Life GreenShoes4All

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CTCP – CENTRO TECNOLOGICO DO CALÇADO DE PORTUGAL

APA, SESSÃO DE DIVULGAÇÃO E WORKSHOPS REGIONAIS
PARA A CALL 2023 DO PROGRAMA LIFE – PORTO, 06-06-2023

CTCP

Since 1986
supporting the Footwear and Leather Goods Cluster

We are a **non-profit organization**

Facilities in **São João da Madeira** and **Felgueiras**

+60 employees, +80% women

We are the **interface centre** that establishes **synergies** within the **Industry** and entities from the **R&D System**

https://www.ctcp.pt/

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MAIN AREAS

QUALITY CONTROL LABORATORY

RESEARCH AND SUSTAINABILITY

INDUSTRIAL ORGANIZATION

TRAINING AND QUALIFICATION

COMMUNICATION

ENVIRONMENT AND SAFETY TESTS

DIGITAL MANUFACTURING

INVESTMENT PROJECTS

INDUSTRIAL PROPERTY

Research and Sustainability

Promoting strategies to evolve, seeking the decarbonization and competitiveness of the cluster

ENVIRONMENT (LCA, RECYCLING..)

MATERIALS AND COMPONENTS

PRODUCT (FOOTWEAR, BAGS)

NEW PROCESS

PRODUCTION TECHNOLOGYES

SOFTWARE

Quality Control Laboratory

Testing Labotatory accredited ISO 17025

PHYSICO-MECHANICAL TESTS

CHEMICALS, RESTRICTED SUBSTANCES

COMFORT

ADVANCED APPLICATIONS AND SAFETY (CE MARK/PPE)

BIODEGRABILITY, COMPOSTING..

CONTENTS

- Life GreenShoes4All
- Implementation of PEF studies to footwear products
- How to reduce the PEF of footwear?
- Case studies: Footwear products with lower PEF & Green materials

LIFE GREEN SHOES 4 ALL

LIFE GREENSHOES4ALL MAIN OBJECTIVES

Product Environmental Footprint (PEF) of footwear

New recycling approaches: materials & components

Green shoes with lower PEF

BENEFICIARIES

COORDINATOR - PORTUGAL

Belgium

Spain

Portugal

Spain

Romania

Portugal

Portugal

Spain

Romania

BUDGET

Total amount: 1 120 129€
% EC Co-funding: 58.9%

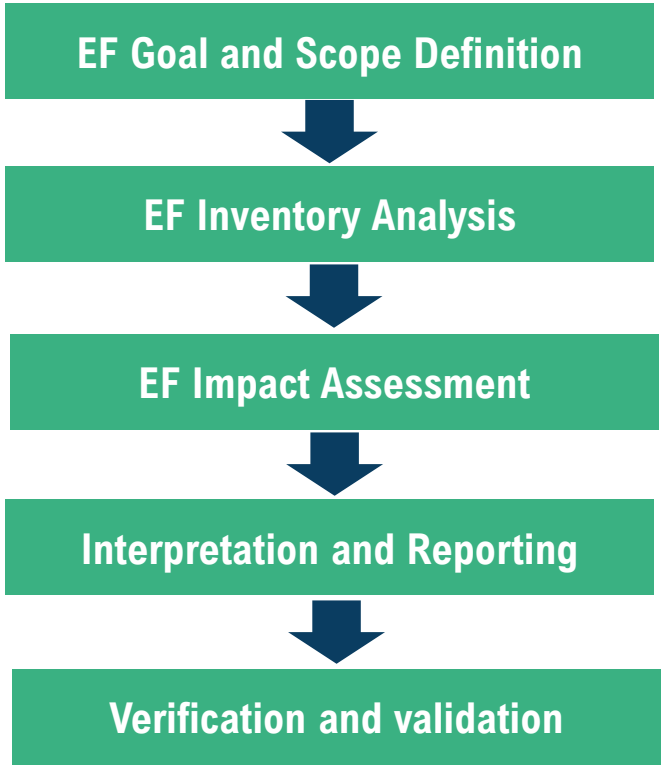
DURATION

01 oct 2018 to
30 set 2022

IMPLEMENTATION OF PEF STUDIES TO FOOTWEAR PRODUCTS

INTRODUCTION

- The **EU Footwear Product Environmental Footprint (PEF) method is designed to measure the life cycle environmental performance** of footwear products.
- The PEF method gives **quantitative information on the impacts of products**, following a Life cycle assessment (LCA) approach.
- **PEF improves the validity and comparability** of the environmental performance of products & can contribute to the **EU Green Deal Industrial Plan for the Net-Zero Age**.
- A **tool to communicate to the consumers is still needed**.



