# SLOVENSKI STANDARD
# oSIST prEN 18027:2024

**01-februar-2024**

**Bioizdelki - Ocenjevanje življenjskega cikla - Dodatne zahteve in smernice za primerjavo življenjskih ciklov bioloških proizvodov z enakovrednimi proizvodi na osnovi fosilnih goriv**

Bio-based products - Life cycle assessment - Additional requirements and guidelines for comparing the life cycles of bio-based products with their fossil-based equivalents

Biobasierte Produkte - Ökobilanzen - Zusätzliche Anforderungen und Leitlinien für den Vergleich der Lebenszyklen von biobasierten Produkten mit ihren fossilen Pendants



Produits biosourcés - Analyse du cycle de vie - Exigences et lignes directrices supplémentaires concernant la comparaison des cycles de vie de produits biosourcés avec leurs équivalents d'origine fossile



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# Bio-based products - Life cycle assessment - Additional requirements and guidelines for comparing the life cycles of bio-based products with their fossil-based equivalents

Biobasierte Produkte - Ökobilanzen - Zusätzliche Anforderungen und Leitlinien für den Vergleich der Lebenszyklen von biobasierten Produkten mit ihren fossilen Pendants

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 411.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Ref. No. prEN 18027:2023 E

# Contents

Page

## European foreword

This document (prEN 18027:2023) has been prepared by Technical Committee CEN/TC 411 “Bio-based products”, the secretariat of which is held by NEN.

This document is currently submitted to the CEN Enquiry.

This document is complementary to EN 16760:2015 *Bio-based products – Life cycle assessment*.

# Introduction

Bio-based products from forestry and agriculture have a long history of application, such as paper, board and various chemicals and materials. The last decades have seen the emergence of new bio-based products in the market. Some of the reasons for the increased interest lie in the benefits of bio-based products in relation to the depletion of fossil resources and climate change. Bio-based products can also provide additional product functionalities. These developments have triggered a wave of innovation with the development of knowledge and technologies allowing new transformation processes and product development.

Acknowledging the need for common standards for bio-based products, the European Commission issued mandate M/492[1], resulting in a series of standards developed by CEN/TC 411 during 2012-2017, with a focus on bio-based products other than food, feed and biomass for energy applications. This document was developed after the expiration of the mandate, upon the initiative of CEN/TC 411/WG 4.

The standards of CEN/TC 411 “Bio-based products” provide a common basis on the following aspects:

— common terminology;

— bio-based content determination;

— life cycle assessment (LCA);

— sustainability aspects; and

— declaration tools.



It is important to understand what the term bio-based product covers and how it is being used. The term ‘bio-based’ means 'derived from biomass'. Bio-based products (bottles, insulation materials, wood and wood products, paper, solvents, chemical intermediates, composite materials, etc.) are products which are wholly or partly derived from biomass. It is essential to characterize the amount of biomass contained in the product by, for instance, its bio-based content or bio-based carbon content.



The bio-based content of a product does not provide information on its environmental impact or sustainability, which may be assessed through LCA and sustainability criteria. In addition, transparent and unambiguous communication within bio-based value chains is facilitated by a harmonized framework for certification and declaration.

This document has been developed with the aim to set a framework for fair comparisons between fossil-based and bio-based product systems through LCA. Today, some comparisons are made in a way which (consciously or unconsciously) disadvantages the bio-based product systems related to a number of aspects. Often, this is due to an incorrect application of LCA, and not being in full conformance with the international LCA standard EN ISO 14044. In this document some of these issues are addressed when setting the framework for how a correct study is to be performed.

The general methodology to perform LCAs of products is described in the standard mentioned above as well as in EN ISO 14040, EN ISO 14067 and, more specific for bio-based products, in EN 16760 and EN ISO 22526-1 to EN ISO 22526-4. However, significant problems often arise when it comes to making well-balanced comparative LCAs between bio-based and fossil-based product systems. This document provides additional requirements and guidelines to enable practitioners to perform comparative LCA studies involving bio-based products with equivalent fossil-based products and disclose the results. Fossil resource use increases the total amount of carbon in the biosphere while bio-based systems can

[1] A mandate is a standardization task embedded in European trade laws. Mandate M/492 was addressed to the European Standardization bodies, CEN, CENELEC and ETSI, for the development of horizontal European Standards for bio-based products.

operate in a renewable way within this system (provided that the biomass grows at at least the same rate as it is harvested). Biogenic carbon returns to the atmosphere and this carbon can then be absorbed as plants, trees and algae grow.

