TECHNICAL SPECIFICATION

ISO/TS 14074

First edition
2022-11

Environmental management — Life cycle assessment — Principles, requirements and guidelines for normalization, weighting and interpretation

Management Environnemental — Analyse du cycle de vie — Principes, exigences et lignes directrices pour la normalisation, la pondération et l'interprétation

Reference number
ISO/TS 14074:2022(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 207, *Environmental management*, Subcommittee SC 5, *Life cycle assessment.*

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The United Nations Sustainable Development Goals (SDGs)[3] identify the need for transition toward sustainable patterns of consumption and production. Life cycle assessment (LCA) can support this goal with a quantitative approach to evaluating the environmental impacts of products from raw material acquisition to end-of-life treatment (disposal, recycling, etc). It can help with the identification of improvement potentials of measures to achieving SDGs and can compare alternative approaches on product, company and country levels.

NOTE The term "environmental impact" is always used in the sense of potential environmental impact.

LCA studies can help to identify ways of improving resource and energy efficiency, avoiding releases to the environment, and developing a circular economy. LCA can also help identify and evaluate trade-offs between different environmental aspects and life cycle stages.

ISO 14040 and ISO 14044 are the generic environmental management standards for LCA. These standards provide principles, requirements and guidelines for the four phases of an LCA: goal and scope definition, life cycle inventory analysis, impact assessment and interpretation.

Normalization and weighting are optional elements of life cycle impact assessment (LCIA). These elements can support the interpretation of the assessed life cycle impact category indicator results, also known as the "LCIA profile".

Presently, LCA results are interpreted through a variety of different methods and approaches. A consistent approach to the interpretation of LCA results can be helpful, especially considering the growth in LCA applications, such as:

— LCA-based regulations, e.g. greenhouse gas reporting;

— national programmes for LCA-based environmental statements, e.g. environmental labelling;

— use of LCA to support public and private sector procurement, e.g. environmental product declarations (EPDs), footprint communication.

Through providing additional principles, requirements and guidelines applicable to normalization, weighting and interpretation of LCA results, this document:

— improves the credibility of LCA results;

— increases the use of LCA results in decision-making related to environmental management;

— increases the number of LCA studies and applications;

— improves the interpretation phase of LCA.

In this way, this document aims to increase the contribution of LCA to advancing sustainable consumption and production patterns.

In this document, the following verbal forms are used:

— "shall" indicates a requirement;

— "should" indicates a recommendation;

— "may" indicates a permission;

— "can" indicates a possibility or a capability.

Environmental management — Life cycle assessment — Principles, requirements and guidelines for normalization, weighting and interpretation

1 Scope

This document specifies principles, requirements and guidelines for normalization, weighting and life cycle interpretation, in addition to those given in ISO 14040 and ISO 14044.

The document is applicable to any life cycle assessment (LCA) and footprint quantification study.

In particular, this document addresses:

— the use of normalization and its limitations;

— the use of weighting and its limitations;

— the selection or development of weighting factors;

— the generation of single scores;

— requirements that relate to documentation and reporting.

For the interpretation phase, it provides, in addition to ISO 14044, procedures and guidance for:

— performing completeness, sensitivity and consistency checks;

— addressing uncertainties and limitations;

— documenting conclusions and recommendations.

This document does not specify the composition of panels for weighting nor does it specify multi-criteria decision analysis.

This document does not intend to recommend or require a specific weighting approach or method or any priority of one weighting approach or method over another as they are based on value choices. Organizations have the flexibility to implement LCA in accordance with the intended application and the requirements of the organization.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14040, *Environmental management — Life cycle assessment — Principles and framework*

ISO 14044, *Environmental management — Life cycle assessment — Requirements and guidelines*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14044 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
weighting
converting and possibly aggregating life cycle inventory results or indicator results across impact categories using *weighting factors* (3.4) based on *value choices* (3.7)

Note 1 to entry: Weighting can result in an aggregated score or in multiple scores.

3.2
normalization
calculation of the magnitude of life cycle inventory results or indicator results relative to reference information

Note 1 to entry: The reference information typically has the same unit as the indicator result, e.g. CO_2e, so the normalized indicator result is reported without a unit, e.g. in per cent.

3.3
reference information
quantitative data that serves as the basis for comparison

3.4
weighting factor
factor that expresses relative importance

Note 1 to entry: The determination of weighting factors is based on *value choice* (3.7).

3.5
normalization factor
number by which an impact category indicator result is multiplied to obtain a normalized impact category indicator result

Note 1 to entry: The normalization factor is the inverse of the *reference information* (3.3).