SCOPE OF THE WORK

- Project Life GreenShoes4All implemented PEF/LCA studies to a total of **6 + 60 FOOTWEAR MODELS,** including: **OPEN-TOED SHOES, CLOSED-TOED SHOES, AND BOOTS**.

- The footwear models comprise **CHILDREN**, **FASHION**, **CASUAL**, **SPORTS**, and **SAFETY/WORK** footwear.

- Reference unit: 1 pair of shoes including packaging (size according user: children, women, men)

LIFE17 ENV/PT/000337 Footwear environmental footprint category rules implementation and innovative green shoes ecodesign and recycling
https://www.greenshoes4all.eu/

SYSTEM BOUNDARIES

The system boundaries of the studies comprise the **entire life cycle** (from cradle to grave), including the following life cycle stages:

- raw material acquisition and pre-processing (including packaging)
- manufacturing
- distribution
- end-of-life.

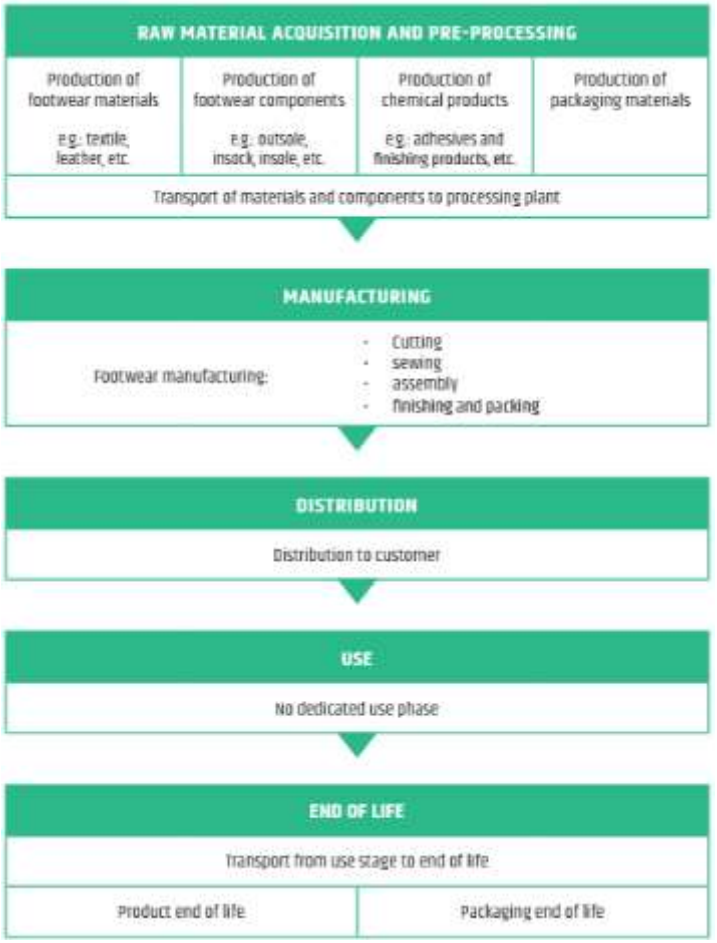


Figure 1 – System boundaries.

IMPACT CATEGORIES

16 EF Impact Categories

Table 1 – Impact categories.

EF Impact Category	Impact category Indicator	Unit
Climate Change, total	Radiative forcing as global warming potential (GWP100)	kg CO_2 eq
Ozone depletion	Ozone Depletion Potential (ODP)	kg CFC-11 $_{eq}$
Human toxicity, cancer	Comparative Toxic Units for humans (CTUh)	CTUh
Human toxicity, non-cancer	Comparative Toxic Units for humans (CTUh)	CTUh
Particulate matter	Impact on human health	disease incidence
Ionising radiation, human health	Human exposure efficiency relative to U^{235}	kBq U^{235} $_{eq}$
Photochemical ozone formation, human health	Tropospheric ozone concentration increase	kg NMVOC $_{eq}$
Acidification	Accumulated Exceedance (AE)	Mol H+ $_{eq}$
Eutrophication, terrestrial	Accumulated Exceedance (AE)	Mol N $_{eq}$
Eutrophication, freshwater	Fraction of nutrients reaching freshwater end compartment (P)	kg P $_{eq}$
Eutrophication, marine	Fraction of nutrients reaching marine end compartment (N)	kg N $_{eq}$
Ecotoxicity, freshwater	Comparative Toxic Unit for ecosystems (CTU_e)	CTU_e
Land use	Soil quality index (+ Biotic production - kg biotic production; Erosion resistance - kg soil; Mechanical filtration - m^3 water; Groundwater replenishment - m^3 ground water)	Dimensionless (pt)
Water use	User deprivation potential (deprivation-weighted water consumption)	m^3 world $_{eq}$
Resource use, minerals and metals	Abiotic resource depletion (ADP ultimate reserves)	kg Sb $_{eq}$
Resource use, fossils	Abiotic resource depletion – fossil fuels (ADP – fossil)	MJ