This document sets requirements for comparisons between fossil-based and bio-based product systems. There can in some cases be many other options (which can be better than both the fossil-based and bio-based option), but this is outside of the scope of this document.

## 1 Scope

This document provides requirements and guidelines for comparing the life cycles of bio-based products with their fossil-based equivalents.

NOTE The term "equivalents" generally refers to the "functional equivalence".

This document builds on existing LCA methodology and provides requirements and guidance on specific topics relevant for making well-balanced comparisons.

## 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.

EN ISO 14040:2006,[2] *Environmental management — Life cycle assessment — Principles and framework (ISO 14040:2006)*

EN ISO 14044:2006,[3] *Environmental management — Life cycle assessment — Requirements and guidelines (ISO 14044:2006)*

EN ISO 14067:2018, *Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification (ISO 14067:2018)*

EN 16575:2014, *Bio-based products - Vocabulary*



EN 16760, *Bio-based products - Life Cycle Assessment*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 14040:2006, EN ISO 14044:2006, EN 16575:2014 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**
**direct land use change**
**dLUC**
change in the land-use category within the product system under study

Note 1 to entry: The change of land-use category can e.g. be from forest land to cropland.

[SOURCE: IPCC Guidelines 2006 [16]]

[2] As impacted by EN ISO 14040:2006/A1:2020.
[3] As impacted by EN ISO 14044:2006/A1:2018 and EN ISO 14044:2006/A2:2020.

**3.2**
**indirect land use change**
**iLUC**
change in the use of land which is the consequence of direct land use change, but which occurs outside the relevant boundary

[SOURCE: EN ISO 14067:2018, 3.1.7.6, modified: Notes to entry and example deleted]

# 4 General principles for LCA studies which compare bio-based with fossil-based products

## 4.1 General

The principles from EN ISO 14040:2006, 4.1 apply for this document. They are followed in both planning, conducting, and reviewing an LCA study. These principles are further elaborated in 4.2-4.8 below to cover the comparison of bio-based products with their fossil-based equivalents.

## 4.2 Life cycle perspective

Due to different supply chains (agriculture and forestry vs. mining and extraction), data availability, quality and appropriateness can deviate considerably between the systems under study.

Also, end-of-life for products can differ considerably due to the specific properties (such as recyclability) and the availability of different treatment options.

The different attributes of bio-based and fossil-based carbon flows are treated consistently in comparative studies that are handling both flows, or in comparisons of studies that handles one or the other of the two flows.



## 4.3 Environmental focus

LCA focuses on addressing environmental aspects and impacts for distinctively different product systems related to the safeguards natural resources, human health, and ecosystems.

Due to the different nature of the supply chains also different economic and social impacts can be observed, see 6.4.1.2. These impacts are typically out of scope but can be addressed in broader assessments.



## 4.4 Relative approach (and functional unit)

Functional equivalence is the core condition for meaningful comparisons and corresponding interpretations. An absolute functional equivalence can be demonstrated for products during their use phase.

## 4.5 Iterative approach

Iterations between LCA phases help to support proper interpretation when making comparisons.

## 4.6 Transparency

Transparency is a key principle for LCA studies comparing bio-based and fossil-based product systems, as for all LCA studies. In particular, this is relevant where conventions (e.g. carbon modelling) and value choices are applied. Transparency along all four phases of an LCA study (goal and scope, inventory, impact assessment and interpretation) helps to ensure proper interpretation (7.3) and appropriate reporting (7.4), including the enabling of a critical review (7.5).

### 4.7 Comprehensiveness

The consideration of all aspects of the natural environment, human health, and resources in LCA avoids burden shifting and identifies trade-offs.

For bio-based and fossil-based product systems this includes impacts of both systems, understanding the different impact pathways in an overall perspective.

Impacts can be driven by emissions (contribution to global warming or eutrophication) which are harmful for the natural environment or can be related to other inventory data like land occupation or land transformation (6.4.1.1).

### 4.8 Priority of scientific approach

Decisions for comparing bio-based with fossil-based product systems are preferably based on natural science, in particular for modelling decisions related to carbon flows, carbon content, carbon storage and emissions and removals. If conventions or value choices are used to determine the difference between two product systems, they are transparently documented and investigated during interpretation.

