Alliance for European Flax-Linen & Hemp



EUROPEAN FLAX-LINEN ENVIRONMENTAL FOOTPRINT GUIDE

PROGRESS REPORT ON LCA, PEF, LIFE CYCLE DATA FOR CERTIFIED FIBRES, PROCESSES AND PRODUCTS

MASTERS OF FLAX FIBRE™ & MASTERS OF LINEN™

OCTOBER 2026 UPDATE

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MAY 2026 UPDATE

EXECUTIVE SUMMARY

In a context where **consumer expectations and regulations** require increasingly robust data – and where claims need to be evidence-based, **understanding and calculating the environmental footprint of products is essential** for the European Flax-Linen value chain and all its stakeholders, from fibre producers to brands and retailers.

This guide explains what environmental footprinting involves, why it is **essential for enhancing both sustainability, compliance and economic performance—helping businesses meet client demands, communicate unique selling points, drive innovation, and secure investments**—and how the sector can collectively rise to this challenge.

The **Alliance for European Flax-Linen and Hemp,** as the only European agro-industrial organisation representing these fibres and the authority guaranteeing technical, scientific and economic data on European Flax-Linen, is leading the sector's **environmental trajectory** with clear objectives:

- to guarantee reliable data, that represent the specificities of Europen Flax-Linen and highlight its environmental profile, rooted in responsible practices;
- to support the Masters of FLAX FIBRE™ (formerly European Flax™) and Masters of LINEN™ certifications,
- to contribute in methodological harmonization, particularly through the **European PEF** (Product Environmental Footprint) framework;
- to ensure the accessibility of certified fibre data by collaborating with leading environmental databases.

The Alliance is committed to supporting **all Flax-Linen stakeholders:**

- **Producers of fibres, yarns, fabrics, reinforcements, and traders,** enabling them to manage their data and meet market expectations in a harmonized manner;
- **Brands, manufacturers, retailers, and consultants,** helping them understand the Flax-Linen specific processes, products, and data required to evaluate European Flax-Linen products effectively.

KEY MILESTONES:

2022 — Publication of the Life Cycle Assessment for Masters of FLAX FIBRE™ long fibre.

2023 — Integration of certified European fibre data into 3 major environmental databases: the EU's EF 3.1, ecoinvent, Higg MSI;

2021-2025 — Participation as a voting member in the PEF sectoral rules for Apparel & Footwear

Dec. 2025 — Completion of life cycle data for Flax-Linen processes, covering six processes and nine semi-finished products, on European averages –resulting from 4 years of co-construction, modelling and external review with members and experts.

Next step — Roll-out of a bespoke digital calculator, available for Alliance members on a voluntary basis, simplifying calculation while safeguarding the confidentiality of industrial data.

While the pace of regulatory and market developments may sometimes appear uncertain, the direction is clear: **environmental footprint will become a prerequisite for market access and meeting brand requirements.** And co-constructing methods and databases remains a continuous challenge.

Therefore Alliance remains committed to representing the sector, defending its specific characteristics, and providing robust data, actionable tools and expert guidance—spanning certifications, digital traceability, environmental trajectory, CSR, marketing, and industry economics.

This comprehensive approach aims to engage and empower the Flax-Linen stakeholders to meet evolving market demands while driving both sustainability and business success.

INTRODUCTION

NAVIGATING ENVIRONMENTAL FOOTPRINT: A STRATEGIC GUIDE FOR THE EUROPEAN FLAX-LINEN SECTOR

In an evolving context, where environmental data play an integral role in shaping market expectations and regulatory discussions—yet where harmonization takes time—**clear communication and shared understanding across the value chain are essential.**

The **Alliance for European Flax-Linen and Hemp,** as the only European agro-industrial organization representing these fibres, is the recognized authority guaranteeing technical, scientific, and economic data on European Flax-Linen.

Our ambition is to position **European Flax-Linen and Hemp as the preferred sustainable fibres worldwide,** supported by our certifications of origin and traceability: **Masters of FLAX FIBRE™** (formerly European Flax™) and **Masters of LINEN™**. These certifications are increasingly requested by brands and industrials, who integrate them in their sustainability strategies - although Flax-Linen represents a niche market (barely 0.5% of global fibres).

This guide is designed to serve as a **common reference tool,** offering a comprehensive overview of environmental footprinting and Life Cycle Assessment (LCA). Its purpose is to facilitate collaboration and **to support all Flax-Linen stakeholders:**

- **Producers of fibres, yarns, fabrics, reinforcements, and traders,** enabling them to manage their data and meet market expectations in a harmonized manner;
- **Brands, manufacturers, retailers, and consultants,** helping them understand the processes, products, and data required to evaluate European Flax-Linen products effectively.

This guide is accessible to all—regardless of prior knowledge of Life Cycle Assessment (LCA). It addresses diverse needs, from high-level strategic insights for decision-makers to technical explanations, as well as practical advice, use case examples and Q&A.

We expect it to help foster meaningful discussions within the sector, and expect to publish future iterations in order to reflect this co-construction, as well as the continuous evolution of footprinting methods: an evolving tool to help each actor navigate the complexities of environmental impact with confidence and clarity.



1

CHAPTER 1
ENVIRONMENTAL FOOTPRINT AND LCA EXPLAINED

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ENVIRONMENTAL FOOTPRINT AND LCA EXPLAINED

CHAPTER KEY POINTS

Understanding the environmental impact of European Flax-Linen products starts with knowing how to measure it.

This chapter breaks down the essentials of Life Cycle Assessment (LCA) and environmental footprinting in simple terms, provide every player in the value chain with a shared foundation, from which you can then explore further the strategic, business or technical topics relevant to your interests.

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1.1 - CONCEPTS AND DEFINITIONS

ENVIRONMENTAL FOOTPRINT (ENVIRONMENTAL IMPACT)

Environmental footprint is a multi-criteria measure of the environmental performance of a good service or organisation throughout its life cycle. To assess the environmental impact of a product, a Life Cycle Assessment (LCA) is carried out.

ENVIRONNEMENTAL FOOTPRINT VS CARBON FOOTPRINT

- **Carbon footprint measures the greenhouse gas emissions** of an activity, product or organisation and their effect on climate change.
- Environmental footprint reflects the larger picture. It takes into account carbon footprint as well as other impacts (water, land use, ecosystems, health, etc.) to avoid impact transfer.
- Carbon is part of environmental impact, but **environmental impact is more comprehensive and robust for informing decision-making** - See 1.3 - Impact categories.

LIFE CYCLE ASSESSMENT (LCA)

Definition: compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.
Source : ISO 14040:2006

WHY MEASURE IMPACT?

- **Identify impacts: understand where and how a product affects the environment.**
- **Reduce impacts: identify 'hotspots' to prioritise reduction actions.**
- **Provide reliable information to internal and external stakeholders: levers for business performance and regulatory compliance.**
See chapter 2

SCOPE OF IMPACT ASSESSMENT

Environmental footprint can be assessed at two distinct levels:

Product level



Assessment at the **process, intermediate product, or finished product** level
Refer to: 1.2 - Life Cycle Stages.

Key Methods:

- ISO 14040 & 14044 standards
- EU method: **PEF (Product Environmental Footprint)**

Organizational Level



Assessment of the comprehensive impact of a company, including its products and activities. This covers both **direct impacts** (within the organization) and **indirect impacts** (e.g., upstream supply chain, downstream product use in the case of a brand).

Key Methods:

- ISO method: **O-LCA (Organizational Life Cycle Assessment)** (ISO 14040 & 14044 + ISO/TS 14072)
- EU method: **OEF (Organizational Environmental Footprint)**

For further details on these methods, refer to Chapter 3.

Alliance works focus on the product scope, which is both:

- Most relevant for members and their clients
- A key part of organizational scope



LCA encompasses a variety of methodological approaches, all grounded in the ISO standards framework but featuring distinct adaptations.

By establishing clear regulatory requirements, policymakers can drive method harmonization, ultimately accelerating the integration of LCA practices across value chains.

1.2 - LIFE CYCLE STAGES

A product's Life Cycle Stages are:

1. **Raw Materials**
   Examples: Masters of FLAX FIBRE™ scutched fibre, Masters of FLAX FIBRE™ rescutched short fibre, extraction in case of petroleum-derived raw materials.
2. **Processing**
   Examples: hackling, spinning, weaving, knitting, finishing, garment manufacturing, etc.
3. **Distribution**
   Examples: retail outlets, e-commerce delivery, etc.
4. **Use**
   Examples: washing and drying a garment.
5. **End of Life**
   Examples: incineration/landfill.

Notes

- Packaging is included in the respective stages.
- Transportation is accounted for based on the study's scope.
- To assess the impacts of the use and end-of-life stages—which brands and retailers do not directly control—default scenarios are proposed.
  These are part of sector-specific rules (e.g., PEF guidelines for the apparel sector).

Scope of Impact Assessment

Impact assessment can be conducted across the entire product life cycle or on a specific, well-defined segment of the life cycle.

Cradle to Grave

The study covers the complete life cycle of the product, syn. "full LCA".

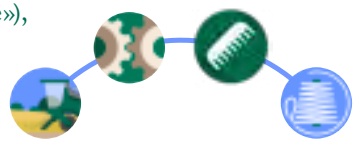
Example: A Linen t-shirt, from raw material to end of life.



Cradle to Gate

The study focuses on a semi-finished product (until the factory exit "gate»), syn. "partial LCA".

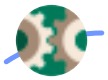
Example: Flax-Linen yarn.



Gate to Gate

The study measures the impact of a **specific transformation process** or multiple consecutive processes (from factory entry to exit gates).

Example: scutching process; preparation to spinning + wet-spinning processes.



THE LIMITS OF PARTIAL LCA SCOPE

Partial LCAs are limited in scope, and limited in use as well, compared to full LCAs. They can lead to incorrect conclusions if used to compare the environmental performance of raw materials which will be processed or used differently downstream - for instance, comparing Flax fibre and cotton fibre, as critical differences in in spinning etc. may be overlooked. When comparing products it's important to make sure they are comparable and to be transparent about the study limits.

1.3 - IMPACT CATEGORIES

DEFINITIONS & EXPLANATIONS

Impact category: class representing environmental issues of concern to which life cycle inventory analysis results may be assigned (definition in ISO 14040 & PEF methods).

It means that each impact category groups different factors that cause the same impact on the environment.

Example, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) and other gases lead to the greenhouse effect and belong in climate change impact category.

Impact category indicator: a quantifiable representation of an impact category.

Example: the impact indicator for climate change is "global warming potential", which is expressed in kg CO_2eq (carbon dioxide equivalent). "Indicator" is sometimes used to refer to "category" as they are very intricately connected.

Impact categories and indicators transform complex environmental data into a single, actionable metric -essentially serving as a "KPI for the environment".

WHAT DO IMPACT CATEGORIES COVER?

Impact categories represent the environmental issues where impacts can be scientifically measured. **As scientific knowledge advances, these categories evolve to reflect new insights.** Commonly addressed areas include Climate Change, Natural Resource Use, Water, Ecosystems, and Human Health.

However, there are different methodological approaches regarding the definition and **selection of impact categories:**

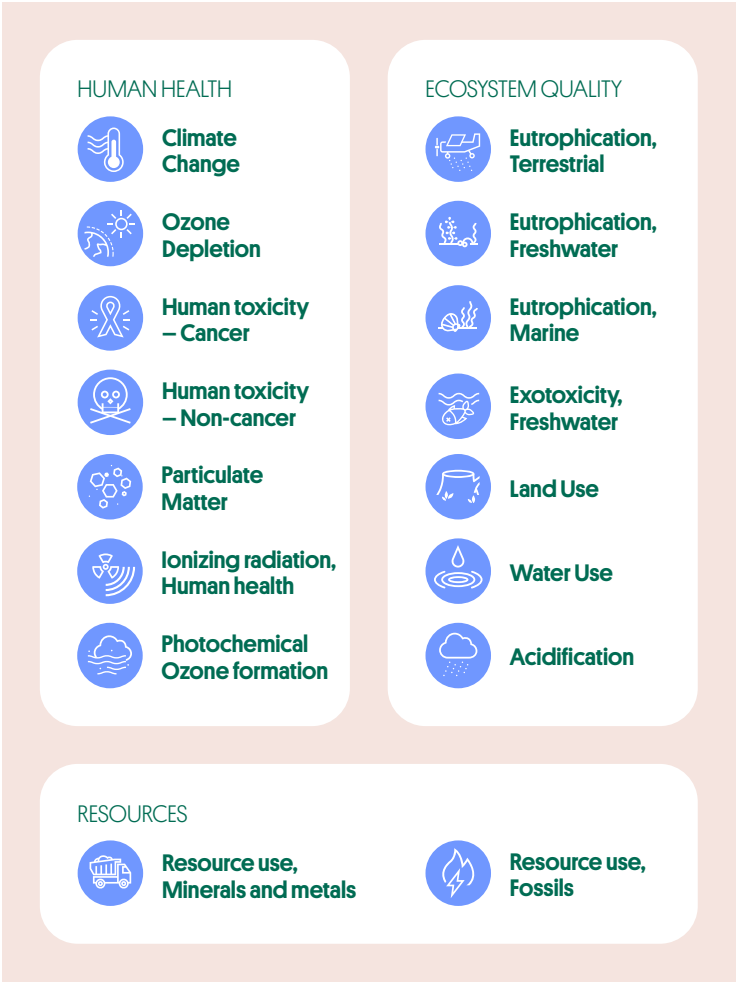
- ISO recommends identifying impact categories based on the specific goal of the study. ISO-compliant LCAs typically focus on a selection of the most relevant categories for the study's objectives.
- The PEF method, on the other hand, defines **16 impact categories** and specifies that all of them must be considered. The PEF then enables to aggregate them into a single score.

WHY IS IT RELEVANT TO CONSIDER THE 16 IMPACT CATEGORIES?

Taking all 16 impact categories into account is crucial to:

- **Avoid impact transfer,** where an improvement in one category might inadvertently lead to deterioration in another.
- Achieve **harmonized and more comparable results,** facilitating consistency across different studies.

Ensuring a holistic view of all potential impacts is the key for meaningful comparisons and overall reduction



Measuring 1 indicator, several or all 16 requires more or less the same resources for companies (time and effort for data collection) and for consultants.

1.4 - OVERVIEW OF LCA AND PEF STUDIES



A. PRELIMINARY STEP

Defining the scope you want to assess and the method you will follow.