3.6
reference system
system that serves as the basis for *normalization* (3.2)

3.7
value choice
subjective decision based on a judgement of what is important

3.8
midpoint indicator
category indicator expressing an environmental impact occurring anywhere along the environmental mechanism before a category endpoint is affected

Note 1 to entry: Despite its name, "midpoint" is not intended to mean that the indicator is located in the (exact) middle of the environmental mechanism.

4 Principles

For the purposes of this document, the principles of ISO 14040 shall apply.

5 General requirements and guidance

Normalization, weighting and interpretation of the results of LCA studies and footprint quantification studies can support informed decision-making.

When LCA results are expressed relative to a reference information, it can help in understanding and communication LCA results.

EXAMPLE Some people find it easier to understand the magnitude of an indicator result related to human toxicity if it is expressed relative to the relevant annual indicator results of an average citizen rather than in units such as comparative toxic unit for human (CTUh).

Similarly, when comparing a range of options, it can be helpful to express results relative to a base case or to a best- or worst-case scenario.

Weighting can help in understanding the relative importance of LCA results covering different impact categories. It can also support the comparison of one LCIA profile with another. However, trade-offs can occur between impact categories, life cycle stages, the geographic regions where environmental impacts occur, and the different areas of concern. These trade-offs are not always evident in results obtained after normalization or weighting. Therefore, whenever normalization and weighting are used, the results shall be reported in sufficient detail to allow understanding of the complexities and trade-offs inherent in the LCA.

Environmental mechanisms have different spatial and temporal scales. In addition, governments and interested parties from different countries and population groups can have different views about environmental priorities. Reference system and information used in the normalization and data used in weighting shall be chosen based on their regional and temporal relevance and shall be documented.

Life cycle inventory results should be consulted iteratively when normalization, weighting and interpretation is performed. When undertaking normalization, weighting and life cycle interpretation, the requirements and guidelines of ISO 14044 shall apply, with a special attention to the validation of data, in accordance with ISO 14044:2006, 4.3.3.2.

Weighting shall not be used in LCA studies intended to be used in comparative assertions intended to be disclosed to the public. However, weighting is permitted for comparisons which are not intended to be used in comparative assertions intended to be disclosed to the public. When publishing a single score weighted result, full non-weighted indicator results shall be available to the public.

6 Normalization

6.1 General

Normalization transforms an indicator result by dividing it by the indicator result for a selected reference system.

Possible uses for normalization include:

— checking the plausibility of impact category indicator results;

— assessment of the relative magnitude of impact category indicator results;

— an intermediate step before weighting;

— assistance in the interpretation of results;

— assistance in communication of results.

Internal normalization describes the situation where the selected reference system is one of the options under study, such as a base case or best-case scenario.

External normalization describes the situation where the selected reference system is external to the product system under study. Examples can include indicator results for:

— a nation or region in a specified time period;

— an average citizen living in a nation or region in a specified time period;

— some other familiar reference, such as driving an average car a specified distance.

EXAMPLE A product is produced and consumed in Germany in 2017. The carbon footprint of the product system was 129 kg CO_2e. The total carbon footprint in Germany in 2017 was 8,7 t CO_2e per citizen. The carbon footprint of the product system can be normalized per citizen in Germany (129/8,700), resulting in a normalized indicator result of 0,014 8 or 1,48 %.

Normalization shall apply the same reference system to all impact categories considered and all the product systems under study. The choice of reference system shall be relevant to and consistent with the goal and scope of the study.

No reference system is unequivocally superior to another.

For a given impact category, the normalization factor and the impact category indicator result shall use the same characterization factors.

Reference systems used for normalization shall be documented and justified in the study report.

The uncertainty and completeness of the normalization factors should be documented when such information is available.

Potential bias introduced by inconsistent elementary flow coverage between the system under study and the reference system shall be documented.

Where the choice of reference system has implications for study results and conclusions, these shall be described in the study report.

When normalization is used as an intermediate step before weighting, the normalization factors shall be relevant for and consistent with the weighting factors applied (e.g. in terms of geographical region or people concerned or involved).

Normalization results without weighting shall not be used for comparisons across impact categories.

6.2 Limitations

Normalization results do not necessarily point to priority environmental concerns. A normalized indicator result of higher value does not necessarily represent an impact of higher environmental concern.

EXAMPLE A product system can make a large contribution to an impact category of smaller environmental concern, or a small contribution to an impact category of larger environmental concern. Similarly, a product system can make a small global contribution to an environmental concern but a large contribution locally. This later case draws attention to the role the choice of reference information can play on study conclusions.

