Underlay 5156 VB Environmental footprint

Amorim Cork Composites, S.A.

Executive summary

August 2021

Building a better working world

Disclaimer

EY environmental footprint analysis follows a life-cycle approach based on ISO Standard 14040 and is based on Amorim Cork Composites data and business assumptions. The results presented are not third-party verified.

Agenda

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2. Carbon footprint

Cradle-to-gate

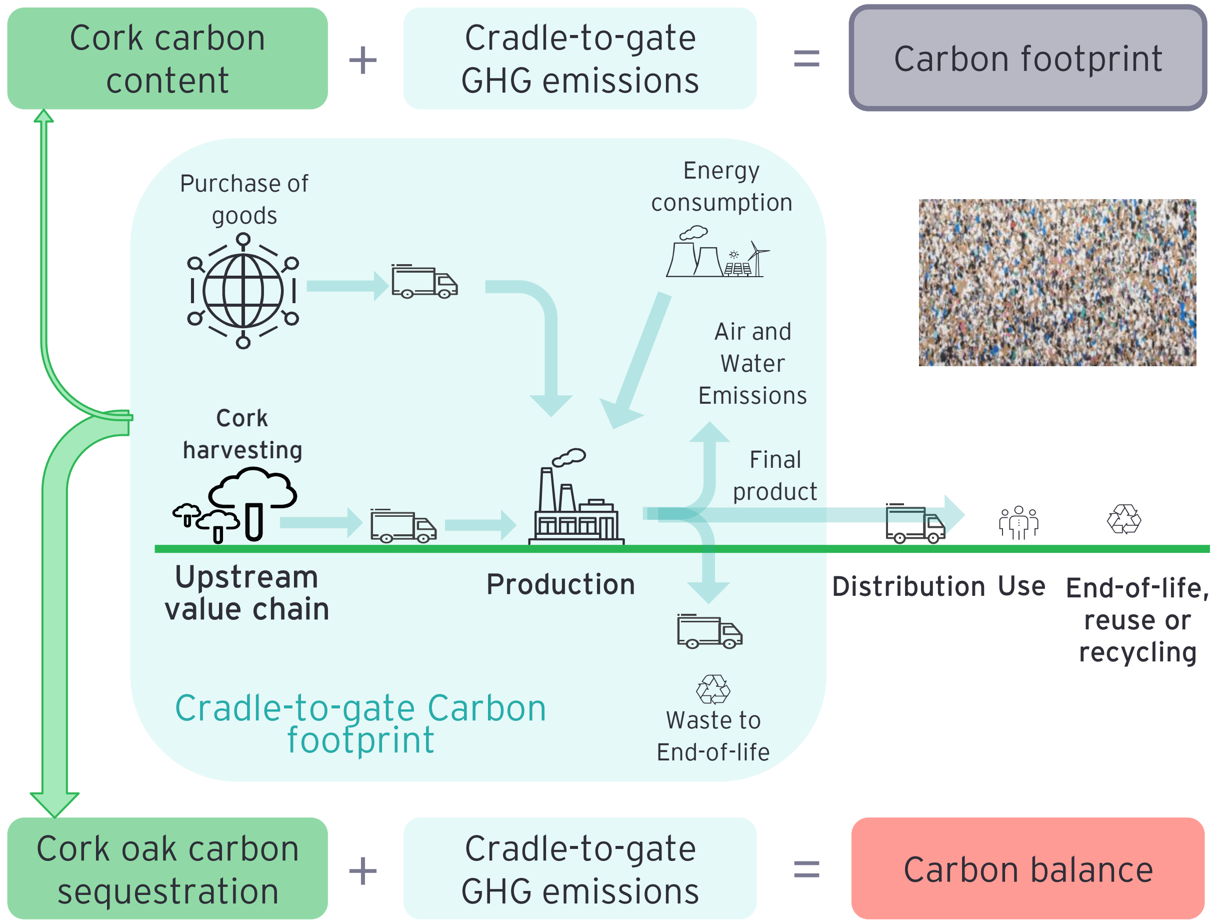
3. Carbon balance

Scenario analysis with carbon sequestration at the forest stage

4. LCA

Lifecycle environmental impacts for cradle-to-gate scope for main impact categories

5. Conclusions



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About the study

About the study

Context

- Corticeira Amorim is the largest world producer of cork products, championing the sector since 1870. The company has a portfolio of products with applications in multiple industries, such as wine, construction, flooring, aeronautical, automobile, footwear, among others. The company has implemented an integrated production process that ensures that no cork is wasted.
- Cork is an ecological and sustainable material 100% natural, renewable, recyclable and reusable.
- Amorim Cork Composites, a subsidiary of Corticeira Amorim is focused in producing innovative solutions with combinations of cork and other materials, by recycling, reusing and reinventing natural and organic materials. The composite cork industry requires high levels of physical and chemical performance, providing adequate solutions to the needs of several industries such as the automotive, aerospace and aeronautical industries, the construction sector, as well as the shoe and interior design industries.
- The **main purpose** of this study is to quantify the potential environmental impacts generated by the production of Underlay 5156 VB by Amorim Cork Composites, through a life cycle approach.
- Underlay 5156 VB is an underlayment for thermal and acoustic insulation with a pre-attached vapour barrier, produced from recycled and natural materials, such as recycled EVA and cork. This underlayment provides comfort, protection and longevity to resilient floors, further contributing to energy efficiency and acoustic insulation.