LCA methods define specific rules for each step of the study: from data collection to modelling and external verification, that's why the choice of the method happens at the very beginning of the study. There are many different methods, for more information refer to chapter 3 Methods.



B. DATA COLLECTION

Gathering all the quantitative and qualitative information needed to describe the product or process studied: in case of a product, the whole upstream value chain is concerned.

The data collected can be either:

- **Process /product-specific data**
  Example for a Flax-Linen transformation process: inputs (energy types and consumptions, water, packaging, etc.), outputs (emissions of waste water, etc.), Flax-Linen material in- and outputs
- **Generic data**
  Example for a Linen finished product, collecting the precise name of raw material and transformation processes in order to find corresponding datasets in a database.



C. MODELLING

Dedicated tools process the data collected:

- **Softwares** for LCA experts (ex: SimaPro, OpenLca, GaBi, Umberto,...)
- Or **online calculators** which have been configurated for specific uses, addressing larger user profiles who may have a more basic LCA knowledge (ex: Glimpact, PEFTrust,...).



To do so, a database will be used to complement the data collected. The database is key in an LCA, this is why Alliance has a lonstanding collaboration with key databases **(more in Chapter 4).**



D. IMPACTS

The result is **quantified impacts for each category.**

Additionally, the PEF method also adds a last step:, ie converting the impacts into a common unit, the PEF micro-point and weighting them to account for the relative importance of each impact category. PEF results are therefore available as 16 scores and a single score, expressed in micro-point unit (µpt).



Interpretation of the results includes identifying the main contributors, i.e. **most relevant life cycle stages, processes and impact categories.** It is a key aspect in order to derive robust conclusions and recommendations. especially to **drive improvement** focusing action where it matters most



For more information about each sub-step, **refer to "LCAs & PEF studies, step by step" in Chapter 3.**

2

CHAPTER 2
THE POWER OF IMPACT DATA: FROM COMPLIANCE TO COMPETITIVENESS

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CHAPTER KEY POINTS

Calculating your environmental impacts isn't just about compliance—it's a strategic tool to meet market demands, strengthen performance, anticipate regulations, and progress over time.

This chapter shows you how impact data can drive both sustainability and business success.

SUB-SUMMARY

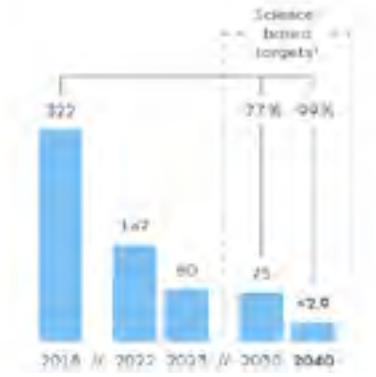
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2.1 - IMPACT DATA FOR BUSINESS PERFORMANCE



BRANDS' REQUESTS



COMPETITIVE ADVANTAGE



FINANCING FACILITATION

A GROWING DEMAND FROM BRANDS

Many brands and public actors are committing to decarbonization and impact reduction strategies.
As a result, they need to measure the impact of their value chain. **For Flax-Linen players, the ability to provide this data is becoming a sourcing criterion, while the capacity to analyze it and design an action plan adds significant value.**

COMPETITIVE ADVANTAGE

As a Flas-Linen mill, you can proactively use impact assessment to:

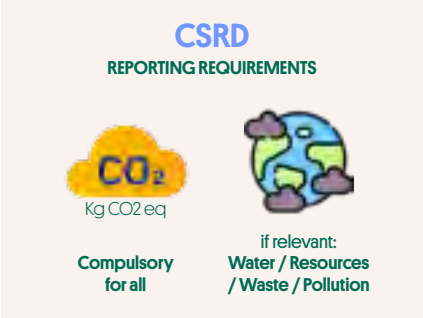
- **Highlight** your best practices, environmental performance, and reduction goals in a concrete and reliable way.
- **Create added value** for your products, eco-design new products, with unique selling points.
- **Strengthen your communication**—whether at trade shows or in marketing materials—by substantiating your claims.

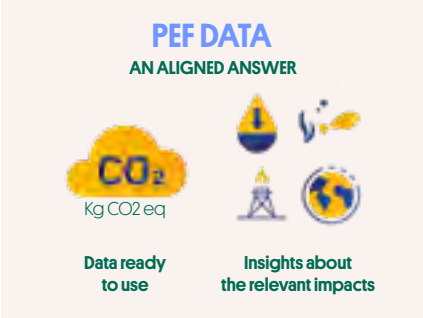
CONVINCING FUNDERS

Whether it's national grants, bank loans, or investors, an increasing number of **funding decisions** are based on environmental performance criteria.

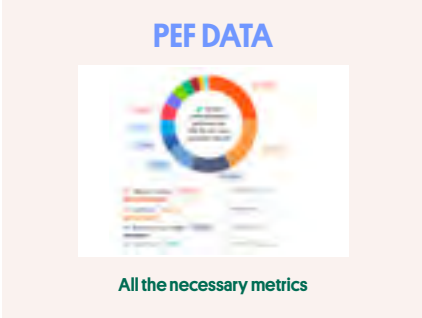
An article with a BtoB perspective
« Why Product Carbon Footprints are Becoming a Strategic Supplier Asset »
https://www.anthesisgroup.com/insights/why-product-carbon-footprints-are-becoming-a-strategic-supplier-asset/

2.2 - IMPACT DATA FOR REGULATORY COMPLIANCE









CORPORATE SUSTAINABILITY REPORTING DIRECTIVE (CSRD)

Objective: Reporting Requirements

- Company reports on their **Environmental, Social and Governance (ESG)** issues.

Product level

- Revised in 2025, it applies to **very large companies,** both EU and non-EU, operating in the EU market, based on their profile and turnover.
- Starting from **fiscal year 2027,** reports due 2028.
- supply chains must be taken not account, so **many companies in our sector will be indirectly affected.**

Environmental Data Concerned:

- **Carbon Footprint: Mandatory**
  Carbon footprint of subject companies shall including their supply chain.
  → Can be assessed with PEF data, including **climate impact in CO_2 equivalent.**
- **Other Impacts:** If Relevant
  Companies must analyze their other issues (water, resources, etc.) across the value chain and integrate the most significant ones into their reporting.
  → **PEF data allows for prioritizing and addressing these issues.**

ECODESIGN FOR SUSTAINABLE PRODUCT REGULATION (ESPR)

Objective: Ecodesign Requirements

- Product i**nformation and performance requirements** to enter the market.
- A **Digital Product Passport (DPP)** is also required.

Scope of Application:

- Directly concerns **finished products** placed on the European market, targeting **brands and retailers.** The **apparel sector** is among the priority sectors: delegated act expected end of **2027,** implementation **2029-2030.**
- **Indirectly, certain information requirements will likely affect the entire value chain, including traceability and environmental impact.**

Potential Environmental Data Concerned:

- Environmental or carbon footprint of the product across the value chain: different options are being studied by the European Commission.
  → Whichever is finally decided can be assessed using the PEF method.

2.3 - STRATEGIC CONCLUSIONS FOR THE FLAX-LINEN PLAYERS

IMPACT IS A STRATEGIC TOPIC FOR FLAX-LINEN BUSINESSES

- **Multiple internal motivations** for Flax industry players: economic performance, innovation, company image, etc.
- **End-market** requirements and upcoming regulations will increasingly challenge the whole value chain by **a trickle-down effect.** The PEF enables companies to be ready for demands from customers, partners and public authorities.
- Environmental impact connects across **several business dimensions**



MONITORING PROGRESS OVER TIME

Whether for economic performance or regulatory reporting purposes, there is a need to measure **progress along a trajectory.** Impact calculation makes it possible to identify relevant reduction levers:

The ability to update the calculation makes it possible to **highlight concrete actions and thus continuous improvement.**

CONTROLING YOUR DATA: A CONFIDENTIALITY ISSUE

By measuring your impact yourself, you can share your impact results with your customers. This allows you to meet your customers' data needs **without having to disclose your industrial data** (processes, consumption, yields, etc.).

Your sensitive data remains confidential.

KEY ADVANTAGES:

- Improved environmental performance and sustainability
- Better compliance with environmental regulations and standards
- Reliable data for making informed business decisions
- Potential cost savings through efficient resource use and waste reduction
- Identification and management of environmental issues
- Enhanced market competitiveness and brand reputation
- Access to new markets and eco-conscious customers
- Fair competition and limiting risk of greenwashing
- Favourable financing terms linked to a strong environmental profile

Source: Benefits for companies : overview of the environmental footprint methods, European Commission

https://op.europa.eu/en/publication-detail/-/publication/10016a22-849b-11ef-a67d-01aa75ed71a1/language-en

2.4 - ALLIANCE'S COMPREHENSIVE AND ACTIONABLE SOLUTIONS

EMPOWERING THE FLAX-LINEN CHAIN: ENVIRONMENTAL FOOTPRINT IS PART OF COMPLEMENTARY TOOLS, TAILORED TO BUSINESS NEEDS

Objectives:

- To convince and communicate through evidence,
- To offer a consistent set of tools and services, created by the Flax-Linen sector for the Flax-Linen sector and its end markets,
- To measure and improve the environmental footprint,
- To secure claims and highlight the unique selling points of Flax-Linen products.

The offer is structured through four pillars:

1. **Masters of FLAX FIBRE™ and Masters of LINEN™ certifications**
   the foundations: origin, traceability, requirements
2. **Digital traceability**
   a complementary tool to reinforce evidence and supply chain management
3. **Robust environmental data**
   to calculate impacts with reliable and accessible reference data
4. **Alliance expertise**
   support for the value chain: CSR, marketing, economics, sector knowledge

For all companies, regardless of their size or level of maturity, with the ambition of strengthening sustainability, transparency and performance.

By structuring this offering, the Alliance is contributing to a more responsible textile market, where innovation is based on evidence and where trust grows alongside environmental requirements.

4 DISTINCT AND COMPLEMENTARY PILLARS

1



STRENGTHENING
- STANDARDS
- CERTIFICATION BRANDING

2



SCALING UP THE DIGITAL TRACEABILITY PLATFORM

3



- SHARING LCA DATA FOR EUROPEAN FLAX-LINEN
- IMPLEMENTING IMPACT CALCULATOR

4

LOVE LINEN

PROVIDING
- SERVICES
- EXPERTISE
- EXPERIENCES

3

CHAPTER 3
DIVING DEEPER IN LCA AND PEF METHODS: INSIGHTS FOR THE FLAX-LINEN SECTOR

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CHAPTER KEY POINTS

This chapter explains LCA and PEF methods from the broad perspective to specific insights: everything you always wanted to know about methods' differences and the implications for Flax-Linen and final markets.

The Q&A section is designed to grow with your input - so don't hesitate to share your questions and help shape the discussion!

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3.1 - OVERVIEW OF METHODS

	CARBON FOOTPRINT	ENVIRONMENTAL FOOTPRINT Multi-criteria (including carbon)	
PRODUCT	**ISO 14067** International general standard. **GHG PROTOCOL PRODUCT STANDARD** International method. More specific than ISO 14067. Work to align them is currently underway.	**ISO 14040 and 14044** International general standards. Describe principles, application, phases of an LCA study, requirements, critical review and reporting **PEF - Product Environmental Footprint** European method based on ISO + addition of more specific and restrictive criteria, including 16 impact categories. Current works will bring PEF's climate change indicator and GHG closer.	+sector-specific complements *Example.: EN 15804[EU standard, construction sector]; PCR [Product Category Rule]* +sector-specific complements **Product Environmental Footprint Category Rules (PEFCR),** see next slides
COMPANY	**ISO 14064-1** International standard for measuring and reporting emissions. **GHG PROTOCOL** International method for measuring and reporting emissions, which is the reference for the SBTi framework. It distinguishes between direct and indirect emissions via 3 scopes: scope 3 integrates the value chain. **National methods** • BILAN CARBONE®, FR • PAS 2050, UK	**ISO : O-LCA - Organizational Life Cycle Assessment** Based on standards ISO 14040/14044 standards + spec ISO/TS 14072 **OEF - Organisation Environmental Footprint** European method for measuring a company's environmental impact, across all its activities, from upstream to downstream, taking into account 16 impact indicators, including climate change	

THE CLIMATE CHANGE INDICATOR OF THESE METHODOLOGIES CAN BE USED TO CALCULATE THE CARBON FOOTPRINT OF A PRODUCT

Product impacts are usually the largest part of companies' impacts, and the most complex part to measure.

Legend

GHG: GreenHouse Gas

GreenHouse Gas Protocol: method developed by World Resource Institute & World Business Council for Sustainable Development (WBCSD) https://ghgprotocol.org/

Bilan Carbone®: method belonging to Association pour la transition Bas Carbone (ABC), France

PAS 2050: method developed by the British Standards Institute (BSI), first Product Carbon Footprint standard published, 2008 https://knowledge.bsigroup.com/products/specification-for-the-assessment-of-the-life-cycle-greenhouse-gas-emissions-of-goods-and-services

PCR: LCA rules defining for a given product type how to collect data, model impacts and format results. Deliverables are Environmental Product Declarations (EPDs)

Product Environmental Footprint (PEF): valid version to-date Commission Recommendation (EU) 2021/2279 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021H2279

SBTi: Science Based Targets initiative, an association that oversees and validates companies' decarbonization objectives based on climate science and aligned with global warming limited to below +2°C. https://sciencebasedtargets.org/

3.2 - WHAT ARE THE DIFFERENCES BETWEEN ISO AND PEF METHODS?

METHODS (PRODUCT SCOPE)	ISO 14040 et 14044	PEF	INSIGHTS
OBJECTIVE	Provide the general framework for conducting an LCA.	Harmonise the calculation of products' environmental impact in Europe.	ISO standards answer the question «HOW TO CONDUCT AN LCA?» The PEF answers the question: «HOW TO COMPARE AND COMMUNICATE RELIABLY?»
METHODOLOGY	Flexibility in the choice of scope, data, and assumptions	LCA based on ISO 14040/44, but with detailed rules on scope, allocation, data, indicators	PEF reduces interpretations, subjectivity, and increases the reproducibility of studies
IMPACT CATEGORIES	No mandatory list; flexible according to the study	16 standardised environmental impact categories (climate, resources, water, ecosystems, health, etc.)	The PEF provides a more complete and comparable view of impacts
COMPARABILITY BETWEEN PRODUCTS	Comparability between 2 products in the same study, but not between results of different studies. Under a PCR, comparison is possible thanks to a certain level of harmonisation.	The PEF is designed to enable reliable comparisons between similar products and between a product and an official benchmark – in particular through PEFCRs.	The comparison makes it possible to justify the claims on differentiating arguments
TRANSPARENCY/ DOCUMENTATION	General principles.	Precise and harmonized rules on documentation, assumptions and data to be provided	The PEF imposes more rigour and transparency
REGULATORY USE	Voluntary international standard, methodological basis	Recommended by the European Commission	Recommended by the European Commission

HOW TO CHOOSE?