A high normalized life cycle impact category indicator result can be the consequence of one or more of the following:

— high impact category indicator results of the product system under study;

— low impact category indicator results of the chosen reference system (i.e. a high normalization factor);

— a bias introduced by inconsistent elementary flow coverage between the product system under study and the normalization data.

The influence of the above aspects on the normalization results should be taken into consideration in the interpretation of the results.

A change in reference system can change conclusions of the study.

Reflecting globalization of supply chains and products of a long lifetime, different processes of a product system can occur in different regions and at different times. For such cases, the selection of

the reference information can depend on many assumptions, which influences the resulting set of normalized indicator results.

For some cases, reference information is difficult to determine and therefore not readily available in literature and in databases.

Normalization results without weighting cannot be used for interpretation of high or low environmental concerns across impact categories.

7 Weighting

7.1 General

According to ISO 14044, weighting is an additional optional element in LCIA which allows aggregation of category indicators obtained from the LCIA modelling, beyond what characterization models based on natural science can quantify.

The weighting method shall be consistent with goal and scope of the study. While LCA gives priority to natural science, the optional element "weighting" is based on value choices and reflects social values, preferences and attitudes towards environmental impacts. Values are inherently subjective and the values of one person cannot scientifically be given more weight than those of another person. Social science methods can be applied to survey these values from a population of interest.

Weighting supports the practitioner in aggregating results into a single score or into multiple scores by assigning a weighting factor to each impact category or inventory indicator. If weighting factors are developed as part of the study, the selected method and the procedure, including data sources, to determine the final weighting factors shall be documented. If the weighting factors are taken from existing literature, the source shall be referenced.

Weighting reflects a process of quantifying the relative importance of environmental impacts based upon a set of criteria. In weighting, the indicator results are multiplied by weighting factors which quantify the relative importance of the impact category. Weighting factors and their derivation shall be transparent. Weighting shall be justified and documented in a transparent manner.

The selection and derivation of weighting factors shall be consistent with the scope of the indicators and their characterization factors. The scope of each indicator and any limitations shall be presented transparently and considered as part of the process of developing weightings.

The selection and derivation of weighting factors shall be consistent with normalization used.

EXAMPLE If normalization is for a certain country, it is not consistent if the weighting factors are at the regional or global level or for a different country.

Weighting can help to aggregate the LCIA results into a reduced number of impact categories or a single score. The development of a set of weighting factors that is transparently presented and whose limitations are highlighted and discussed can help not only to lead to better decisions but also to make the decision process more transparent. Aggregation should not be applied to data with different dimensions or units.

Weighting is not intended to conceal indicator results in LCA reports. All indicator results prior to and after the weighting in the study shall be included in the LCA report. Life cycle inventory results shall be accessible to the practitioner who performs weighting. Different weighting methods use different criteria on which to convert and aggregate indicator results into one or more aggregated value(s).

The set of weighting factors shall be the same for all alternatives assessed in a study.

7.2 Different approaches to weighting

7.2.1 General

A variety of different approaches is available to perform weighting in LCA. They include, but are not limited to:

— distance-to-target (DtT) weighting (see 7.2.2);

— panel-based weighting (see 7.2.3);

— monetary valuation (see 7.2.4);

— a combination of approaches.

The choice of methods influences the results and any decisions taken based on these. Weighting factors can be determined for a population of interest with the help of social science methods. Statistical and social science methods can be used to evaluate the consistency, completeness, uncertainty, representativeness and relevance of these values in a specific decision-making context.

Even though the resulting weighting factors remain value choices, the method to derive them shall be justified in accordance with the principle of the priority of the scientific approach (see ISO 14040:2006, 4.1.8) and transparently documented.

7.2.2 Distance-to-target weighting

The DtT approach values the importance of indicators by applying weighting factors that depend on the distance between the existing impact level and a target level. Weighting factors in the DtT approach can be based on a calculation which is performed on reference information developed for LCA for the selected geographical area based on policy goals and regulatory limits. DtT weighting factors can be applied to indicator results, normalized indicator results and life cycle inventory results.

EXAMPLE DtT weighting factor = $(R_i - R_{iT})/R_{iT}$, where R_i is the total release or resource use of substance i in a specific region, and R_{iT} is the target release or resource use for the same region.

DtT weighting factors may be based on actual situations compared to goals set by governments or other interested parties that relate to the environment.

Targets of the DtT approach can be based on:

— policy goals and regulatory limits;

— maximum threshold based on scientific assessments;

— societal boundaries.