## 5 General requirements for LCA studies which compare bio-based with fossil-based products

### 5.1 General

When performing LCA according to this document, the requirements in EN ISO 14040, EN ISO 14044, EN ISO 14067 and EN 16760 shall be met.



The comparison of bio-based and fossil-based products relates to many challenges as there are inherent differences between the systems and a balanced modelling can in practice not be achieved. To support a meaningful interpretation and appropriate reporting, data collection and documentation shall be guided by the principles for LCA in general and the specific aspects of comparing bio-based with fossil in particular, where e.g. the feedstock or raw material (oil, wood or crops) sourcing can be the dominating or discriminating stage of the life cycle.

Due to different supply chains data availability, quality and appropriateness can deviate considerably between bio-based and fossil raw material and the same can be valid for different end-of-life options. In addition, temporal boundaries can deviate.



This asymmetry between the systems shall be considered through a careful set up of any LCA study that intends to compare the product systems and shall be considered also when comparing the outcome of different studies of bio-based and fossil-based systems. Differences can be compared given that the modelling follows the same principles and assumptions, and the context of each study are equivalent.

LCA offers a variety of techniques to limit bias introduced by such asymmetries and ensure comparability. Main techniques are:

— sensitivity analysis for any modelling assumption based on value choices or conventions; and

— statistical procedures to explore the relevance of data gaps.

Given that asymmetries cannot be avoided, the transparent documentation of limitations related to goal and scope of the study and further reporting requirements of value choices, rationales, and expert judgements, followed up with a comprehensive critical review, are pre-requisites for meaningful conclusions to be drawn.

EN ISO 14044:2006 sets requirements for comparative studies, which shall be the basis when making comparisons between bio-based and fossil-based product systems, see text box below.

**EN ISO 14044:2006, 4.2.3.7 Comparisons between systems**

In a comparative study, the equivalence of the systems being compared shall be evaluated before interpreting the results. Consequently, the scope of the study shall be defined in such a way that the systems can be compared. Systems shall be compared using the same functional unit and equivalent methodological considerations, such as performance, system boundary, data quality, allocation procedures, decision rules on evaluating inputs, and outputs and impact assessment. Any differences between systems regarding these parameters shall be identified and reported. If the study is intended to be used for a comparative assertion intended to be disclosed to the public, interested parties shall conduct this evaluation as a critical review.

Furthermore, the requirements for comparability set in the bullet list of EN ISO 14025:2010, 6.7.2 shall be met, see below for the list (slightly adapted to the scope of this document):

a) The product category definition and description (e.g. function, technical performance and use) are identical.

b) The goal and scope definition for the LCA of the product, according to the ISO 14040 series, has the following characteristics:

— the functional unit is identical;

— the system boundary is equivalent;

— the description of data is equivalent;

— the criteria for the inclusion of inputs and outputs are identical;

— the data quality requirements including coverage, precision, completeness, representativeness, consistency, reproducibility, sources and uncertainty are equivalent; and

— the units are identical.



c) For the inventory analysis:



— the methods of data collection are equivalent;

— the calculation procedures are identical; and

— the allocation of material and energy flows and releases is equivalent.

d) Impact category selection and calculation rules, if applied, are identical.

e) Predetermined parameters for reporting of LCA data (inventory data categories and impact category indicators) are identical.

f) Requirements for provision of additional environmental information, including any methodological requirements (e.g. specifications for hazard and risk assessment) are equivalent.

g) Materials and substances to be declared (e.g. information about product content, including specification of materials and substances that can adversely affect human health and/or the environment, in all stages of the life cycle) are equivalent.

In order to compare bio-based and fossil-based product systems based on information modules, either the environmental impacts of omitted life cycle stages of the products shall not be significant, or the data of omitted life cycle stages shall be identical within the accepted uncertainty of the data.

# 6 Aspects to consider

## 6.1 General

For comparing bio-based with fossil-based product systems all aspects in Clause 6 for both systems shall be comprehensively addressed.

## 6.2 Guidance and requirements on biogenic and fossil carbon flows

### 6.2.1 Modelling considerations for carbon flows

#### 6.2.1.1 General

There are different ways to handle carbon containing elementary flows in a life cycle inventory, different approaches to handle allocation of carbon flows for a process or processes shared by more than one product system, including those at end-of-life; and different approaches to treatment of fossil and biogenic carbon flows in life cycle impact assessment.