The choice of method will depend on the intended use by the company, and by its customers in the case of a company in the Flax-Linen value chain.

Hence the advantage of the PEF method, which meets more requirements and produces results that can be used more widely - See examples in the chapter « Use cases »

European Commission

CHALLENGES OF LCA SO FAR, EF RESPONSE

LCA used across many industries, but in incompatible schemes, with proliferation of labels and diverging claims

→ Ensure reproducibility, comparability

- Narrow down LCA method overall PEF/ OEF Methods, plus more specific per product-category / sector PEFCR/OEFSR
- Define scope and functional unit for comparisons within product categories
- Require common EF-compliant background data with common interoperable data set format and common elementary flow list instead of generic data quality and consistency requirements

→ Provide clear-cut decision support

- Prescribe impact methods instead of 10-20 impact indicators from free-to-chose LCIA methods
- Provide weighting factors to calculate single score
- Reporting template, communication requirements

→ Improve reliability
with minimum reviewer/verifier qualifications, verification scope details

→ Authoritative scheme by EC

Source: Environmental Footprint for 'Newbies' by the European Commission, Sphera and Maki consulting

3.3 - LCA & PEF STUDIES STEP BY STEP: FROM DATA COLLECTION...

Preliminary step: define the scope you want to assess and the method you will follow

LCA methods define specific rules for each step: data collection, inventory (the PEF requires using the European database), characterization, external verification (critical review).

1. Data collection

Gathering all the quantitative information needed to describe the product, process, or service being studied.

The data collected can be either:

- **Process /product-specific data** (aka primary data)
  They are collected in the company or its supply chain
  Example for a Flax-Linen transformation process: inputs (energy types and consumptions, water, packaging, etc.), outputs (emissions of waste water, etc.), Flax-Linen material in- and outputs.
- **Generic data** (aka secondary data) incl.
  - industry average data (eg number of reuses of a pallet in EU)
  - and **datasets** found in **databases**:
  Example impact data of 1 kwh electricity in Italy ; impact data of different types of bleaching or dyeing

→ The PEF method defines minimal requirements for specific data depending essentially on whether the process has a high impact (PEFCR help identify that) and whether the company performing the study has control/access to process data or not. A company of course always has the choice to collect more specific data than the minimum required for a more robust calculation.

2. Life Cycle Inventory (LCI)

Converting these inputs and outputs into elementary flows (also called elementary exchanges), using a **database.**

Example: an electricity dataset typically contains around 2000 flows corresponding to the elementary resources consumed and emissions caused by these kwh.

3 . Classification

Assigning all inventory flows to the relevant impact categories.

Example: all flows that result in greenhouse gas emissions are assigned to the climate change category.

4. Characterisation (LCIA)

Quantifying the impact of a category thanks to a model with a multiplier (characterisation factor, CF) for each flow.

Example: the model for the global warming potential indicator provides multipliers for different greenhouse gases (CO_2, CH_4, N_2O etc.) based on their respective harmfulness.

→ The result is a **Life Cycle Impact Assessment (LCIA)** ie quantified impacts for each category.

→ The PEF method adds a last step: **normalizing and weighting,** ie converting the impacts into a common unit (the PEF micro-point, based on impact of average European inhabitant) and weighting them to account for the relative importance of each impact category.
PEF results are therefore available as LCIA + 16 scores in micro-point unit (µpt) + single aggregated score in µpt.

SPECIFIC DATA

+ the more specific the data, the more representative and accurate the study is and the higher its relevance for decision-making.
- Take more time to collect

GENERIC DATA

+ very useful for data about the processes not run by your company [background processes],
- representativity is quite variable, for instance in the case of a certified Linen product:
  → the **Masters of FLAX FIBRE™ scutched long fibre dataset is highly representative,**
  → a generic spinning dataset much less so.

3.4 - LCA & PEF STUDIES STEP BY STEP: ...UNTIL DELIVERABLES

5. Interpretation: levers for reduction

Including Interpretation of the results of a life cycle assessment (LCA) study is a mandatory phase of LCA and it is a key aspect in order to derive **robust conclusions and recommendations** and to provide the decision makers with comprehensive and understandable information.
Source: JRC, Guide for interpreting life cycle assessment result.

Both ISO 14044 and the PEF method provide schemes to analyse and structure the results of the LCI and LCIA, that include identifying the main contributors to the LCIA results, i.e. **most relevant life cycle stages, processes and elementary flows,** commonly referred to as **"hotspots"**, as well as most relevant impact categories.

Hotspots have 2 main interests:

- to target **efforts of data collection** - for instance to measure real consumptions of a process instead of industry averages,
- to focus attention in order to **improve the environmental performance,** by prioritizing action where it matters most

Collecting data, performing an LCA and interpretation, then collecting more precise data and again, is an iterative and often lengthy process. To make it more efficient and possibly save some iterations, **sectorial rules and guidance** enable to identify the hotspots commonly found for some product categories (for instance PEF Category Rules for Apparel & Footwear).

Example from the PEF Apparel & Footwear: study of a "representative shirt", ie a shirt representative of the average of all the different compositions on the market:

- 6 most relevant impact categories account for more than 80% of total impacts (see graph)
- the **"raw material" and "manufacturing" stages** are most relevant for these 6 categories. This is commonly observed, even for sectors other than fashion. This is why **data regarding fibre production and processing are crucial for brands and final markets.**

6. Verification

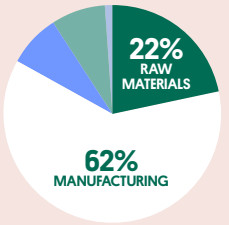
External verification by a qualified reviewer:

- **is required if the study is intended for external use,** like BtoB or BtoC communication,
- **is not required for internal uses** like ecodesign,
- shall cover specific verification points, including compliance with PEF and/or PEFCR requirements. In addition, the external reviewer may identify and examine particular areas of focus based on the product under study, the identified hotspots, and their sector-specific expertise..

Results from PEFCR Apparel &Footwear, representative product study, shirt.

IMPACT CATEGORY	% OF TOTAL IMPACT
Climate change	21%
Particulate matter	19%
Acidification	6%
Water use	15%
Resource use, minerals and metals	7%
Resource use, fossils	13%
Total most relevant contribution	81%
Total impacts	100%

Most relevant impact categories



Most relevant Life cycle stages, contributions to climate change impact category



Most relevant Life cycle stages, contributions to water impact category

PROCESS	CONTRIBUTION
Weaving	24,3%
Cotton fibre	13,5%
Spinning, for woven, ring-spun	8,8%
Finishing, stain resistant	7,4%
Dyeing, batch, direct, sulfur, vat or reactive	4,7%
Knitting, circular	4,2%
Washing, 40 degrees C	4,2%
Cargo plane	3,9%
PET granulates	2,3%
Spinning, for knit, ring-spun	1,8%
Dyeing, batch, disperse or cationic dyes	1,5%
Thermal energy from natural gas	1,5%
Pre-dye	1,5%

Most relevant processes, contribution to Climate change impact category

3.5 - PEF: A PHASED CONSTRUCTION

2013

Adoption and publication of the EF methods (PEF for products, OEF for organisations) by the European Commission as part of the European «Single Market for Green Products» policy.
Objectives: to provide a robust, repeatable and recognized framework for environmental assessment and product comparison, namely:

- **Quantify the environmental** impacts of products or services and reduce them
- **Standardize, harmonize and specify** impact calculation methods
- **Establish 'generic' data** for materials and processes
- Enable the control of **environmental claims** on the basis of scientific results.

Launch of 10 pilot PEFCRs (PEF Category Rules).

2021

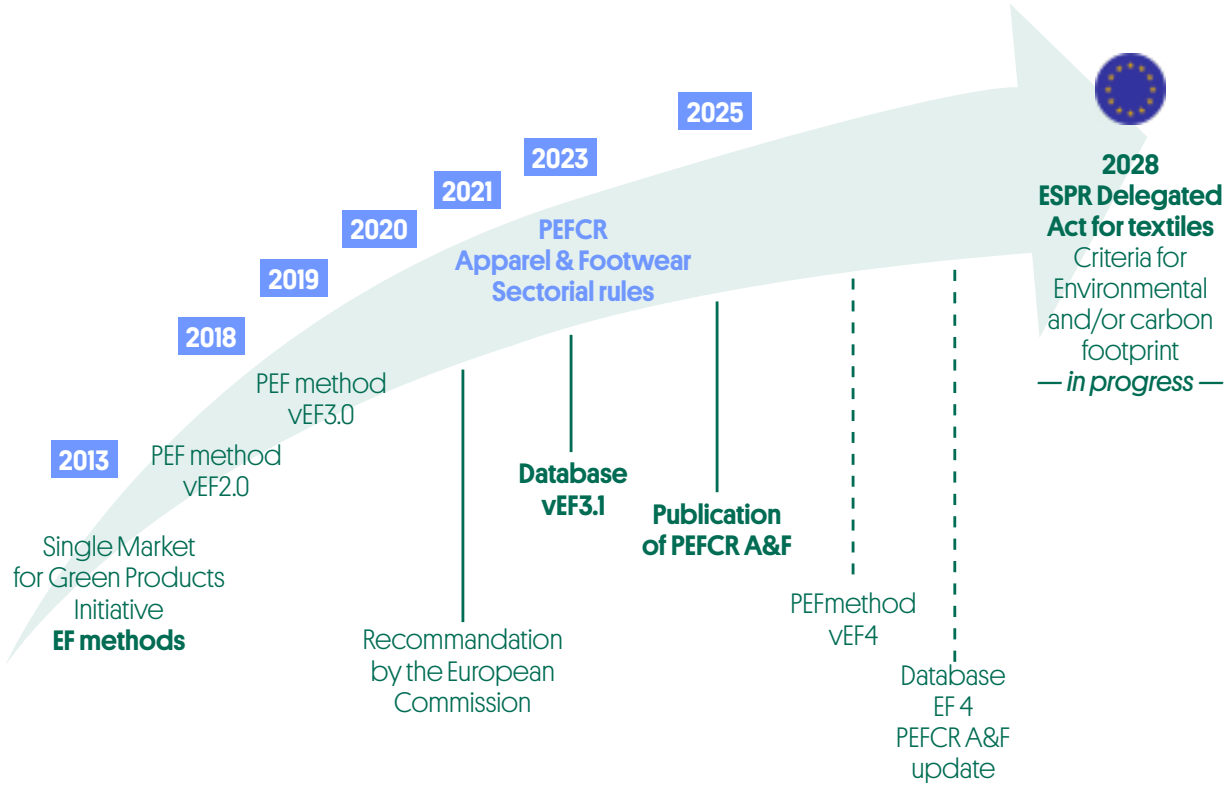
Recommendation on the use of EF methods published by the EC: from now on, PEF is THE method recognised by the EC, and potentially the reference method for current or future regulations.

EF methods are regularly evolving to take into account new scientific work. This then triggers renewals or updates:

- of the EF database
- of the sectoral rules (PEFCR).

EF methods, PEFCRs, datasets in the database and PEF study results therefore all have a validity date.

Note : since January 1, 2026, the whole EF 3.1 database is no longer valid. Temporary solutions are studied both for the EF general data and the sectorial data needed for PEFCRs, until the arrival of the EF 4 database.



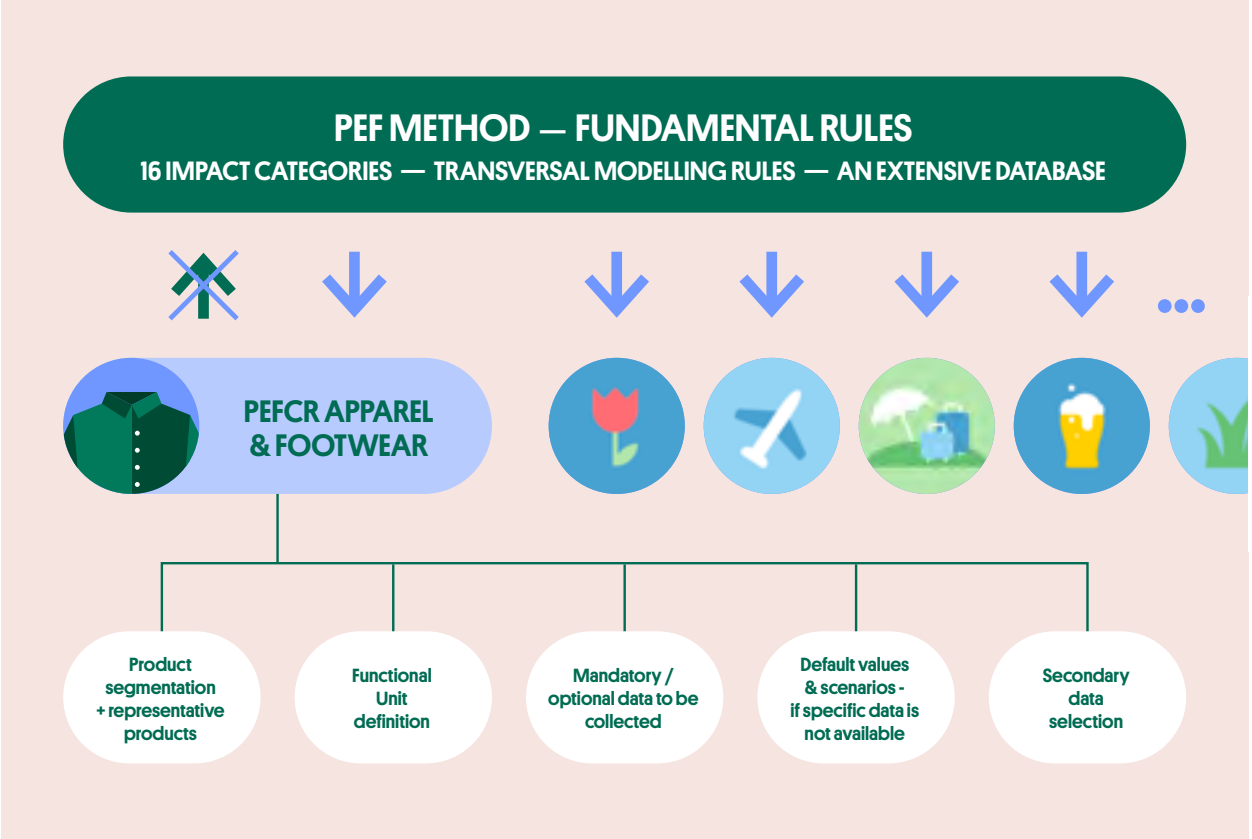
For more information about the EF phases:
https://green-forum.ec.europa.eu/green-business/environmental-footprint-methods_en

3.6 - PEF CATEGORY RULES (PEFCRS)

OBJECTIVES

PEFCRs establish consistent and specific rules for calculating and comparing the environmental information within a product group with the aim to support, simplify and reduce costs in PEF studies.