DATA COLLECTION

A specific inventory was prepared to support the data collection, including:

1. **General data** of product under study and total production of manufacturing facilities.
2. **Materials and components** composition and weight, origin, and type of transport.
3. **Chemical and auxiliary** products consumption used on models.
4. **Energy consumption**, including electricity, natural gas, fuel oil, coal, etc.
5. **Water** consumption.
6. Other **wastes and emissions** generated in the facilities and EoL.
7. **Distribution**, including distance and type of transport.

Figure 2 – Inventory

PEF RESULTS

Table 2 – **Characterised, normalised, and weighted results** of EF impact categories calculated for a pair of shoes (example).

Impact category	Characterised results		Normalised results			Weighted results		
	Reference unit	Total impacts	Global NFs	Units	Total impacts	Weighting factors	Units	Total impacts
Acidification	mol H+ eq	2,10E-01	5,56E+01	Person-years	3,78E-03	6,20	Points	2,34E-04
Climate change	kg CO2 eq	23,96	8,10E+03	Person-years	2,96E-03	21,06	Points	6,23E-04
Ecotoxicity, freshwater	CTUe	4,92E+02	4,27E+04	Person-years	1,15E-02	1,92	Points	2,21E-04
Eutrophication, freshwater	kg P eq	2,57E-03	1,61E+00	Person-years	1,60E-03	2,80	Points	4,48E-05
Eutrophication, marine	kg N eq	5,85E-02	1,95E+01	Person-years	2,99E-03	2,96	Points	8,85E-05
Eutrophication, terrestrial	mol N eq	7,28E-01	1,77E+02	Person-years	4,12E-03	3,71	Points	1,53E-04
Human toxicity, cancer	CTUh	5,87E-08	1,69E-05	Person-years	3,48E-03	2,13	Points	7,40E-05
Human toxicity, non-cancer	CTUh	3,35E-07	2,30E-04	Person-years	1,46E-03	1,84	Points	2,68E-05
Ionising radiation	kBq U-235 eq	1,18E+00	4,22E+03	Person-years	2,80E-04	5,01	Points	1,40E-05
Land use	Pt	3,05E+02	8,19E+05	Person-years	3,72E-04	7,94	Points	2,96E-05
Ozone depletion	kg CFC11 eq	2,34E-06	5,36E-02	Person-years	4,37E-05	6,31	Points	2,75E-06
Particulate matter	disease inc.	1,99E-06	5,95E-04	Person-years	3,33E-03	8,96	Points	2,99E-04
Photochemical ozone formation	kg NMVOC eq	4,76E-02	4,06E+01	Person-years	1,17E-03	4,78	Points	5,60E-05
Resource use, fossils	MJ	8,63E+01	6,50E+04	Person-years	1,33E-03	8,32	Points	1,10E-04
Resource use, minerals and metals	kg Sb eq	4,00E-05	6,36E-02	Person-years	6,29E-04	7,55	Points	4,75E-05
Water use	m3 depriv.	4,25E+00	1,15E+04	Person-years	3,70E-04	8,51	Points	3,15E-05
Total (single score)	n/a	n/a	n/a	Person-years	n/a	n/a	Points	2,06E-03

INTERPRETATION OF PEF RESULTS & CONCLUSIONS

Table 3 – Most relevant impact categories, Life cycle stages, Processes and Flows (example).