The main issues arising for fossil and biogenic carbon flows respectively are:

— Different methodological approaches can reveal or obscure that fossil carbon, once extracted from the ground, can ultimately be released as a $CO_2$ emission to the atmosphere.

— Some methodological approaches do not recognize that biogenic $CO_2$ has been removed from the atmosphere nor recognize any benefit where such $CO_2$ is not subsequently emitted.

NOTE Guidance on how to handle algae grown with fossil $CO_2$ can be found in B.1.1.

#### 6.2.1.2 Life cycle inventory

Greenhouse gas (GHG) emissions and removals arising from fossil carbon sources and biogenic carbon sources and sinks shall be included and listed separately in the inventory.



The GHG inventory shall cover all carbon flows in such a way that the effect of choices related to stored or released carbon (bio- or fossil) and storage period(s) at the product end-of-life can be assessed in sensitivity analyses during the interpretation phase (see 7.3)

Multi-functionality shall be handled, if possible by subdivision or by system expansion to avoid allocation (following EN ISO 14044). Where allocation cannot be avoided it is important to realize that allocation can introduce problems for the accounting of biogenic carbon flows.

If the applied allocation is based on a physical relationship like mass or energy, the modelled biogenic carbon flows might not reflect the actual physical content and flows. Biogenic carbon content and flows shall be allocated reflecting the physical flows.

#### 6.2.1.3 Impact assessment

To calculate life cycle impact assessments, all biogenic and non-biogenic carbon emissions and removals should be considered. The impacts shall be reported separately, e.g. climate change – biogenic, climate change – fossil. Two examples can be found in B.1.2.

### 6.2.2 Quantification of removal/emissions of biogenic carbon

#### 6.2.2.1 General

There are different ways to deal with biogenic carbon removals and emissions in LCA. Annex A provides an overview of the different approaches used in LCA standards.

The main issues that can be observed are:

— There is a need for a harmonized and transparent approach on how the biogenic carbon removals and emissions are to be handled. The inconsistency in approaches of handling the removals and emissions of biogenic $CO_2$, in the life cycle inventory and when performing impact assessments results in different outcomes and interpretations.

— There are different approaches regarding how to report biogenic carbon emissions and removals in cradle to gate studies, whether biogenic carbon removals are to be included as a negative when the positive emissions from the end-of-life is not included in the scope.

#### 6.2.2.2 Life cycle inventory

Biogenic carbon is captured as $CO_2$ from the atmosphere and sequestered during biomass growth, a process commonly referred to as photosynthesis. This biogenic carbon can at the end of the life cycle be emitted as $CO_2$, CO or $CH_4$ as a result of the oxidation and/or reduction of biogenic carbon in the product by means of its transformation or degradation (e.g. incineration, biodegradation, landfilling). The biogenic carbon can also flow into other products by mechanical, chemical, or organic recycling. The inventory of biogenic carbon flows shall include both the removals and the emissions with dedicated elementary flows e.g. carbon dioxide (biogenic). Biogenic GHG emissions and removals shall be included and shall each be reported separately in both cradle to gate and cradle to grave assessments.



For cradle to gate studies, biogenic carbon content in the intermediate products shall be reported separately to allow to calculate biogenic carbon emissions and removals when the intermediate product is used in a final product and a cradle to grave study is to be carried out.

#### 6.2.2.3 Impact assessment



As described in EN 16760:2015, two main approaches may be applied for modelling $CO_2$ emissions and removals related to biomass:

a) The $CO_2$ incorporated in biomass during the growth phase is inventoried as a removal during the cultivation/growth phase, and as an emission when it is released at end-of-life or throughout the life cycle. The characterization factor (CF) for $CO_2$ removal is then set equal to −1, while emissions of biogenic $CO_2$ correspondingly have a CF of 1 (referred to as the +1/-1 approach). Or,

b) The $CO_2$ incorporated in biomass during the growth phase and the corresponding emissions throughout the entire life cycle are both characterized with a characterization factor of zero (referred to as the 0/0 approach).

NOTE Characterization factors are used to quantify the potential impact of the modelled $CO_2$ emissions and uptakes (within the climate change impact category).

Other biogenic GHG emissions (e.g. $CH_4$) should always be characterized as these are substances which are not by default part of the carbon cycle, but the result of conversion processes that lead to substances which have a higher radiative forcing than $CO_2$.