They are based on the PEF and complement it to reflect sector specificities, without modifying the fundamentals.



PEFCR DEVELOPMENT

When are PEFCRs developed?

Usually the European Commission (EC) identifies priority sectors and issues a tender for development (official PEFCRs).
For example Apparel & Footwear, Aviation, Hotel Accomodation, Feed for food producing animals, Beer, Pasta etc.

Alternatively a sector can undertake it following EC's rules, like the Winter Sports Equipment PEFCR https://winter-sports.net/PEFCR/. The upcoming revision of EF methods should provide guidance on submitting "shadow PEFCRs" to become official.

By whom?

A Technical Secretariat (TS) is created: it has to represent 51% of EU market to be validated by the EC.

How?

An iterative process based on
- Successive drafts by the TS,
- Public consultations and expert reviews.
- Studies of Representative Products ,
- Studies of real products.

Finally, EC gives green light, acknowledging the PEFCR.

Information about PEF, list and links to official PEFCRs on:
https://green-forum.ec.europa.eu/green-business/environmental-footprint-methods/pef-method_en

3.7 - PEFCR APPAREL & FOOTWEAR: FRAMEWORK

GOVERNANCE OF THE PEFCR APPAREL & FOOTWEAR

ALLIANCE has been a voting member of the PEFCR Apparel & Footwear since 2021 and until the PEFCR was finally adopted.

Alliance's participation aimed to ensure that the specificities of European Flax-Linen were taken into account in the PEFCR.



Indeed, fashion is the main end-market for Flax fibres, but Flax accounts for barely 0,5% of world fibres so it could be overlooked without Alliance's involvement.

Other members of the TS were:

- Coordinator: Cascale (ex. Sustainable apparel Coalition)
- Trade associations representing fibres and raw materials, textile, footwear, fashion/luxury, and sport sectors;
- Brands and retailers, technical textile manufacturers,
- Public organisations, NGOs etc.

with Quantis as Technical Lead, and Observers including the EC.

SCOPE

The PEFCR precises the PEF method by setting rules for many parameters that are specific for the fashion and footwear sectors, so that companies can assess their products without making their own assumptions, hypotheses, scenari .

Need for specific data

Minimal requirements include: type, weight and origin of raw materials, type of processing steps, % of plane distribution, unsold product rate etc. But collecting more than the minimum is always possible and encouraged.

Default values

Example: average number of wears per product type "Duration of Service – DOS" (ex: x for a shirt)

More information about the PEFCR Apparel & Footwear

- 13 product subcategories and their respective "Representative Product"
- primary data that are mandatory (or mandatory if available)
- precise rules for modelling and calculations

https://pefapparelandfootwear.eu/whats-behind-the-methodology/

PEFCR Apparel & F. FAQ
https://pefapparelandfootwear.eu/faq-glossary/

3.8 - PEFCR APPAREL & FOOTWEAR: CHALLENGES

Dedicated working groups within the TS tackled the key method challenges, such as physical durability, repairability, extrinsic (holistic) durability and circularity. Alliance participated in all of them to co-construct robust science based methods and to represent Linen specificities when relevant.

LIFETIME MULTIPLIERS

These 3 indicators are optional, and can be used as multipliers for the standard Duration of Service to reflect better the product's potential for increased number of wears:

- **Intrinsic quality or physical durability**
  - Refers to wear and tear, deterioration of materials, or other physical aspects.
  - Measured by a framework of lab tests inspired by the Durhabi study in which the Alliance participated.
  - Alliance represented Linen specificities, supported by test learnings, to ensure it was not unfairly excluded by some thresholds.
- **Repairability**
  - Refers to the ability to keep the product in good condition.
  - Measured through repair possibility, availability and accessibility taking into account repair cost vs product price ratio
- **Extrinsic Durability**
  - Refers to external influences on user preferences, such as selling practices that encourage overconsumption.
  - Is acknowledged in the PEFCR but lacks scientific assessement. The Alliance is participating in the European DEX study to address this.

FIBRE FRAGMENTS INCLUDING MICROPLASTICS

As the science is still in progress, impacts are assessed only partially under PEFCR version 2025:

- **Impacts: on the marine environment** - after MariLCA study, that models fibres' impact data, including Flax-Linen
- **Release:** during use phase – using data from The Microfibre Consortium.
- **Results:** reported as additional info, not included in the product PEF score

Future evolutions are expected :

- **Medium term:** in the overarching PEF method (refer to "Evolution of Environmental Footprint methods"),
- **Longer term:** further scientific studies are needed on release and on impacts in fresh water / air / soil areas.

COMMUNICATING RESULTS OF A GARMENT STUDY UNDER PEF APPAREL & F. V2025

BtoC Communication	BtoB Communication	Internal Use
No single score ✗	Single score ✓	Single score ✓
Indicators results ✓ ≥ 4 most relevant	Indicators results ✓ ≥ 4 most relevant	Indicators results ✓ ≥ 4 most relevant

WHAT ABOUT THE FRENCH ENVIRONMENTAL COST?

The methodology for calculating and displaying the impacts of garments was published in France by decree, in September 2025. It establishes a labelling scheme, on a voluntary basis (except when impacts calculated under another method are communicated). It is based on PEF + PEFCR Apparel & Footwear and faces the same challenges, but opted for different responses. Therefore, future scientific progress on these topics are expected to also bring alignment between the 2 methods.

https://www.ecologie.gouv.fr/politiques-publiques/affichage-environnemental-vetements (in French)

https://affichage-environnemental.ademe.fr/en (mostly in French)

BIODEGRADATION OF FLAX-LINEN FIBRES IN MARINE CONDITIONS

Alliance conducted **research about the biodegradability of Flax-Linen** fibres and fabric in marine environment with expert laboratory HYDRA Marine Science (Germany).

- The study's results show the **very rapid degradation rate of Flax-Linen** (consistent with its cellulose-based composition).
- Results were shared to MariLCA researchers and have now been integrated in their characterization factors **As a result, the impact of Flax-Linen per gr released is the smallest across natural and artificial fibres, and several hundred times inferior to polyester's impacts.**

Avalailable on Alliance's media library https://allianceflaxlinenhemp.eu/en/european-flax-linen-hemp-media-library/170/biodegradation-of-flax-linen-fibres-in-marine-conditions

3.9 - METHOD Q&A: BIOGENIC CARBON

WHAT ABOUT BIOGENIC CARBON?

Definition:

Biogenic carbon refers to carbon derived from biological sources. In the context of Environmental Footprint, it is a subcategory of the climate change impact category: "Climate change – biogenic" which takes into account:

- the **CO_2 uptake** from the atmosphere through photosynthesis, that translate to natural materials carbon content.
- the **carbon emissions** to air (CO_2, CO and CH_4) resulting from biomass (not including soil),

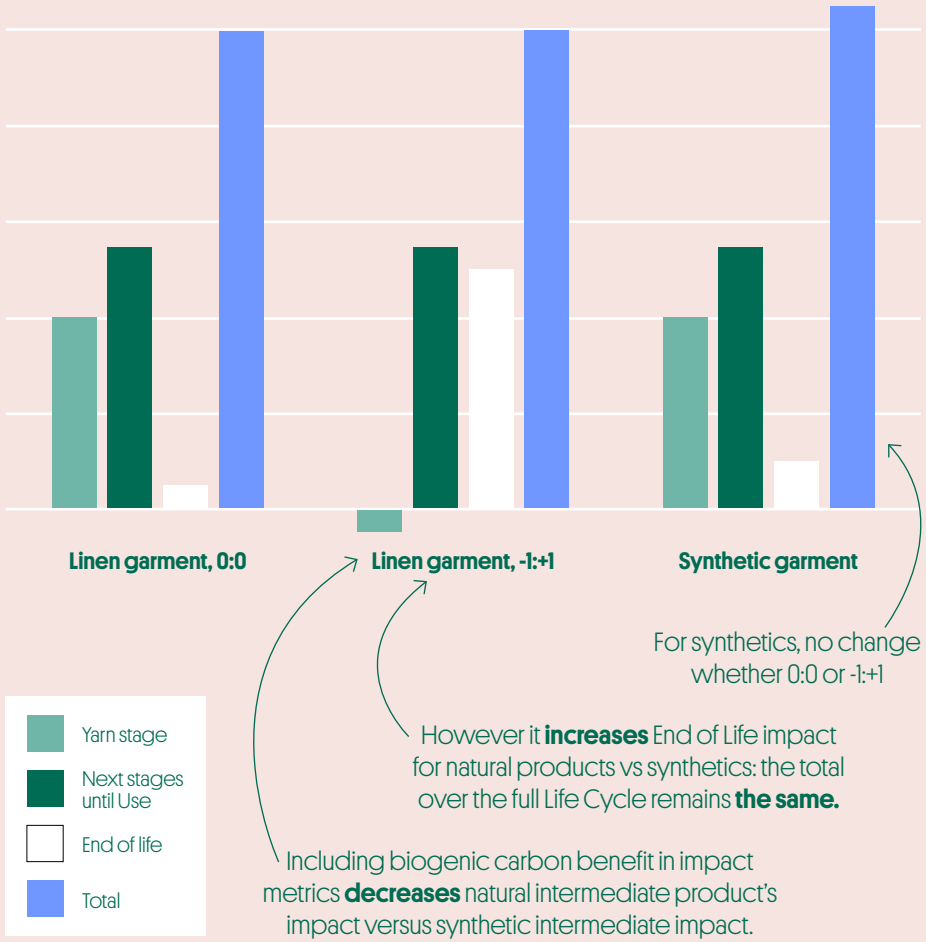
What's the issue?

- **Unclarity** due to different approaches for **temporary carbon storage** among methods and databases,
- Concerning: **intermediate products,** that will be used in consumption goods with short lifespan of months or years (long life sectors such as building deal with the topic differently).

What do the methods say?

1. **The PEF method** currently does **not include temporary carbon storage in the impact metrics** of intermediate natural products, considering a simplified 0:0 approach where the CO_2 uptake in field and release in End-of-life (EOL) offset each other. It only takes into account the end of life release of methane (CH_4) and Carbon Monoxide (CO), much more impactful than CO_2 (just slightly less so in case of natural materials). The PEF allows to feature the biogenic CO_2 content as additional info.
2. **Other frameworks allow to compare results with and without biogenic CO_2 impact,** and some databases propose the 2 options ie 0:0 and -1/+1.
   For example, ecoinvent enables both options but clearly warns users: "The two methods are complementary, and the latter is not meant to be used as a stand-alone method."
   Indeed, metrics including temporary storage can be misleading if wrongly understood, communicated or used, for instance double counting the benefit.

Carbon Footprint scenarii with the 2 approaches for biogenic carbon
[kgCO2eq - with average EOL: mix of incineration and landfill]



What does it mean for Flax-Linen?

- When using the **PEF 0:0 approach,** temporary carbon storage in natural intermediate products - such as Linen yarn - is not credited as a benefit, and in return their end-of-life (EOL) impact is minimal (Note that EOL impact will not be zero but will depend on EOL scenario ie the % of incineration that is favorable for natural materials and % of landfilling that is favorable for synthetics - because natural materials release methane and synthetics don't)
- With the **-1/+1 approach,** temporary carbon storage **is credited as a benefit** for natural materials. However, their **EOL impact becomes higher** than that of synthetics (also subject to EOL scenario).
- Overall **when performing an LCA over the full Life Cycle, both methods result exactly the same.**
- **When communicating an impact result for an intermediate product to a client, companies should make sure to be very clear about the modelling used.**

What's next?

The European Commission is currently working on the evolution of EF methods and considering moving towards including the biogenic carbon benefit in intermediate products. Limitations are expected regarding supply chain partners' exchange of data, to avoid potential mistakes. Alliance is following these works in order to understand and anticipate the implications for our sector.



It is currently scientifically difficult to capture the temporary aspect of this carbon storage in LCA.
Beyond the biogenic debate, the really effective ways to lower the impact of natural materials in LCA, over the full life cycle, will be:

- to increase the recycling rate of products [garments, home textiles...] when they reach end of life
- or if recycling is not [yet] possible, to increase the share of incineration vs landfilling, for products made of natural materials.

3.10 - METHOD Q&A: ALLOCATIONS & SUPPORT

WHAT ABOUT ALLOCATIONS?

Definition:

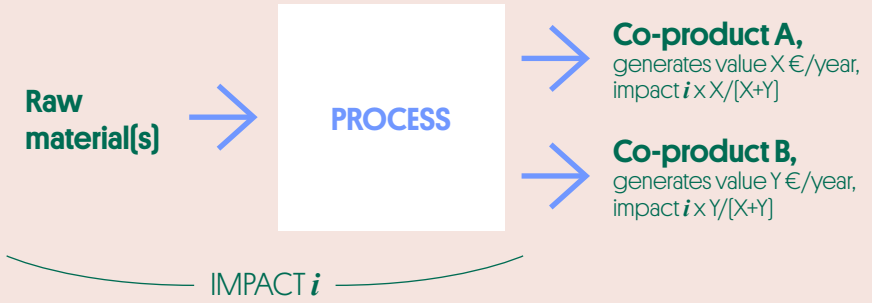
An allocation is the partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems. (PEF method). In the context of the Flax-Linen sector, the question of allocation usually arises **to divide impacts between the different products / co-products of a process.**

What are the options?