Impact category	% Contribution	Life cycle sub-stage	% Contribution	Processes	% Contribution
Acidification	9,2%	Raw materials (in final product)	71,5%	Upper - Leather	46,1%
				Upper - Cotton	9,6%
		Raw materials (that go to waste)	20,9%	Upper - Leather	20,9%
Climate change	24,9%	Raw materials (in final product)	68,8%	Upper - Leather	32,5%
				Outsole	22,1%
		Raw materials (that go to waste)	14,8%	Upper - Leather	14,8%
Ecotoxicity, freshwater	10,4%	Raw materials (in final product)	68,6%	Upper - Leather	39,3%
				Upper - Cotton	13,2%
		Raw materials (that go to waste)	17,6%	Upper - Leather	17,9%
Eutrophication, marine	6,1%	Raw materials (in final product)	80,4%	Upper - Leather	31,8%
				Upper - Cotton	29,4%
				Insock	11,3%
		Raw materials (in final product)	14,4%	Upper - Leather	14,4%
Eutrophication, terrestrial	6,4%	Raw materials (in final product)	72,2%	Upper - Leather	49,5%
				Upper - Cotton	10,5%
		Raw materials (that go to waste)	22,4%	Upper - Leather	22,5%
Particulate matter	10,7%	Raw materials (in final product)	67,2%	Upper - Leather	47,7%
				Upper - Cotton	7,2%
		Raw materials (that go to waste)	21,7%	Upper - Leather	21,7%
Water use	17,2%	Raw materials (in final product)	98,9%	Upper - Cotton	62,9%
				Insock	23,7%

INTERPRETATION OF PEF RESULTS & CONCLUSIONS

Table 4– Most relevant impact categories, Life cycle stages, Processes and Flows (example).

Impact category	% Contribution	Life cycle stage	% Contribution	Material / component / process	% Contribution
Climate change	24,0%	Raw materials in final product	55,5%	Outsole	22,3%
				Insole	8,0%
				Interlayer	7,8%
				Insock	6,9%
				Upper	3,5%
		Raw materials that goes to waste	3,0%	Interlayer	1,4%
		Waste	19,8%	Urban waste	15,7%
		End of Life	7,3%	Transport passenger car	3,8%
				Municipal solid waste	3,2%
Resource use, fossils	16,8%	Raw materials in final product	68,0%	Outsole	35,1%
				Insole	9,9%
				Insock	7,5%
				Interlayer	5,6%
		Waste	15,4%	Urban waste	12,0%
		Raw materials that goes to waste	2,8%	Interlayer	1,3%
Resource use, minerals and metals	16,1%	Waste	90,9%	Urban waste	84,0%