7.2.3 Panel-based weighting

The panel-based weighting approach values the relative importance of the impact categories by applying weighting factors determined by a panel, which can involve the practitioner of the study, the commissioner of the study and any other interested parties.

Panel members shall declare transparently their interests unless they were selected randomly. The selection of members of the panel should be described.

If panel members are randomly selected, the method for their selection should also be described.

A description of the panel shall be reported. The description of the panel and its setup should include the following:

— the number of panel participants;

— a profile of the panel participants (e.g. gender, age, income, interests);

— their education;

— their expertise in the topic;

— the regions they come from;

— classification of their professional work;

— how they were asked the questions and the time frame;

— the data processing;

— concerns expressed by panel members.

The way in which weighting factors are generated shall be documented, including the background information provided to the panel.

If a panel survey is conducted as part of an LCA study, the following shall be documented and justified in the study report:

— the panel composition;

— the survey design;

— the way in which known bias are avoided or treated;

— a range per weighting factor which reflects the differences in values between the different members of the panel.

NOTE Further information on the use of panel methods is provided in ISO 20252.

7.2.4 Monetary valuation

The monetary valuation approach values the importance of environmental impacts or related environmental aspects in monetary terms.

The associated weighting factors are proportional to the maximum utility the affected population is prepared to give up for a reduction in adverse environmental impact or to accept compensation for an increase in adverse environmental impact. The weighting factors may be expressed in currency units that are purchasing-power corrected and may be equity weighted. The monetary values can be obtained from market prices, as revealed preferences or as stated preferences. Stated preference methods are survey methods, similar to panel methods, but with panels that are representative of the affected human population.

NOTE More guidance and requirements regarding monetary valuation is provided in ISO 14008.

7.3 Weighting at different points along the environmental mechanism

Weighting may be applied at different points of the environmental mechanisms. As a result, weighting can concern inventory indicators, midpoint indicators or damage indicators. A damage indicator is a category indicator expressing an environmental impact at category end-point level whereby all environmental impacts on the same kind of end point are expressed in the same unit.

7.4 Limitations in weighting

7.4.1 General

The main limitation of weighting results is that they often are context specific and not relevant in other contexts. Methods that rely on preferences for abstract goods or features, e.g. environmental issues

such as potentially disappeared fraction (PDF) of species, disability-adjusted life years (DALYs) or comparative toxic unit (CTU), should be regularly updated to represent current views. It is difficult to use them for product development and for other decisions with long-term consequences.

There is no universally valid weighting method. Values of different persons, cultures, organizations, governments and countries vary and can change weighted results.

Weighting methods can lack consistency across impact categories as it can sometimes be difficult to calculate weighting factors for all impact categories consistently.

7.4.2 Uncertainty in weighting

Weighting factors are generated based on value choices. Value choices of people can change over time. When different panels are asked for their values, it needs to be borne in mind that the people are influenced by their context, e.g. legislation or their experiences. Consequently, the weighting factors set can change significantly depending on the approach, how they were generated, the time scale, the region and the set of indicators addressed. As a consequence, the weighted results differ and can have a higher level of uncertainty. In addition, the methods for the determination of the sets of weighting factors can be different and deliver different sets of weighting factors.

7.4.3 Potential shift of importance of impact between life cycle stages and environmental impacts

Using different weighting factors can assign different levels of importance to the impact categories evaluated for a product's life cycle. As a result, aggregated weighted results can highlight different life cycle stages as the most important ones. The influence of weighting methods on the importance of different life cycle stages should be assessed.

7.4.4 Distance-to-target weighting

The time perspectives in DtT methods can give information about the stability of the weighting factor. The target value can be changed by legislation. An ambitious target value does not need to be based solely on the high importance of the relevant impact category; other reasons can also apply.

When there are different relative distances to the targets for different impact categories, DtT weighting will give different weights to the same damage (e.g. the same years of life lost, caused by the different impact categories).

7.4.5 Panel-based weighting

A limitation in panel-based weighting is that panels are not necessarily representative of the affected human population.

7.4.6 Monetary valuation

The outcomes from monetary valuation can vary according to the method used. Different weighting methods should be used to assess and report the variation in outcome from different monetary valuation methods. This can be included a sensitivity analysis.

The variability of market prices or marginal abatement costs indicate the level of reproducibility of weighting factors. Monetary values can vary, for example, because there is a potential for markets to be affected by regulations, inflation, state control and subsidies.

7.4.7 Weighting factors change over time

Weighting factors can vary over time. The stability of weighting factors over time should be considered. If basic conditions for the setup of the weighting factors change (e.g. opinions, importance of environmental impacts, targets or monetary values), the results of the weighted overall results can be affected significantly.