- Mass allocation dispatches impacts according to weight (mass)
- Economic allocation : the distribution key is each (co)product's share of total value the reasoning is that each (co)product economically motivates the industrial activity, and is thus partly responsible for its environmental impact, proportionnally.

What do the methods say?

- In the case of Flax-Linen processes producing several products / co-products, **economic allocation makes the most sense.** Among different reasons, because the products are not exactly similar or interchangeable, like scutched long fibre and scutching short fibre or hackled sliver and hackle short fibre. the use of economic allocations has been consistently made by all experts Alliance collaborated with:
  - Glimpact (for all Alliance-developed data sets),
  - Blonk (for our certified long fibre data set present in EU database EF 3,1),
  - ecoinvent for their own database.



OUTPUTS OF SCUTCHING	MASS FRACTIONS	SHARE OF TOTAL VALUE
Long scutched fibre	**22%**	**83%**
Short scutched fibre	**11%**	**12%**
Shive (Anas)	**50%**	**3%**
Seeds (Graines)	**5%**	**2%**
Dust, stone, misc.	**12%**	**0%**
Total	100%	100%

Mass vs economic allocation %

What does it mean for Flax-Linen?

- The impact per kilo will be higher for scutched long fibre than scutching short fibre, and for hackled sliver vs hackle short fibre – while they would have same impacts in case a massic allocation would be used.
- This could be a problem in case those impacts would result in very high impacts for products made of long fibre sliver or wetspun yarn, compared to competing fibres. So far, assessments show that this is not the case.
- This is good news, on the contrary, for dry or semi-dry spun Linen yarns, which are often used in heavier fabrics, so overall the impact per sqm can remain moderate.

What's next?

Alliance will keep looking for final products LCA and PEF results to better understand the environmental performance of different types of Linen products compared to markets benchmarks.

OTHER QUESTIONS?

Alliance supports its members in their understanding and upskilling about LCA and PEF:

- we welcome other questions and comments, feel free to reach out !
- these exchanges can lead to updates of the present Guide
- Alliance is considering sharing trainings or e-learning to members if interested: we're listening to your needs and ideas!

mdemaegdt@allianceflaxlinenhemp.eu

SUPPORT BY THE EC

PEF trainings

The European Commission organises a series of webinars: "PEF for newbies", method and data, capacity building etc.

Recordings, slides and Q&A documents available for download: https://green-forum.ec.europa.eu/green-business/environmental-footprint-methods/learning-materials_en

Guidance

The European Commission's Joint Research Centre published the Understanding Product Environmental Footprint and Organisation Environmental Footprint methods https://publications.jrc.ec.europa.eu/repository/handle/JRC129907

PEF helpdesk

For technical questions about the PEF method, you may contact: EF_Helpdesk@thinkstep.com

3.11 - PEF METHOD EVOLUTION: WHAT'S NEXT?

EVOLUTIONS IN PROGRESS

The European Commission is currently working on the evolution of EF methods, with a draft expected in 2026 and revised EF methods vEF4 expected later in 2026. Focus on some evolutions expected based on discussions to-date, that would be relevant for fibre crops:

NEW IMPACT CATEGORIES

NEW Biodiversity

- Complementing the already existing impact categories that also affect biodiversity: climate change, aquatic freshwater eutrophication, aquatic marine eutrophication, terrestrial eutrophication, acidification, water use, land use, and freshwater ecotoxicity.
- Adding a new subcategory "Land Use – biodiversity" in the Land Use category
- Objective: to capture the effects of human activities on land biodiversity (genetic diversity, species, ecosystem integrity).
- However, only few types will be characterized in the medium term (eg intensive vs extensive, whether organic or not), so a lot of research will need to be carried out on the longer term to reflect the large number of responsible practices, including those of European Flax farming (rotation, cover crops,..).

NEW Microplastics & microfibres

- Possible inclusion of a new impact category
- Assessing impacts on marine life (based on MariLCA research project, where data for Flax fibre has been included - same as PEFCR Apparel & Footwear, see above slide)
- Considering releases in different life cycle stages, from the production of plastic granulates (larger scope than current PEFCR A&F)

→ Finally, weighting will be revised to take into account the addition of the new (sub)categories

EVOLUTION OF EXISTING IMPACT CATEGORIES

Land use

- The existing indicator, focusing on soil quality, will be renamed "Land Use –soil". It should evolve in the future to take into account positive externalities linked to responsible farming practices, versus only few types characterized today (eg intensive vs extensive).
- However, in the short-medium term of EF 4.0 it is expected that only the organic type will be added, so a lot of research will need to be carried out on the longer term to reflect the large number of responsible practices, including those of European Flax farming (rotation, cover crops,..).

Climate change

- Biogenic carbon refer to previous slide
- Land Use change: impacts of permanent grassland conversion, if relevant, over 20 years with linear discounting (vs equal discounting currently):

Water use

- More granularity to better capture water scarcity situations
  - Geographic granularity
  - Time granularity (period of the year)

Alliance is following these works via expert consultants, in order

- to understand the implications for our sector, especially if evolutions make sense for Flax-Linen farming an processing practices;
- to list any additional needs for data to be collected for future PEF evaluations of our fibre crops and their processing steps.

4

CHAPTER 4
LIFE CYCLE DATA FOR CERTIFIED EUROPEAN FLAX-LINEN

CHAPTER 4
LIFE CYCLE DATA FOR CERTIFIED EUROPEAN FLAX-LINEN



CHAPTER KEY POINTS

Alliance, as the reference for all data – economic, environmental, technical etc – about Flax-Linen, is actively engaged with its ecosystem of members and experts into measuring environmental impacts:

- **To accurately represent our sector's agricultural and industrial specificities and geography;**
- **To highlight the environmental profile of European Flax-Linen, reflecting responsible practices from farming to scutching and processing;**
- **To support the Masters of FLAX FIBRE™ (ex-European Flax™) and Masters of LINEN™ certifications of origin and traceability.**

As part of our continuous efforts and commitments to our environmental trajectory, we are:

- **Co-constructing Life Cycle data with Flax-Linen sector players, completing in December 2025 the assessment of 7 processing steps until spinning, after 4 years collection, modelling and external review;**
- **Collaborating with leading databases - the European EF database, Higg and ecoinvent ;**
- **And developing a bespoke calculator for Alliance members.**

Through accessibility of the data, guidance and support we help sector players, industry and brands to meet their needs for robust data and progress towards their sustainability commitments.

SUB-SUMMARY

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4.1 - OBJECTIVE 1: **RELIABILITY AND REPRESENTATIVITY**

RELIABILITY

The European Flax-Linen sector has very early been committed to Life Cycle Assessment: the first LCA of the Linen shirt was published 2008. However we noticed important data gaps for Flax fibre in environmental databases, data were either wrong, or from inconsistent geographies, or missing altogether.

Alliance, as warrant for all data regarding European Flax-Linen and representing ¾ of world Flax long fibre production therefore decided to develop reliable Life Cycle data for its sector.

REPRESENTATIVITY

Alliance's Life Cycle data are not built on literature, but on activity data 100% specific to our sector's practices and geography.

As step one of our environmental trajectory, we've built **data** for **Masters of FLAX FIBRE™ scutched Flax fibre,** ensuring that they are representative of:

- The **certification scope:** France, Belgium and the Netherlands;
- The **practices in the fields,** thanks to the expertise of the two Agronomic reference institutes for Flax (Arvalis Institut du Végétal for France and Inagro for Belgium and the Netherlands),
- Surface and yield **statistical data** from the Flax-Linen and Hemp Economic Observatory.

> *"It is to be highlighted that the raw data collection by the European Flax producers and processors covers essentially all producers and sites up to dry and wet spun yarn at a very high quality and completeness of the data and the average data represents excellently the industry. This demonstrates the commitment of the Flax and Linen industry, but also serves as example that also industries composed mostly of SMEs can develop high quality Environmental footprint datasets about their own products."*
>
> **Marc-Andree Wolf**
> Maki Consulting, Qualified Independent External Reviewer

GEOGRAPHIC SCOPE:

The choice to publish common data gathering France, Belgium and the Netherlands instead of 3 separate national data is relevant because of:

- The certification scope,
- The small territory size,
- And fibre blending, a key step of Flax-Linen spinning, for optimal and regular yarn quality.

The data is therefore representative of fibre blends found in Masters of FLAX FIBRE™ and/or Masters of LINEN™ certified materials.



LCA OF MASTERS OF FLAX FIBRE™ [EX-EUROPEAN FLAX] SCUTCHED FLAX FIBRE, 2022

Study performed by Yukan with its innovative technology Glimpact, critical review by Maki Consulting.

Beyond robust results [compliant to version EF2.0, now obsolete] the publication sill **offers valuable insights:**

- **Transparent description of the Masters of FLAX FIBRE™ responsible farming and scutching practices;**
- **Data quality, rated as 'very high quality' reflecting high precision and representativeness;**
- **Interpretation of main findings such as the remarkably low impacts** [Water consumption; Eutrophication, freshwater], or major impact [Land use].

For these reasons the LCA remains available for download although **impact data vEF2.0 are no longer valid and can no longer be used.**

Access : Life Cycle Assessment [LCA] of European Flax scutched fibre.

4.2 - OBJECTIVE 2: ACCESSIBILITY THROUGH KEY DATABASES

DATA CO-CONSTRUCTION FOR ACCESSIBILITY

Beyond publishing the LCA of Masters of FLAX FIBRE™ (ex European Flax™) scutched Flax fibre, Alliance decided to proactively initiate collaborations with databases. This required dedicated co-construction with each database - as they each operate under different frameworks of methods, formats, background data –under specific collaboration agreements.

An important milestone was achieved in 2023 when data for Masters of FLAX FIBRE™ (ex European Flax™) were integrated in 3 key databases.

HIGG INDEX
By Cascale
(ex- Sustainable Apparel Coalition)

Part of the **worldly** suite of tools, one of the leading platforms especially for the **apparel sector**

More than 500 global brands are committed to using its tool for value chain sustainability assessment. *(source: Worldly)*

Environmental footprint results:
4 impact categories

app.worldly.io
> Product Impacts > higg MSI

EF DATABASE
By the European Commission

This is the database which has to be used with the **PEF method** (Product Environmental Footprint), the only method recognized by the EC

The PEF method is explicitly mentioned in **key EU regulations,** especially regarding **textiles and apparel.**

Environmental footprint results:
16 impact categories

green-business.ec.europa.eu /environmental-footprint-methods_en

ECOINVENT
By the ecoinvent association

A **global leader** that is referent for many sectors, including **technical textiles and composites;** ecoinvent data are **plugged into most LCA sotwares**

Over 5,000 leading organizations use ecoinvent data *(source: ecoinvent)*

Environmental footprint results:
Inventory (LCI) that can be modelled under different LCA methods.

ecoinvent.org

MORE ROBUST LCAs

By offering this flexibility, Alliance enables LCA consultants to use a Flax fibre dataset that is consistent with the method and database of their study rather than mix and match data developed in different frameworks, thus enabling more robust assessments for Flax-Linen products.



4.3 - RESULTS: **OVERVIEW OF AVAILABLE DATA**

DATA		RAW MATERIALS			TRANSFORMATION PROCESSES AND SEMI-PRODUCTS							
GRANU-LARITY	FRAMEWORK	Masters of FLAX FIBRE™ scutched long fibre	Masters of FLAX FIBRE™ scutching short fibre	Masters of FLAX FIBRE™ rescutched short fibre	Hackling, long fibre	Preparation to spinning, long fibre	Wet spinning	Carding-combing, short fibre	Dry or semi-dry spinning	Cottonizing	Weaving, Knitting, Non-woven production	Bleaching, dyeing, finishing
EU AVERAGE	PEF [vEF3.1]	●		●	●	●	●	●	●	●		
EU AVERAGE	FRAMEWORKS OTHER THAN PEF	●	●	●								
ALLIANCE COMPANIES' DATA	PEF [vEF3.1]	●	●	●	●	●	●	●	●	●	●	●

LEGEND

Available from Alliance, by request
See 4.4 - Flax-Linen Transformation Processes

Dedicated calculator for Alliance members developped with Glimpact

4.4 - RESULTS: **OVERVIEW OF FLAX-LINEN PROCESSES**

Flax-Linen fibre types, semi products and transformation processes from raw fibre to yarn are completely specific to Flax-Linen and often unknown or unclear for downstream companies.

The Mapping of processes aims to help brands, industrials and retailers:

- Identify the processes and intermediate products in your supply chains
- Use shared and relevant naming
- Select appropriate dataset to model your products

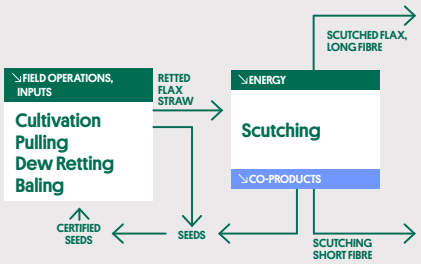


Download in Alliance's media library:
allianceflaxlinenhemp.eu

4.5 - RESULTS: MASTERS OF FLAX FIBRE™ SCUTCHED LONG FIBRE

Masters of FLAX FIBRE

Production of Masters of FLAX FIBRE™ scutched long fibre





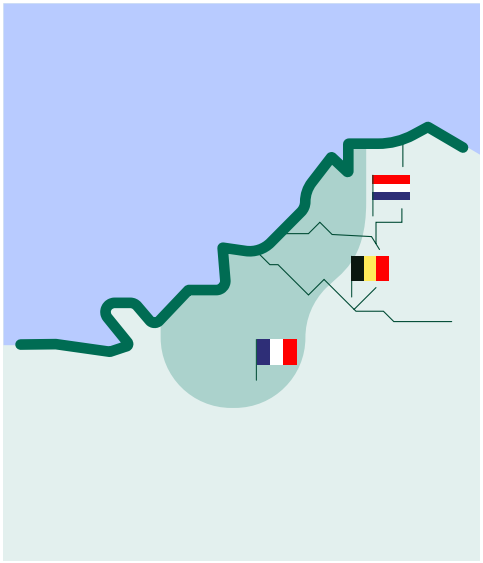
SCOPE AND PROCESS

This data represents the Masters of FLAX FIBRE™ scutched long fibre, cradle to gate resulting from:

- **Cultivation,**
- **Retting on the ground** (dew retting),
- **Scutching** (extraction).