INTERPRETATION OF PEF RESULTS & CONCLUSIONS

Most relevant life cycle stages

Raw-materials acquisition and pre-processing

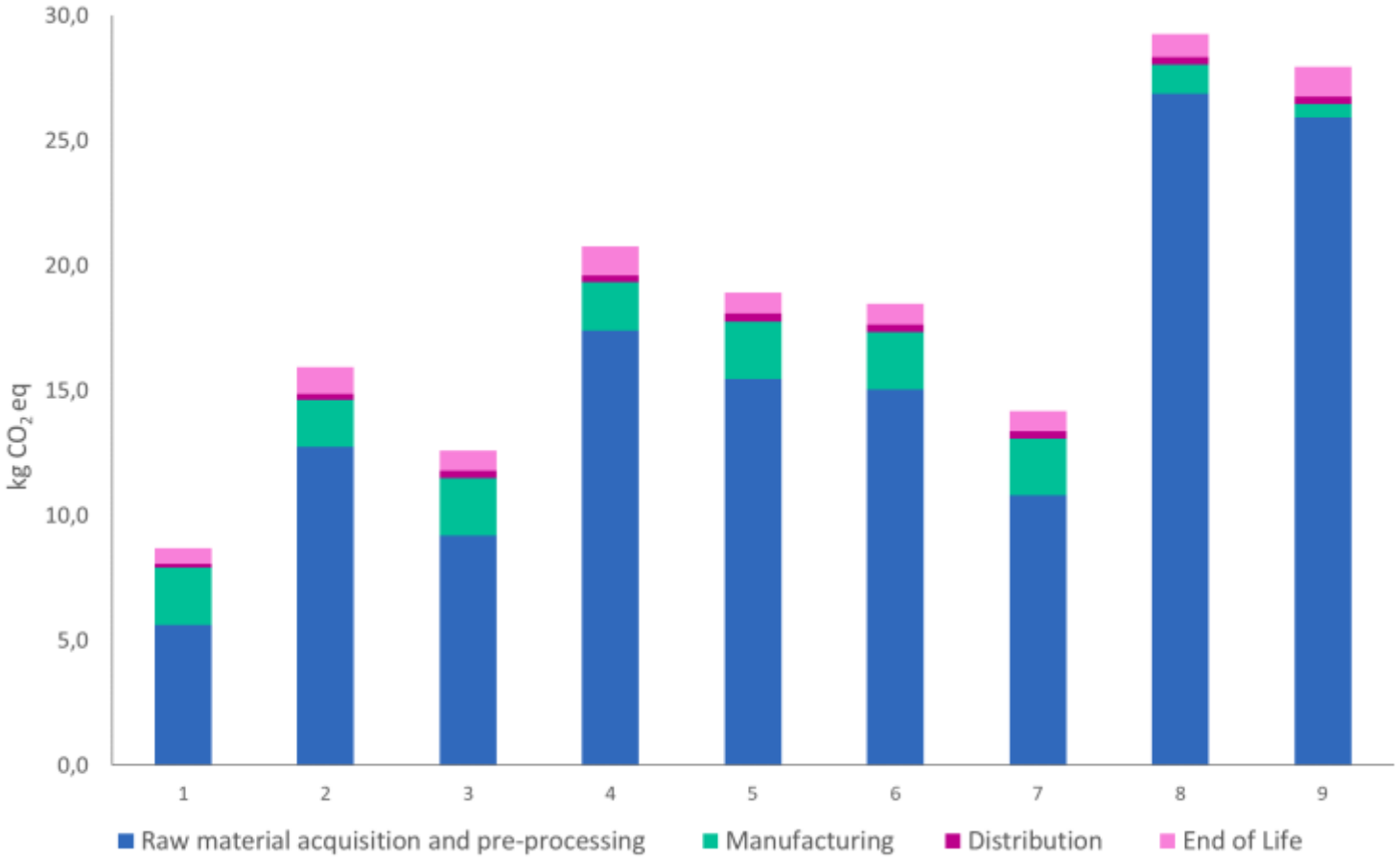


Figure 3 – Climate Change (GWP) value calculated by life cycle stage for boots.

HOW TO REDUCE THE PEF OF FOOTWEAR?

1 Design for a need

2 Design for durability and reparability

3 Design for recycling, reuse and recovery

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4 Select less, lighter and lower impact materials

5 Avoid potentially hazardous substances and materials

6 Optimise manufacturing processes

7 Select more environmental efficient distribution

8 Reduce the environmental impact in the use stage

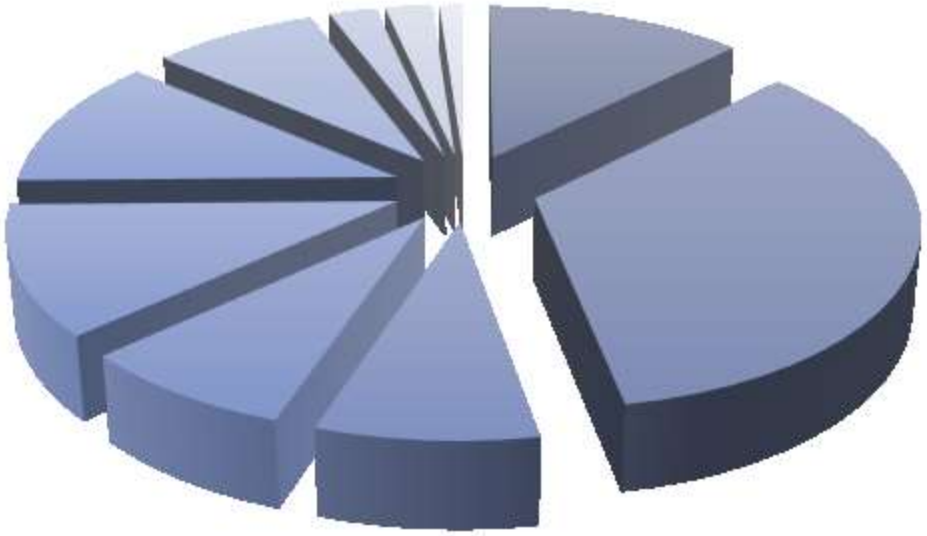
9 Optimise the EoL

HOW TO REDUCE THE PEF OF FOOTWEAR?

Actions to increase sustainability

CTCP, identifies 10 areas with high potential of increasing footwear sustainability and reduce the PEF

- Design
- Materials & Components
- Materials Efficiency
- Go Circular
- Research
- Green Energy
- Business Models
- Processes
- Chemicals
- Packaging



HOW TO REDUCE THE PEF OF FOOTWEAR?

Actions to increase sustainability

Ecodesign: Product ecodesign for longer life, repairability and circular use/recyclability.

Materials & Components: Upper, lining, and bottom that have low environmental, carbon and water footprint, have lower weight and are recycled / recyclable.

Materials Efficiency: Using materials more efficiently and reducing wastes.

