) (**Situation C2**). C1 is used unless C2 is specifically prescribed by the commissioner's goal of the study.

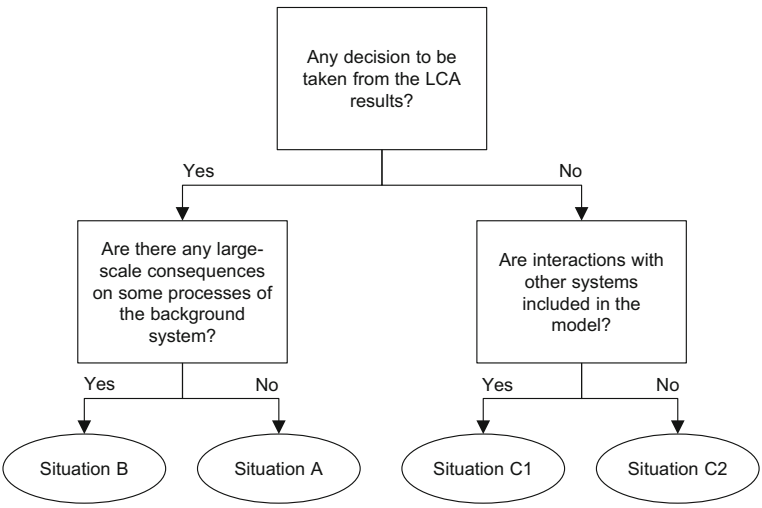

Fig. 7.2 Decision tree for how to identify the correct decision context

Figure 7.2 shows that the identification of the decision context depends on:

- Whether the study is intended as decision support
- Whether structural changes in interacting systems are expected from a decision supported by the study.
- Whether it is chosen to model interactions with other systems as part of the product system model or to handle them partially through allocation (see Chap. 8).

In the illustrative case of the window frames, the reason to carry out the study was to attract environmentally conscious consumers, through the use of an eco-label that the LCA results would help obtain. The study is thus to be used for decision support, but since it is concerned with a single product, this decision support is not expected to lead to structural changes in other systems. The decision context of the study is therefore Situation A (Micro-level decision support).

7.5 Target Audience

The goal definition must state the target audience of the study, i.e. to whom the results of the study are intended to be communicated. The target audience may be consumers, consumer organisations, companies (managers, product developers, etc.), government, NGOs and others. The target audience greatly influences the extent to which details of the study should be documented, the technical level of reporting (Chap. 8) and the interpretation of results (Chap. 12). In the illustrative window frame case study, the employees of the window producer NorWin's environmental and design departments are the target audience. Since this audience is unfamiliar with LCA, the content of the report was presented pedagogically by explaining technical terms that the readers could not be expected to be familiar with. When the readers are unfamiliar with LCA it may also be appropriate to provide brief background information about LCA of the type given in Chap. 2 of this book.

7.6 Comparative Studies to Be Disclosed to the Public

The goal definition should explicitly state whether the LCA study is of a comparative nature (see Sect. 7.2) and if it is intended to be disclosed to the public. If this is the case, the ISO standard specifies a number of requirements on the conduct and documentation of the study and an external review process, due to the potential consequences that the communication of the results of the study may have for external companies, institutions, consumers and other stakeholders. The ISO requirements are detailed in Chap. 8 and are basically meant to ensure transparency and good quality of a study.

7.7 Commissioner of the Study and Other Influential Actors

The goal definition should also explicitly state who commissioned the study, who financed it (usually the commissioning organisation) and other organisations that have influence on the study, including those of the LCA experts conducting the study. This step of the goal definition is meant to highlight potential conflicts of interest to readers of the study. Such conflict of interest may occur if a key provider of data has an economic interest in particular LCA results and interpretations. In comparative studies, it may also lead to an unintentional bias of the data collection. The commissioner of the study will normally provide data that is up to date and reflects the current performance of the technology for the commissioner's own product. In contrast, the data collection for the other product(s) in the comparison will typically have to be based on literature and databases and hence, due to the delay involved in publishing the data, represent the state of the art several years ago.

References

This chapter is to a large extent based on the ILCD handbook and the ISO standards 14040 and 14044. Due to the scope of this chapter, some details have been omitted, and some procedures have been rephrased to make the text more relevant to students. For more details, the reader may refer to these texts:

EC-JRC.: European Commission—Joint Research Centre—Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook—General Guide for Life Cycle Assessment—Detailed Guidance. First edition March 2010. EUR 24708 EN. Publications Office of the European Union, Luxembourg (2010)

ISO.: Environmental Management—Life Cycle Assessment—Principles and Framework (ISO 14040). ISO, the International Organization for Standardization, Geneva (2006a)

ISO.: Environmental Management—Life Cycle Assessment—Requirements and Guidelines (ISO 14044). ISO, the International Organization for Standardization, Geneva (2006b)

Author Biographies

Anders Bjørn part of the LCA community since the early 2010s. Main focus is interpretations of sustainability and integration of sustainability targets in LCA to enable absolute sustainability assessments.

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Mikołaj Owsianiak involved in development and application of life cycle impact assessment methods in sustainability assessment of technologies. Has worked on issues associated with: soils (remediation), metals (toxic impact assessment), biodiesel (fate in the environment), and carbonaceous materials (biochar and hydrochar).

Stig Irving Olsen LCA expert both as researcher and as consultant. Involved in the development of LCA methodologies since mid 1990's. Contributed to UNEP/SETAC working groups on LCIA methodology. Main LCA interest is human toxicity impacts, emerging technologies, and decision making.