GEOGRAPHY

Scope is aligned with certification geography: **Europe,** namely **France, Belgium and the Netherlands, which account for ¾ of world production of Flax fibre.**



PRODUCTS

The outputs are:

- **scutched long fibre - main product,**
- scutching short fibre (second product),
- seeds, shive and dust (co-products).
- no waste, as all (co)products are used.

End-markets for scutched long fibre:

- **apparel** is the main market
- **household Linen** comes second (bed, table, kitchen, bath Linen).
- **technical textiles and composite materials** is a new, growing outlet.

Subsequent processes are entirely specific to Flax long fibre:

- Hackling, long fibre, to produce sliver;
- Preparation, long fibre, to produce roving ;
- then Wet-spinning to produce boiled or bleached Linen yarn (see mapping).

DATA COLLECTION AND MODELLING

Alliance published all information, including:

→ the **details of each process:** cultivation, retting and scutching activity data collected and sources

→ the **economic allocation** between the (co) products (dispatch based on their value).

Please refer to the Life Cycle Assessment of Masters of FLAX FIBRE™ (ex-European Flax™) scutched fibre, 2022

Life Cycle Assessment of Masters of FLAX FIBRE™ (ex-European Flax™) scutched fibre, 2022

https://allianceflaxlinenhemp.eu/en/european-flax-linen-hemp-media-library/12/detailed-life-cycle-assessment-lca-of-european-flax-scutched-fibre

PEF RESULTS

Calculations were made according to the PEF method, version EF 3.1.

Results are published:

- In LCIA format (Life Cycle Impact Assessment), corresponding to the results for the PEF's 16 impact categories,
- As PEF 16 normalized and weighted scores as well as single score,
- As Life Cycle Inventory (LCI): on request, in ILCD format (format of the PEF method).

CONDITIONS FOR USE

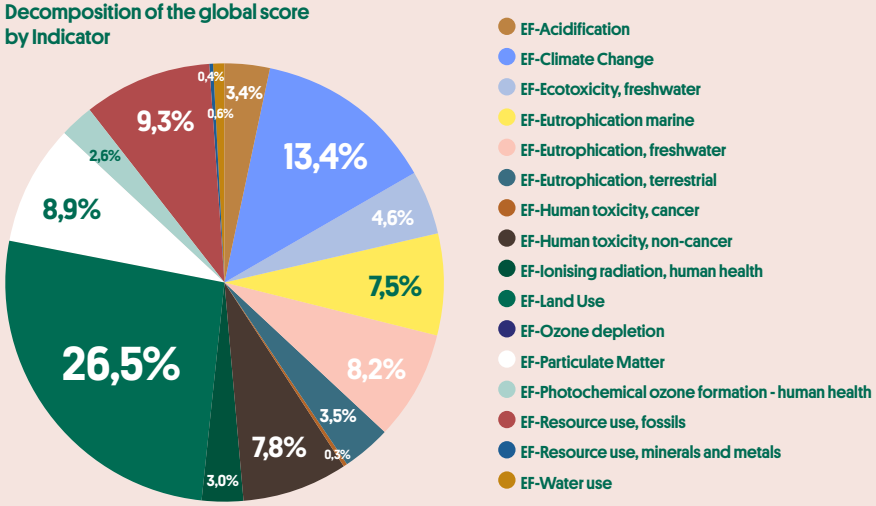
Alliance makes available the following results to be used:

- To model a product (intermediate or final) made of **European, Masters of FLAX FIBRE™ certified scutched long fibre,**
- Under **relevant assessment method:** for consistency, it's recommended to use of the PEF or compatible carbon footprint assessment methodologies. If another method is used: please check whether this data already exist in other frameworks first, and otherwise please check technical and methodological compatibility
> see chapter "Use cases"

Impact of 1 kg Masters of FLAX FIBRE™ scutched long fibre:
16 indicators and single score

IMPACT CATEGORY	Value [/FU]	UNIT	PEF RESULT [µPT]	% OF SINGLE SCORE
EF-Acidification	5,64E-03	mol H+ equivalents	6,29	3,4%
EF-Climate Change	8,54E-01	kg CO2 Equivalents	23,81	12,9%
EF-Ecotoxicity, freshwater	2,66E+01	CTUe	9,00	4,9%
EF-Eutrophication marine	9,85E-03	kg N equivalents	14,92	8,1%
EF-Eutrophication, freshwater	9,44E-04	kg P equivalents	16,46	8,9%
EF-Eutrophication, terrestrial	3,13E-02	mol N equivalents	6,58	3,6%
EF-Human toxicity, cancer	5,18E-10	CTUh	0,64	0,3%
EF-Human toxicity, non-cancer	1,09E-07	CTUh	15,55	8,4%
EF-Ionising radiation, human health	2,41E-01	kBq U235 equivalents	2,86	1,6%
EF-Land Use	5,49E+02	dimensionless (pt)	53,20	28,9%
EF-Ozone depletion	5,18E-09	kg CFC11 equivalents	0,01	0,0%
EF-Particulate Matter	1,13E-07	disease incidence	17,00	9,2%
EF-Photochemical ozone formation - human health	4,08E-03	kg NMVOC equivalents	4,78	2,6%
EF-Resource use, fossils	8,92E+00	MJ	11,41	6,2%
EF-Resource use, minerals and metals	6,83E-07	kg Sb equivalents	0,81	0,4%
EF-Water use	1,18E-01	m3-world equivalents	0,87	0,5%
Single PEF score	-	-	184,2	100%

Decomposition of the global score by Indicator



THESE PEF RESULTS ARE THE EXACT SAME AS THE EF COMPLIANT DATASET WHICH WAS FEATURED IN THE EUROPEAN COMMISSION'S DATABASE EF 3.1.

This dataset was developed thanks to the collaboration of Alliance with EC's data provider, a consortium including ecoinvent and Blonk, under a specific collaboration agreement. The dataset was validated by an external review and then by the European Commission. Its use was subject to a contract between the EC and the data provider, that expired 31 December 2025 and is currently being extended in progress as of the date of the present Guide.

4.6 - RESULTS: MASTERS OF FLAX FIBRE™ SCUTCHED LONG FIBRE IN DATA BASES



HIGG INDEX

By Cascale
(ex- Sustainable Apparel Coalition)

Dataset name: *"Flax hackled long fiber (linen) {European Flax® certified}"*

Scope: Hackled long fibre sliver (includes all steps from farming to hackling, aggregated)

Publication: Since Dec. 2020

Access: results can be viewed online for free, used under platform conditions.

Points of attention: Caution about the Higg's generic value, which is called "average production » but is NOT world production calculated average (3/4 EU, etc.). It's rather a theoretical value representing Flax fibre with no certification, and it should not be used for comparison purposes.

app.worldly.io
Product Impacts > higg MSI
Search for Flax, click In Raw material source click on « Flax fiber (linen), average production »

EF DATABASE

By the European Commission

Dataset name: *"Linen; European Flax® scutched long fibre, dew retted"*

Scope: Scutched long fibre (includes all steps from farming to scutching, aggregated)

Publication: vEF3.1, Jan. 2023

Access: Was free of charge for users of a PEFCR, but expired 31 December 2025 according to the contract between data provider and the EC.

Points of attention: The EF database will be totally revised in vEF4 in 2028, with temporary replacement solutions and some continuity gaps to be expected in the meantime.

lcdn.blonkconsultants.nl
> Register + accept EULA

ECOINVENT

By the ecoinvent association

Dataset name: *"fibre production, Flax, scutching Europe / reference product fibre, Flax, long, scutched"*

Scope: Scutched long fibre (includes all steps from farming to scutching, disaggregated)

Publication: Since v3.10, Nov. 2023 (updates v3.11 in 2024, v3.12 in 2025)

Access: under license (usually included in LCA software license).

Points of attention:

- Methodological choice and result use are the user's responsibility.
- Caution about ecoinvent's generic global Flax values: they represent a theoretical cultivation in India, not real crops : this inconsistency should be solved soon.

ecoquery.ecoinvent.org

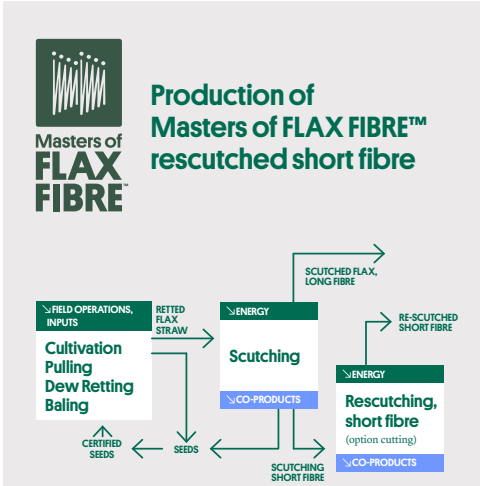
LACK OF COMPARABILITY

Results differ in each database, so there is no such thing as "the" CO2 impact of Masters of FLAX FIBRE™ scutched Flax, even for the same cultivation and scutching itinerary.

- Because databases use different methods and/or different background data
  => CO2 eq metrics = 0,85 kg in EF 3.1 vs 1,05 kg in ei 3.10 (with EF 3.1 modelling).
- Because versioning matters
  => CO2 eq metrics = 0,65 kg in vEF2.0 (2022) or 0,93 kg in ei 3.12 update.

This reflects the iterative nature of LCA works. It also illustrates why users should avoid mix and match datasets between frameworks/versions, especially regarding raw materials which often represent a large part of finished product's impacts.

4.7 - RESULTS: MASTERS OF FLAX FIBRE™ RESCUTCHED SHORT FIBRE





SCOPE AND PROCESS

This data represents the rescutched short fibre, cradle to gate resulting from:

- **Cultivation,**
- **Retting on the ground** (dew retting),
- **Scutching** (extraction) > scutching short fibre, the 2nd product of scutching (modelled with an economic allocation),
- **Rescutching:** process to **clean scutching short fibres** and separate them from shive and dust, performed on rescutching lines with several drums (either by the scutchers or by companies specialized in rescutching and other pre-processing steps). Rescutching is absolutely **necessary** for any further textile or non-woven processing.

GEOGRAPHY

Europe: rescutching mills are located in France and Belgium.



PRODUCTS

The outputs are:

- **rescutched fibre, also called rescutched tow - main product,**
  > With a cleanliness level of at least 80%, which is the minimum level for further processes.
  > including the case of rescutched and cut fibres (e.g. before cottonizing) which were found similar as they have similar prices and end-markets, and the cuttle machine generates neglectible impact and no waste.
- co- and by-products: very short fibres called 'Duvex fibres', shive and dust
- no waste, all co- and by-products are used.

End-markets for rescutched short fibre:

- **home decoration and upholstery, strings and ropes**
  > subsequent processes are carding+combing, then Flax dry spinning or wool spinning producing thick Linen yarns.
- **blended textiles,** usually with cotton, viscose, etc
  > subsequent processes are "cottonizing" (shortening and refining), then cotton spinning systems,.
- **non-woven needlepunched mats** for automotive sector, door interior panels, rear trunk lids and insulation materials, **spunlaced wallcovering,** etc.

DATA COLLECTION AND MODELLING

Rescutching data refer to 2021, except product yields averaged on several years to account for crop variability.

Data were collected from French and Belgian rescutchers **representing 80% of the total EU rescutching production,** and then collectively consolidated by the mills to check consistency.

Activity data include:

- Consumption of energy, for the rescutching itself (drums) as well as vacuuming (which accounts for a major part of the energy consumption);
- Fuel for material handling/ lifting engines
- Packaging (iron wire)
- Water consumption: no water is used in the process.
- Transport to rescutching

An economic allocation between rescutching (co)products based on multi-year average prices was applied.

LCI modelling was done **according to the EF method and EF 3.1** background data. The LCIA results were obtained applying the EF 3.1 LCIA methods and characterisation factors.

Data for the raw scutching short fibre is not useful alone without rescutching.
It is therefore not published by Alliance.

EXTERNAL REVIEW

All the activity data of all participating producers and the averaging were checked for plausibility and the LCI modeling and application of the LCIA methods was sample-reviewed against the PEF method requirements and the EF 3.1 reference package by Dr. Marc-Andree Wolf of maki Consulting, as Qualified Independent External Reviewer. The review by maki Consulting was completed on 19 Dec. 2025.

PEF RESULTS AVAILABLE

- in LCIA format (Life Cycle Impact Assessment), ie results for the PEF's 16 impact categories,
- as PEF 16 normalized and weighted scores as well as single score, in µpt
- as Life Cycle Inventory (LCI): on request, in ILCD format (format of the PEF method).

CONDITIONS FOR USE

Alliance makes available the following results to be used:

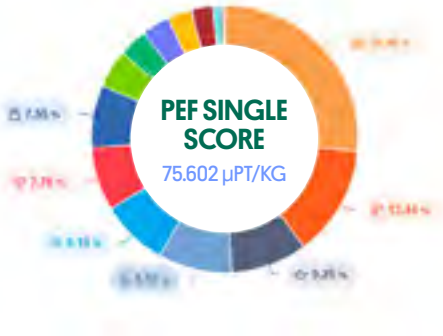
→ To model a product (intermediate or final) made of **European, Masters of FLAX FIBRE™ certified** rescutched short fibre,

→ **Under relevant assessment method:** for consistency, it's recommended to use of the PEF or compatible carbon footprint assessment methodologies. If another method is used: please check whether this data already exist in other frameworks first, and otherwise please check technical and methodological compatibility. See chapter "Use cases"

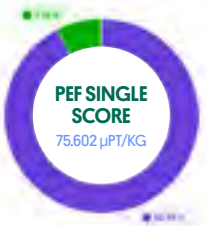
Impact of 1 kg Masters of FLAX FIBRE™ rescutched short fibre : 16 indicators and single score

IMPACT CATEGORY	Value [/FU]	UNIT	PEF RESULT [µPT]	% OF SINGLE SCORE
EF-Acidification	2,30E-03	mol H+ eq	2,57	3,4%
EF-Climate Change	3,64E-01	kg CO2 eq	10,16	13,4%
EF-Ecotoxicity, freshwater	1,03E+01	CTUe	3,48	4,6%
EF-Eutrophication marine	3,77E-03	kg N eq	5,71	7,5%
EF-Eutrophication, freshwater	3,55E-04	kg P eq	6,18	8,2%
EF-Eutrophication, terrestrial	1,25E-02	mol N eq	2,62	3,5%
EF-Human toxicity, cancer	2,05E-10	CTUh	0,25	0,3%
EF-Human toxicity, non-cancer	4,10E-08	CTUh	5,87	7,8%
EF-Ionising radiation, human health	1,89E-01	kBq U235 eq	2,25	3,0%
EF-Land Use	2,07E+02	dimensionless (pt)	20,02	26,5%
EF-Ozone depletion	2,09E-09	kg CFC11 eq	0,00	0,0%
EF-Particulate Matter	4,47E-08	disease incidence	6,72	8,9%
EF-Photochemical ozone formation - human health	1,70E-03	kg NMVOC eq	1,99	2,6%
EF-Resource use, fossils	5,47E+00	MJ	7,00	9,3%
EF-Resource use, minerals and metals	2,64E-07	kg Sb eq	0,31	0,4%
EF-Water use	6,39E-02	m3-world eq	0,47	0,6%
Single PEF score	-	-	75,60	100%

Decomposition by impacts



Decomposition by stages



- 91,5% incoming material: Flax scutching short fibre
- 7,5% rescutching process
- 1% transport of scutching short fibre to the rescutching mill.