Go Circular: Increasing production waste & used products circularity and recycling.

Research: Developing materials, product concepts, processes and business models with lower environmental, carbon and water footprint (impact).

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Actions to increase sustainability

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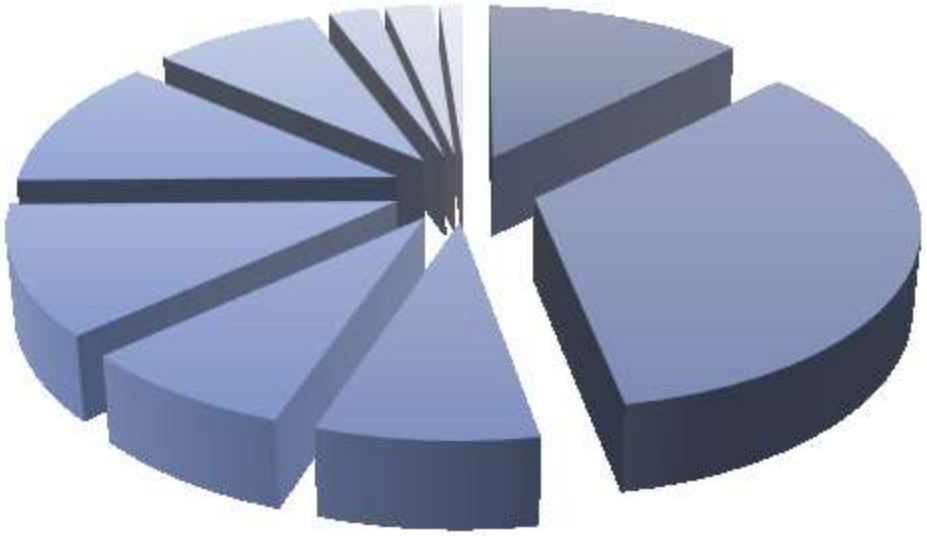

I&I Bioeconomy (1-4)

- In footwear, the **materials, components and waste are the major contributors to GHG emissions**, and investigation and innovation (I&I) are core to pursuing the 2030 targets.

- The sectors need to develop and deploy the **“next generation” of sustainable materials and processes**, including biological and plant-based materials, man-made biobased materials, material-to-material recycling and innovative production technologies and products.

- **BioShoes4All** national project supported by the program “Recuperar Portugal” PRR C-12 “Bioeconomia Sustentável” (project nº 11) was designed with this purpose and includes **70 partners from industry to retail and academia** (2022-2025).

I&I Bioeconomy (2-4)

PRR

REPÚBLICA PORTUGUESA

Financiado pela União Europeia

APICCAPS

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SKYPRO Feel the ultimate care.

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Aloft

AMF SAFETY SHOES

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IBERIA ADVANCED HEALTHCARE

CVR

Dermas Leather Comércio e Indústria de peles, S.A

Demoscore

DIAS RUIVO

DREAMPLAS

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VALUNI SHOES WITH CHARACTER

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isep Instituto Superior de Engenharia do Porto

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COBLEX

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RAP

I&I Bioeconomy (3-4)

1. Biomaterials
2. Ecological footwear
3. Circular Economy
4. Production Advanced Technologies
5. Capacitation and Dissemination

5 Pillars

11 Initiatives

23 Measures

+ 80 Activities

Pillars 1 a 4
Research, Innovation & Deployment

I&I Bioeconomy (4-4)

Results expected

- Promote the transition of footwear sectors to the bioeconomy and sustainable circular economy
- New bio and eco fibers, charges, materials, components, products and processes
- Footwear, leather goods... functional, durable, circular, < PEF
- Advanced and digital production technologies (automation, robotization, in-situ recycling..)
- Solutions for the valorization / use of biological waste, sector production waste and post-consumer products

PRR REPÚBLICA PORTUGUESA Financiado pela União Europeia

CASE STUDIES: FOOTWEAR PRODUCTS WITH LOWER PEF & GREEN MATERIALS

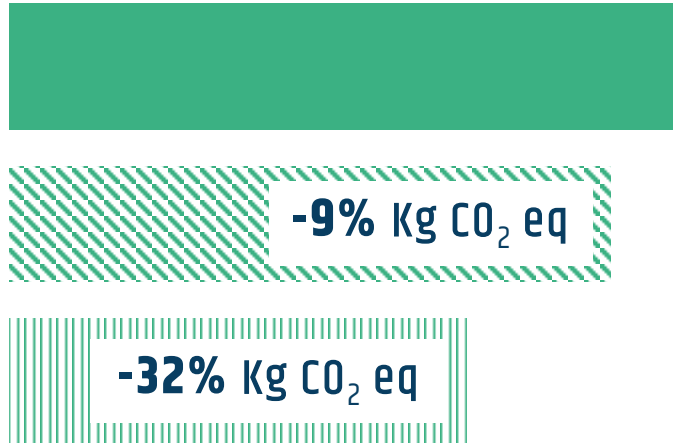
Footwear MAIN STRATEGIES TO REDUCE PEF

Selection of materials of lower environmental impacts (e.g., recycled materials)