8 Documentation and reporting requirements for normalization and weighting

In LCA studies using normalization and weighting, the results with and without the application of normalization and weighting shall be presented and discussed. If the LCA results are reported to third parties, life cycle inventory and, if any, impact category indicator results obtained prior to any normalization or weighting shall be made available together with the normalized or weighted results.

Discussion on weighting is important as there is not one generally accepted approach or method. Different normalization and weighting approaches or methods have their relative strengths and weaknesses and should be considered in the study design and discussed in the interpretation.

The documentation and report shall include the following elements:

— A detailed description and the reasons for selecting the particular method (including its approach). If a sufficiently detailed description of the normalization or weighting method used has already been published, a reference to that publication may be sufficient.

— The methodology of the normalization and weighting as applied in the LCA study in question. This should include enough intermediate steps and transparency so that the results are reproducible.

— A discussion about the influence of each underlying normalization and weighting method on the results. Using different weighting methods allows the variability in resultant outcomes to be tested in a sensitivity analysis.

— When panel-based, the composition of panel(s), the way in which the panel participants have been selected, the procedure used when panel members interact, and full results of the panel for each normalization and weighting component.

— Uncertainties in normalization and weighting.

For weighting, the selected approach to deliver weighting factors and the variability shall be reported.

In view of the likelihood that variability can occur between the different weighting methods, the report shall contain full justification for the use of the weighting methods applied in the study.

According to the goal and scope of the study, any inherent differences and their scale should be explained.

9 Interpretation of life cycle assessment results

9.1 General

Interpretation shall be done in accordance with ISO 14044. This document provides additional guidance on interpretation in general, not limited to the normalization and weighting.

The results of an LCI or an LCIA, or both, shall be summarized, discussed and documented. Conclusions and recommendations shall be included, in accordance with the defined goal and scope as a basis for decision-making.

If the benefit of the function of the product under study is assessed, it shall be reported separately from the LCA results of the product and shall not be aggregated with impacts associated with the function of the product.

EXAMPLE 1 There can be human health impacts (typically negative) associated with the production and distribution of food (e.g. from the use of pesticides). There can also be human health impacts related to the function of food. Such impacts can be positive (e.g. preventing malnutrition) or negative (e.g. contributing to malnutrition). Food suitable for human consumption can also be wasted, used for feeding livestock, used for bioenergy or in some other industrial process. Foods can also contribute to poor dietary patterns that contribute to disease.

NOTE The consumption of a given amount of food (e.g. 1 kg of wheat or 500 g of yoghurt) also has dietary impacts, not analysed in LCA.

EXAMPLE 2 When assessing the environmental impacts of electricity production and distribution, the human health benefits of electricity use are not deducted.

9.2 Identification of significant issues

Identification of significant issues is an indispensable tool to help draw conclusions from a study. Several examples are given in ISO 14044:2006, B.2.1 to B.2.8.

NOTE Significant issues can be identified, for example, by the use of hotspot analysis, contribution analysis or dominance analysis, or by comparison with previously published studies.

The identification of significant issues shall address the most significant life cycle stages, the most significant processes and the most significant elementary flows for each impact category assessed. Methodological choices (e.g. functional unit, geographical and technological scope, allocation, selection of data sources) with significant relevance for the result shall be addressed.

The identification of significant issues shall include, if applied, the interpretation of normalization and weighting. It shall be determined and reported, which indicator results are significant for the overall interpretation of the study. It should be determined and reported in which way the application of different normalization or weighting methods changes and influences these significant issues.

9.3 Completeness checks

Completeness check shall include, if applied, normalization factors and weighting factors (e.g. whether all normalization factors and weighting factors are available and complete).

Mass and energy balances of input and output flows should be performed to check for completeness and/or potential errors. Comparison with similar studies is a useful approach to identify potential data gaps.

9.4 Consistency checks

Consistency checks shall be done in accordance with ISO 14044 and shall include, if applied, normalization factors and weighting factors (e.g. whether all normalization factors and weighting factors are consistently applied throughout the study and are in accordance with the goal and scope definition performed).

The consistency check should cover:

— consistency between goal and scope and the intended application;

— consistency in use of terms and definitions;

— consistency in defining the functional unit and reference flows;

— consistency in selection of impact categories and LCIA methods;

— consistency in system boundaries;

— consistency in choice of reference systems;

— consistency in choice of data;

— consistency in aggregation levels;

— consistency in calculation procedures;

— consistency in value choices;