4.8 - FLAX-LINEN TRANSFORMATION PROCESSES

There are **6 transformation processes, entirely specific to Flax-Linen,** if we take into account pre-processing and spinning in the different forms of long, short and cottonized Flax.

For a reliable assessment that matches your supply chain, it is important to identify:

- The right processes/semi-products: 6 pre-processing and spinning steps, see Alliance mapping which provides a clear and shared nomenclature
- Their geography: please note that below EU data are not proxies for other geographies

1. DATA FOR PROCESSES, EUROPEAN SCOPE

Data from Alliance are calculated on EU average and PEF compliant. They are available on request as Alliances wants to ensure that they are used in a consistent way, ie. **to model supply chains where processing steps indeed take place in Europe.**

3 formats are possible, depending on the type of study:

- **LCIA results of the (semi-)product:** results of PEF's 16 impact categories
- **LCIA results of the process:** results of PEF's 16 impact categories
- **LCI of the (semi-)product:** full list of elementary flows (Life Cycle Inventory) in ILCD format (format of the PEF method).

Please send requests for informations or data to Alliance:

- Describing the datasets needed: process/semi-product concerned, format(s) and how they match the intended study.
- Committing not to modify the dataset (including name, scope, description) without Alliance consent; not to remodel the data without Alliance consent (in case you request an LCI); and to credit Alliance as source for the data in case the dataset is used for a report or study, or in a Footprinting tool, for instance.

Contact: mdemaegdt@allianceflaxlinenhemp.eu

Data for processes, European scope

PROCESS DATA	LCIA	SEMI-PRODUCTS DATA	LCII	LCI
Hackling, long fibre, Europe	✓	Flax-Linen hackled long fibre sliver	✓	✓
Preparation to spinning, long fibre, Europe	✓	Flax-Linen hackle short fibre	✓	✓
		Flax-Linen roving	✓	✓
Wet spinning, Europe	✓	Flax-Linen bleached wetspun yarn	✓	✓
Carding-combing, short fibre, Europe	✓	Flax-Linen carded and combed sliver ("tops")	✓	✓
		Flax-Linen combing co-product	✓	✓
Preparation and dry or semi-dry spinning, Europe	✓	Flax-Linen greige semi dry spun yarn	✓	✓
Cottonizing, Europe	✓	Flax-Linen cottonized fibre	✓	✓

2. PEF DATA FOR PROCESSES PERFORMED OUTSIDE EU OR IN UNKNOWN GEOGRAPHY

Unfortunately, there are no datasets available in any database representing these transformation processes, which are specific to Flax-Linen. Although Asia represents a large majority of textile processing (for Flax: hackling, spinning,...), their impacts are not documented.

To fill these gaps, proxies are provided in the PEFCR Apparel & Footwear published May 2025:

Proxies for Flax-Linen specific process in the PEFCR Apparel & Footwear, 2025

FLAX-LINEN SPECIFIC PROCESS	PROXY: COMBINING DATABASE GENERIC PROCESSES, WITH LOSS RATES SPECIFIC TO FLAX-LINEN					
Hackling, long fibre	**carding**	**25%**	**+ combing**	**8%**		
Wet-spinning (incl. boiling)	**scouring**	**11%**	**+ spinning** (cotton or bast)	**11%**		
Wet-spinning (incl. bleaching)	**scouring**	**11%**	**+ bleaching**	**1%**	**+ spinning** (cotton or bast)	**11%**

ALLIANCE SUPPORTS ITS MEMBERS AND THE GLOBAL SECTOR BY DEVELOPING A DIGITAL TRACEABILITY PLATFORM FOR CERTIFIED MATERIALS.

It is an optional complement to the Masters of FLAX FIBRE™ and Masters of LINEN™ certification standards, enabling mills and brands to reach higher level of control, proof and compliance. Specifically for **environmental footprinting,** this digital traceability helps **to identify precisely the types, locations and mills involved in the processing steps of their supply chains, therefore supporting more accurate calculations, with proof and potential to improve footprint over time.** See Chapter 2

4.9 - ALLIANCE COMPANIES' DATA

Alliance supports its members with a **dedicated calculator** - a collective tool which **makes impact calculation easier, more affordable and more reliable** - as well as guidance and assistance.

1. OBJECTIVES

ADDED VALUE	→ Providing more specific answers for clients → Highlighting mills' sustainability initiatives → Identifying where to prioritize your efforts
A DIGITAL TOOL	→ Aligning on PEF method and EU reporting regulations → Efficiency, agility → Industrializing impact calculation for scalability
MANAGE YOUR OWN DATA	→ Managing confidentiality of business sensitive data → Standardizing answer to clients' sustainability requests → Managing individual environmental performance

→ TO TEST ECODESIGN SCENARII

→ AND MONITOR PROGRESS OVER TIME

2. CO-CONSTRUCTION

A CUSTOMIZED TOOL	→ Adapting to the specificities of each Flax-Linen processing step → Testing and validation by Alliance members
PRECOMPETITIVE INTELLIGENCE	→ Mutualizing effort, save time and money → Pooling FAQ, assistance from consultants, support, training,...
COLLECTIVE CONSISTENCY	→ Using same modelling, assumptions, allocations for each player → Improving reliability and trust thanks to external review

→ CO-CONSTRUCTION WITH THE GLIMPACT TECHNOLOGY

→ OUR PARTNER SINCE 2020

→ PIONEER PEF EXPERTISE

CO-CONSTRUCTION WITH AND FOR THE VALUE CHAIN

The Alliance-Glimpact calculator was possible thanks to all sector players who participated in the big joint effort of data collection, and thanks to pilot companies who tested the tool and provided valuable feedback.
This helped ensure that the tool meets members' needs and specificities.
After 3 pilot phases over 2024-2025, launch is expected in 2026 across Alliance members, on a voluntary basis.

3. PROCESSING STEPS AND FUNCTIONNALITIES

Dedicated forms for precise industrial data, for each Flax-Linen specific processes as well as fabric formation:

- Scutching
- Hackling, long fibre
- Preparation to spinning, long fibre
- Wet spinning
- Carding-combing, short fibre
- Preparation and dry or semi-dry spinning
- Cottonizing
- Weaving/knitting/ non-woven production

Simplified form for bleaching, dyeing, finishing (using generic process datasets as these steps are often subcontracted by Alliance mills, and they are highly complex in terms of footprinting).

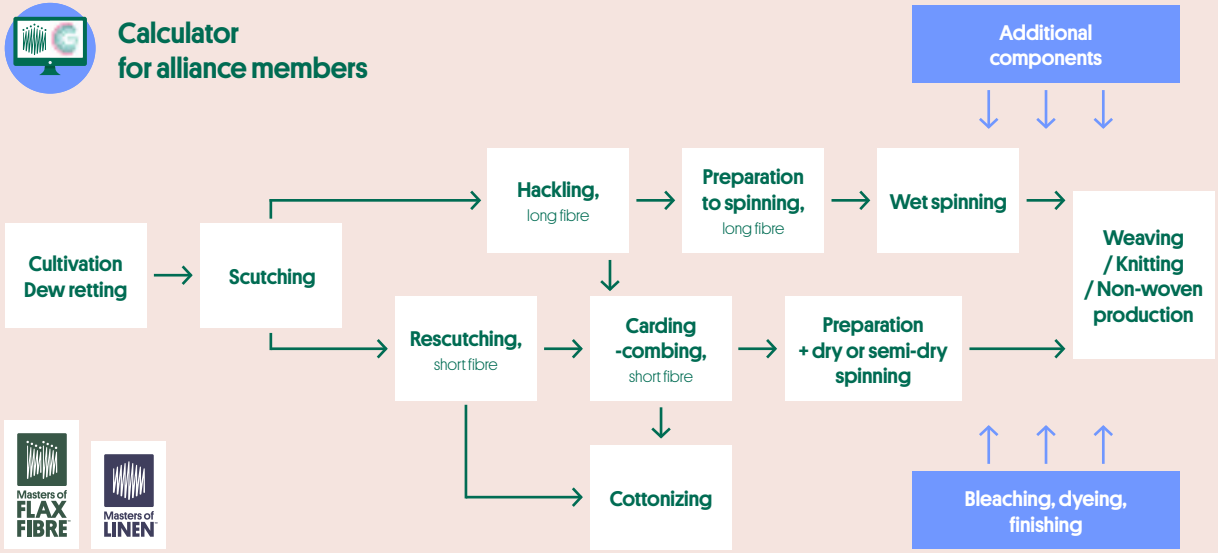
4. FUNCTIONNALITIES

- Combining different processes (gate-to-gate),
- Combining a full supply chain (cradle to gate) to model a product
- Modelling components other than European Flax-Linen *(Example: Linen yarn from overseas spinning; other fibres and materials)*
- Averaging data between several sites or multi-year average (for upstream crop-sensitive processing steps)

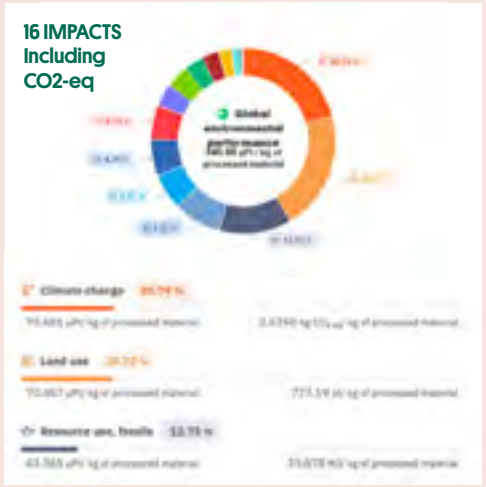
5. TOOL'S DELIVERABLES / RESULT

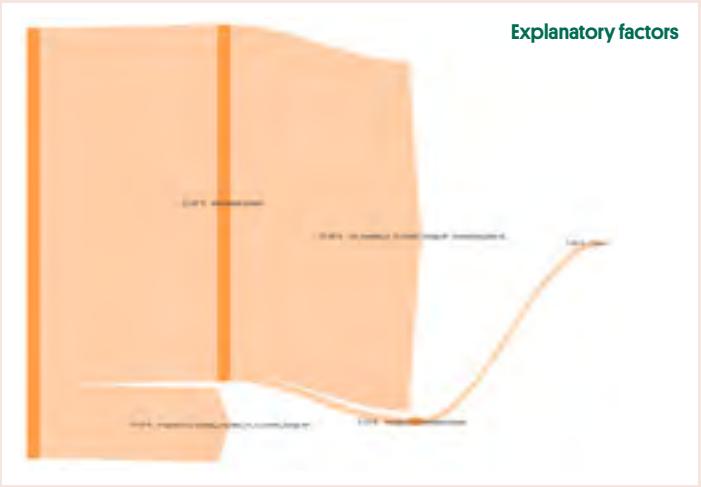
- Results for each of the 16 impact categories, PEF compliant
  - Including carbon footprint in k CO_2 eq. unit.
  - And global PEF score
  - Can be downloaded in jpeg graph format, or as excel table.
- Graphic analysis
  Explaining visually where the most relevant impacts occur in your product's value chain

Calculator for alliance members



Example of environmental footprint for 1 kg Flax-Linen roving





5

CHAPTER 5
USE CASES & USE Q&A

CHAPTER 5
USE CASES & USE Q&A

CHAPTER KEY POINTS

This section presents practical use cases for different types of Flax-Linen environmental data, which can be leveraged for general and specific comparisons, compliance, or strategic decision-making.

To ensure the guide remains actionable and relevant, the chapter includes a Q&A section addressing common practical questions. We actively encourage all Flax-Linen stakeholders to share their needs, use cases, and questions. This collaborative approach will foster a harmonized response to the practical challenges of LCA, and enrich this document, ensuring future iterations increasingly meet sector needs.

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5.2 - **Use Q&A: data compatibility** 50

5.3 - **Use Q&A: data verification & validity** 51

5.1 - USE CASES FOR DIFFERENT TYPES OF FLAX-LINEN DATA

TYPE & SCOPE	FIBRE DATA	PROCESS & SEMI PRODUCT DATA	CALCULATOR FOR MEMBERS
	Masters of FLAX FIBRE™ LONG SCUTCHED FIBRE, RESCUTCHED FIBRE	EU AVERAGES: ALLIANCE GEOGRAPHY	MEMBER SPECIFIC, PRODUCT SPECIFIC
USE CASE EX.	FOR GENERAL COMPARISONS *Ex: certified Flax vs non-certified Flax* → **to test ecodesign simulations** **Caution: compare what is comparable!***	FOR GENERAL COMPARISONS *Ex: Flax semi-product vs other material; certified FLAX vs non-certified* → **to test ecodesign simulations** **Caution: compare what is comparable !***	FOR SPECIFIC COMPARISONS *Ex: different product configurations between them or vs generic products or vs non-EU product* → **to support granular ecodesign decisions & product innovation***
		FOR COMPLIANCE *Ex: average impact of EU wet-spun yarn* → **to send to a client for** • **his Carbon Footprint** • **his corporate reporting**	FOR COMPLIANCE *Ex: impact of your specific product* → **to send to a client for** • **his Carbon Footprint** • **his corporate reporting**
			FOR STRATEGY AND PROGRESS • **TRAJECTORY** **Supporting footprint reduction** *Ex: setting targets, facilitating financing, tracking progress* → **for you / for your clients** • **INNOVATION** *Ex: identify levers for improvement, support investment choices*

COMPARISON : CAUTION RECOMMENDED FOR PRODUCERS AND USERS OF IMPACT DATA

In the past, the most common way to perform impact assessment was comparing in the same study a product to a standard product considered as a benchmark, other things being equal. Today, the "industrialisation" of life cycle data calculation and exchange can induce comparisons, relevant or not.