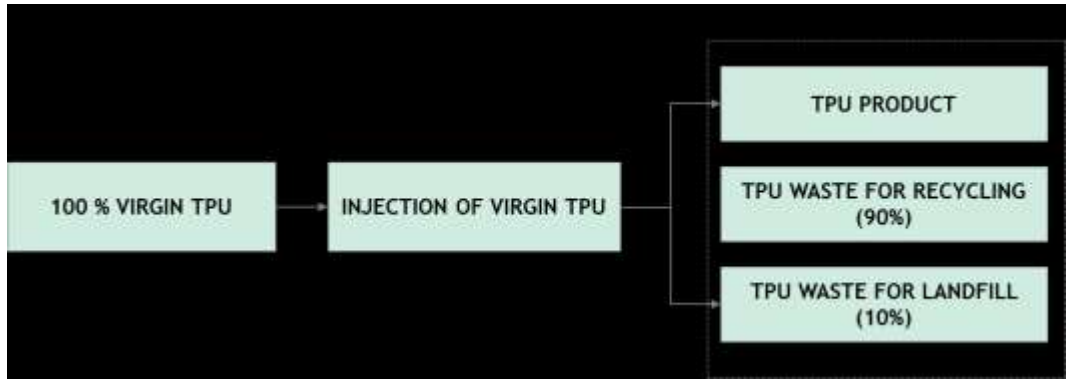
Reduction of the mass of raw materials & components

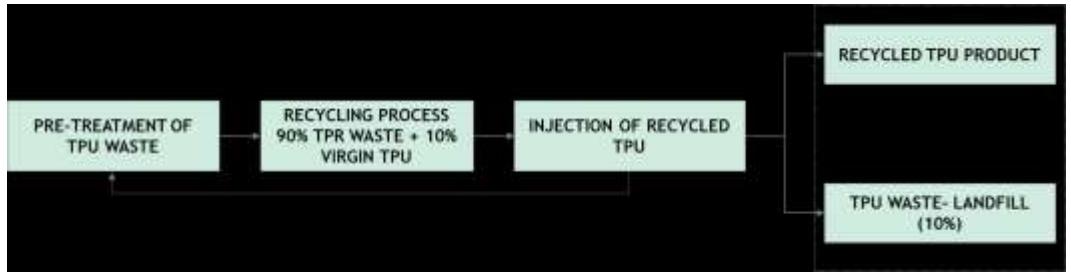
Reduce the manufacturing waste (e.g., optimization of cut operation)

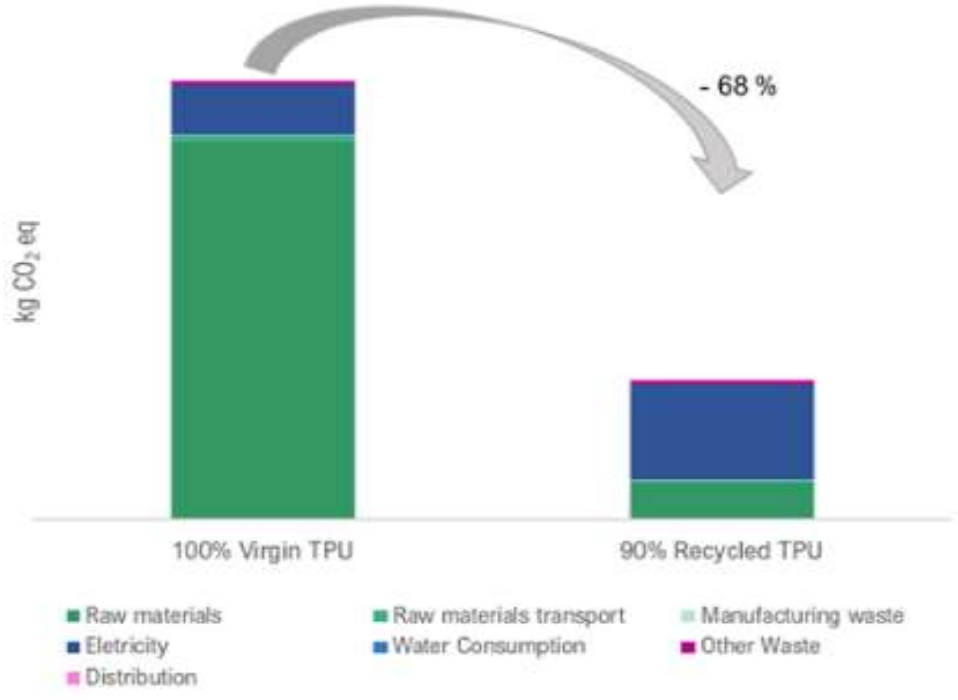
More energy efficient manufacturing processes



New recycled plastic materials and components (up to 90% TPU waste)







REDUCING THE **CARBON FOOTPRINT** OF OUR PRODUCTS

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-4% Kg CO_2 eq

8% Recycled EVA with cork

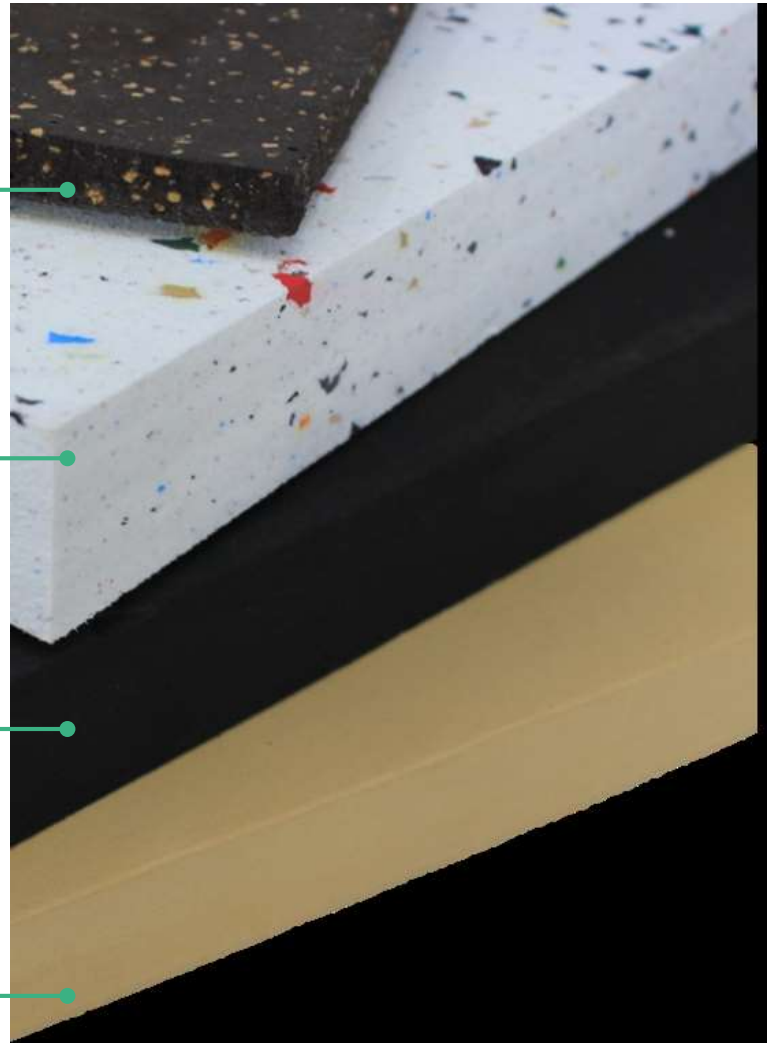
-8% Kg CO_2 eq

15% EVA recycled sheet

-70% Kg CO_2 eq

100% EVA recycled sheet

Conventional sheet



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Recycled rubber

Recycled rubber formulation

Recycled rubber material

RECOMMENDATIONS AND LESSONS LEARNED TO IMPROVE PEFCR

RECOMMENDATIONS AND LESSONS LEARNED

1) Definition of a common **template for data collection**

2) Specific **datasets** for footwear materials, including new materials (e.g., recycled and recyclable, biobased, biodegradable)

3) **Specific scenarios** for footwear manufacture and end-of-life

4) Common methodology to measure and integrate the durability of products in LCA. **Valorisation of durability**

5) PEF for all types of footwear, including **working shoes**

6) **More default scenarios** for lack of available primary data

7) A **tool to communicate the PEF** /label (e.g. A, B…F).

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Thank you very much for your attention!

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