Comparison is justified when:

- **The method and background database are consistent**
  that is why the Alliance has developed a calculator for the Flax-Linen value chain, based on the PEF
- **Comparing comparable products**
  - ✓ Comparing finished products with the same function
    For example: products made of different compositions
  - ✓ Comparing semi-finished products
    For example: fabrics - which have similar next Life Cycle stages: similar transformation, similar use (durability) etc.
  - ✗ Comparing Flax fibre vs cotton in case the spinning, and further transformations are different.

5.2 - USE Q&A: DATA COMPATIBILITY

If I provide impact data on my Flax-Linen product calculated following a method, can my client use them in a study following another method?

1. GENERAL REMARK

Following a robust method like the PEF gives you more options for the usability of your data in your clients and partners impact assessments.

2. METHOD COMPATIBILITY

The compatibility may be ruled by the method followed by the client:

- the ISO does not provide specific guidelines about using data from different frameworks but requires general methodological consistency (e.g. allocations): this is the case for PEF compliant data and generally for major databases.
- the PEF restricts the use of data from frameworks other than PEF to 10% of the study's total PEF result.

GOOD TO KNOW: **if your data is PEF-compliant, it can be used in your clients' assessments using other methods, but it's seldom the case the other way round.**

3. ROBUSTNESS

If method compatibility is OK, then it will be up to the client to decide the best compromise for his study, between data precision (eg. your primary data, which is the most representative of your product) and data consistency (eg. generic data from same database used throughout the client's study).

GOOD TO KNOW: **as most Flax-Linen transformation processes are specific and absent from databases, there is a good chance that your primary data will be more robust than the generic dataset present in the database.**

For instance, if the client is related to the automotive industry and his study relies on ISO standards and ecoinvent database, they are likely to be very much interested by an Alliance member's roving results or Alliance's EU-average roving results even if PEF compliant, as no dataset matching hackling and preparation of roving exist in ecoinvent so far.

4. FORMAT COMPATIBILITY

- **Between PEF aligned tools**
  The PEF format for Life Cycle Inventory results, called ILCD, is **designed to enable transfer of data between partners.** For instance, your result calculated through Glimpact tool can be read automatically by other PEF-aligned platforms like PEFTrust, Carbonfact, Fairly Made etc.
- **From PEF to other framework**
  - PEF LCI flows may need a conversion to be used in another framework.
  - PEF LCIA (ie the results of the 16 PEF impact categories) may be used directly, for instance by a client using ecoinvent with EF3,1 modelling.
- **Between frameworks, other than PEF**
  there are many different cases, formats are not often compatible or convertible

5.3 - USE Q&A: DATA VERIFICATION

If I provide impact data about my Flax-Linen product to my client, will my data be verified or audited?

1. GENERAL REMARK

External verification depends on the intended use of the study: it will be necessary in case of external use, like BtoB or BtoC communication, but not for internal uses like ecodesign (see 3.4 - LCAs & PEF studies step by step: until deliverables)

2. AREAS OF FOCUS

The external reviewer will identify and examine particular areas of focus based on the product under study, and **particularly the hotspots and most relevant contributors identified.** Your Flax-Linen product may or may not be considered as a hotspot: it will likely be the case if the final product is a 100% Linen garment, probably not if the final product is made of a huge number of components, like a car for instance.

If that's the case, the reviewer's questions will likely be based on the **plausibility** of the impact data, in light of the reviewer's experience or published data, if available. For example, in case the climate change impact, or more precisely the impact related to fossil carbon dioxide emissions flows seems low, the reviewer could ask if energy consumption is 100% renewable and to provide justification (such as existence of solar panels or a specific contract with electricity supplier.

GOOD TO KNOW: **external reviews are documentary: they are not audits, you will not be asked for your invoices, and there will be no visits to your company.**

ADVICE: **always keep record of how you have calculated your data for future reference:**

- **Year for data collection**
- **Measurements and/or calculations – for ex. Water consumption measured; electricity consumption calculated by dividing between 2 processes in the mill, etc.**

3. REGULATIONS

Future regulations may clarify the needs for external review, for instance ESPR (refer to 2.2 Impact data for regulatory compliance) or the delayed Green Claims Directive which aims to establish norms on how to substantiate claims about environmental aspects or performance of products and organisations using robust, science based and verifiable methods.

6

CHAPTER 6
RESOURCES

CHAPTER 6
RESOURCES

SUB-SUMMARY

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6.1 - PEF'S 16 IMPACT CATEGORIES

IMPACT CATEGORY	IMPACT CATEGORY INDICATOR	UNIT OF MEASURE	DESCRIPTION	WEIGHTING FACTORS [%]
Acidification	Accumulated Exceedance - AE	mol H+ eq	Acidification from air, water, and soil emissions (primarily sulfur compounds) mainly due to combustion processes in electricity generation, heating, and transport	6,2
Climate change, total	Radiative forcing as global warming potential - GWP100	kg CO2 eq	Increase in the average global temperature resulting from greenhouse gas emissions (GHG)	21,06
Ecotoxicity, freshwater	Comparative Toxic Unit for ecosystems	CTUe	Impact of toxic substances on freshwater ecosystems	1,92
Eutrophication, freshwater	Fraction of nutrients reaching freshwater end compartment	kg P eq	Eutrophication and potential impact on ecosystems caused by nitrogen and phosphorous emissions mainly due to fertilizers, combustion, sewage systems	2,8
Eutrophication, marine	Fraction of nutrients reaching marine end compartment	kg N eq		2,96
Eutrophication, terrestrial	Accumulated Exceedance - AE	mol N eq		3,71
Human toxicity, cancer	Comparative Toxic Unit for humans	CTUh	Impact on human health caused by absorbing substances through the air, water, and soil. Direct effects of products on humans are not measured	2,13
Human toxicity, non-cancer	Comparative Toxic Unit for humans	CTUh		1,84
Ionising radiation, human health	Human exposure efficiency relative to U-235	kBq U-235 eq	Impact of exposure to ionising radiations on human health	5,01
Land use	Soil quality index, representing the aggregated impact of land use on: Biotic production; Erosion resistance; Mechanical filtration; Groundwater replenishment	Dimensionless pt	Transformation and use of land for agriculture, roads, housing, mining or other purposes. The impact can include loss of species, organic matter, soil, filtration capacity, permeability	7,94
Ozone depletion	Ozone Depletion Potential - ODP	kg CFC-11 eq	Depletion of the stratospheric ozone layer protecting from hazardous ultraviolet radiation	6,31
Particulate matter	Impact on human health	disease incidence	Impact on human health caused by particulate matter emissions and its precursors (e.g. sulfur and nitrogen oxides)	8,96
Photochemical ozone formation, human health	Tropospheric ozone concentration increase	kg NMVOC eq	Potential of harmful tropospheric ozone formation ("summer smog") from air emissions	4,78
Resource use, fossils	Abiotic resource depletion, fossil fuels - ADP-fossil	MJ	Depletion of non-renewable resources and deprivation for future generations	8,32
Resource use, minerals and metals	Abiotic resource depletion ADP ultimate reserves	kg Sb eq		7,55
Water use	Weighted user deprivation potential	m3 world eq	Depletion of available water depending on local water scarcity and water needs for human activities and ecosystem integrity	8,51
				100

6.2 - GLOSSARY & INDEX

TERMS	SHORT EXPLANATIONS	INDEX: SUBCHAPTERS
Allocation	Dividing the input or output flows of a process or a value chain between different product systems – typically for the Flax-Linen sector, dividing impacts between different products/co-products.	3.10
Biogenic carbon	Refers to carbon derived from biological sources namely the CO2 uptake and the greenhouse gas emissions of the biomass. In the context of natural materials, it raises issues regarding whether or not to include the benefit of temporary storage in the impact assessment.	**3.9**
Carbon footprint	measures the total greenhouse gas emissions associated with an activity, product or organisation and their effect on climate change	**1.1 1.3 2.2 3.1**
CO2 eq	carbon dioxide equivalent	**2.2**
Comparison	Caution: comparing impacts is justified in specific cases, for ex. for finished products meeting the same function, and if the method is strictly similar	**5.1**
Cradle-to-gate	study focusing on a raw material or semi-finished product	**1.2**
Cradle-to-grave	study covering the complete life cycle of the product	**1.2**
CSRD	Corporate Sustainability Reporting Directive: defines mandatory reporting for very large companies regarding their Environmental, Social and Governance (ESG) issues	**2.2**
Database	Contains datasets with elementary flows (LCI) of the materials and processes where the company performing the assessment cannot calculate themselves and when suppliers did not provide calculations. These datasets are usually generic, representing market averages, possibly with regional granularity. Alliance collaborated with 3 key databases to ensure the presence and availability of Masters of Flax Fibre ™ data, both long and short : European EF database, Higg MSI, ecoinvent.	**1.4 3.3. 3.6 3.9 3.10 4.1 4.2 4.5 4.6 4.8 5.2**
Environmental Footprint	a multi-criteria measure of the environmental performance of a good service or organisation throughout its life cycle (including carbon footprint and other impacts: water, land use, ecosystems, health)	**1.1**
ESPR	Ecodesign For Sustainable Product Regulation: sets information and performance requirements for finished products to enter the market and establishes a Digital Product Passport (DPP)	**2.2**
Gate-to-gate	study measuring the impact of a specific transformation process or multiple consecutive processes	**1.2**
GHG Protocol	International method for measuring and reporting emissions, which is the reference for the SBTi framework	**3.1**
Impact category	class representing environmental issues of concern (ex: climate change, water use, resource use-fossils, ecotoxocity-freshwater)	**1.3**

TERMS	SHORT EXPLANATIONS	INDEX: SUBCHAPTERS
Indicator > Impact category indicator	a quantifiable representation of an impact category; for ex. the impact category indicator for climate change is "global warming potential", which is expressed in kg CO2eq (carbon dioxide equivalent).	**1.3**
ISO 14040 & 14044	ISO international standards dedicated to Life cycle assessment: principles and framework (14040) and detailed guidance for implementing each step of an LCA (14044)	**1.1 3.1 3.2**
ISO 14067	ISO international standard dedicated to carbon footprint	**3.1**
LCA	Life Cycle Assessment : compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle	**1.1**
LCI	Life Cycle Inventory: phase of the LCA involving the compilation and quantification of inputs and outputs for a product throughout its life cycle, broken down into elementary flows.	**3.3**
LCIA	Life cycle impact assessment (LCIA): phase of life cycle assessment aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system throughout the life cycle of the product.	**3.3 4.5 4.7 4.8**
Masters of FLAX FIBRE™ impact data	The impacts of Masters of Flax Fibre™ (ex-European Flax™) scutched long fibre and Masters of Flax Fibre™ (ex-European Flax™) rescutched short fibre are present in key databases and presented in this guide as LCIA	**4.3 4.5 4.6 4.7**
Masters of FLAX FIBRE™ LCA	The LCA study of Masters of Flax Fibre™ (ex-European Flax™) scutched long fibre was published 2022 – note that impact data were updated since	**4.5**
Microfibres > Fibre fragments	Fibre fragments (commonly called 'microfibres') have important impacts - especially those of synthetic origin which have very poor biodegradation capacity - but they are only partially assessed so far, as the science is still in progress.	**3.8**
OEF	European method for measuring a company's environmental impact, across all its activities, from upstream to downstream, taking into account 16 impact indicators.	**1.1 3.1**
PEF	EU-recommended LCA-based method to quantify the environmental impacts of products (goods or services). It builds on ISO standards with additional, more specific requirements including 16 impact categories.	**1.1 2.2 3.1 3.5**
PEF Apparel & Footwear	Category rules complementing the PEF method specifically for the apparel and footwear finished products, developped by brands, retailers, trade organisations, textile manufacturers, public organisations and NGOs, where Alliance was a voting member. Publication May 2025.	**3.7 3.8**
PEFCR	Product Environmental Footprint Category Rules: sector-specific complements to the PEF method aiming for studies' reproductibility and comparability.	**3.6**
SBTI	Science Based Targets initiative, an association that oversees and validates companies' decarbonization objectives based on climate science and aligned with global warming limited to below +2°C.	**3.1**
Verification	The process of confirming that LCA results are accurate and comply with standards. Verification is expected when these results are meant for external communication: for BtoC, upcoming ESPR regulation shall provide some guidance.	**5.3**

Alliance for European Flax-Linen & Hemp

The Alliance for European Flax-Linen & Hemp is the only European agro-industrial organization that serves as a global reference and brings together all players in the European Flax-Linen and Hemp value chain.

A platform for reflection, market analysis, dialogue, and strategic orientation, the Alliance for European Flax-Linen & Hemp presides over an industry of excellence in a globalized context. It encourages dialogue with national and European public authorities.

The Alliance for European Flax-Linen & Hemp creates an environment that fosters competitiveness of industrial businesses as part of its three-fold mission of informing members, brands, and consumers, supporting the European ecosystem and European expertise, and promoting European Flax-Linen and Hemp as the preferred sustainable premium fibres worlwide.

It connects 10,000 businesses in 16 European countries and bases its work on the values of solidarity, innovation, scientific validation, and respect for people and planet.

It promotes, initiates, and organizes strategic reflections and research on its fibres to be able to provide all of its interlocutors with evidence-based economic data, environmental information, and reliable scientific evidence.

The Alliance for European Flax-Linen & Hemp strives to increase the international visibility of its fibres, whose technical and environmental properties inspire global creation and open new opportunities for industrial innovation. It guarantees the traceability of Flax fibre thanks to the Masters of FLAX FIBRE™ and Masters of LINEN™ certifications.

With its Technical Section, Alliance for European Flax-Linen & Hemp helps its members move towards the future to discover new opportunities such as high-performing composite products. This Section brings together fibre and semi-finished product suppliers, preparers and processors, serving as a bridge between the requirements of the multi-segment industry and the value chain's industrialization capacity for technical Flax and Hemp applications.

The Alliance for European Flax-Linen & Hemp is the new name of the CELC, an association founded in 1951. Western Europe is the number one Flax-producing region in the world (France, Belgium, and the Netherlands account for 3/4 of production).

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