Product characteristics	Average dimensions
Product composition Confidential information	

*approximate values

About the study

Methodology

- The study analyses the environmental footprint of the Underlay 5156 VB, through a life cycle analysis (LCA) approach.
- **Guidelines:** The study was based on ISO 14040/44 series of standards, complemented with the guidelines from the International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance
- **Approach:** *cradle-to-gate* (from raw material extraction to the finished product at the factory gate)
- **Life cycle stages assessed:** forest management activities, cork granulate production, grinding white EVA, grinding colored EVA, agglomeration, transformation and packaging, as well as transport of raw materials from suppliers
- **Functional unit**: 1 m^2 of packed Underlay 5156 VB
- **Modelling software and database**: SimaPro 9.1 with ecoinvent 3.5 database
- **Method:** Midpoint characterization factors recommended by the International Reference Life Cycle Data System (ILCD). The potential climate change impacts (**carbon footprint**) of each stage were estimated selecting the impact category Climate Change from the ILCD method.

About the study

Methodology (cont.)

- Impact categories assessed :

Impact category	Unit	Description	Reference
Climate Change (CC)	kg CO_2 eq	Global Warming Potential calculating the radiative forcing over a time horizon of 100 years.	IPCC 2007
Ozone Depletion (OD)	kg CFC-11 eq	Ozone Depletion Potential (ODP) calculating the destructive effects on the stratospheric ozone layer over a time horizon of 100 years.	World Meteorological Organization (WMO) 1999
Human Toxicity: Cancer Effects (HTC)	CTUh	Comparative Toxic Unit for humans (CTUh) expressing the estimated increase in morbidity in the total human population per unit mass of a chemical emitted (cases per kilogramme). Specific groups of chemicals require further works.	USEtox
Human Toxicity: Non-Cancer Effects (HTCN)	CTUh	Comparative Toxic Unit for humans (CTUh) expressing the estimated increase in morbidity in the total human population per unit mass of a chemical emitted (cases per kilogramme). Specific groups of chemicals require further works.	USEtox
Photochemical Ozone Formation (POF)	kg NMVOC eq	Expression of the potential contribution to photochemical ozone formation. Only for Europe. It includes spatial differentiation.	van Zelm et al. 2008.
Acidification (A)	mole H^+ eq	Accumulated Exceedance (AE) characterizing the change in critical load exceedance of the sensitive area in terrestrial and main freshwater ecosystems, to which acidifying substances deposit. European-country dependent.	Seppälä et al. 2006 and Posch et al. 2008.
Terrestrial Eutrophication (TEu)	mole N eq	Accumulated Exceedance (AE) characterizing the change in critical load exceedance of the sensitive area, to which eutrophying substances deposit. European-country dependent.	Seppälä et al. 2006 and Posch et al. 2008.
Freshwater Eutrophication (FEu)	kg P eq	Expression of the degree to which the emitted nutrients reaches the freshwater end compartment (phosphorus considered as limiting factor in freshwater). European validity. Averaged characterization factors from country dependent characterization factors.	ReCiPe version 1.05

About the study

Methodology (cont.)

- Impact categories assessed :

Impact category	Unit	Description	Reference
Marine Eutrophication (ME)	kg N eq	Expression of the degree to which the emitted nutrients reaches the marine end compartment (nitrogen considered as limiting factor in marine water). European validity. Averaged characterization factors from country dependent characterization factors.	ReCiPe version 1.05
Freshwater Ecotoxicity (FEc)	CTUe	Comparative Toxic Unit for ecosystems (CTUe) expressing an estimate of the potentially affected fraction of species (PAF) integrated over time and volume per unit mass of a chemical emitted (PAF m3 year/kg). Specific groups of chemicals require further works	USEtox (recommended + interim)
Mineral and Fossil Resource Depletion (MFRD)	kg Sb eq	Scarcity of mineral resource with the scarcity calculated as 'Reserve base'. It refers to identified resources that meets specified minimum physical and chemical criteria related to current mining practice. The reserve base may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics	van Oers et al. 2002

- To evaluate other relevant potential impacts, water use, and energy consumption were also assessed

Impact	Unit	Description	Reference
Water consumption (AWARE)	m3	AWARE is to be used as a water use midpoint indicator representing the relative Available WAter REmaining (AWARE) per area in a watershed after the demand of humans and aquatic ecosystems has been met. It assesses the potential of water deprivation, to either humans or ecosystems, building on the assumption that the less water remaining available per area, the more likely another user will be deprived.	AWARE 2016
Energy consumption	MJ	The Cumulative Energy Demand (LHV) method was created by PRé Consultants team based on data published by ecoinvent for raw materials available in the SimaPro database. The method calculates Lower Heating Values (LHV) of fuels used in each process.	Frischknecht, R. et al,. 2007. Weidema B, et al 2013

About the study

Methodology (cont.)

- **Data collection procedure**

Underlay 5156 VB production data	General data (raw materials production, energy, transport and waste management
↓	↓
Amorim Cork Composites activity (local data), for the year 2020, using questionnaires	Ecoinvent 3.5. database, compiled in 2018

- **Biogenic emissions and CO_{2eq} removals due carbon content in the reference flow are also considered, with the following assumptions:**
  - All cork raw materials that enter the system were considered to have a similar amount of carbon stored. The calculation of CO_2 uptake is based on the atomic weights of carbon (12) and carbon dioxide (44), as well as the carbon fraction (dry basis) of 55% and a moisture fraction of 6%[1].
  - Given the purpose of the assessment, emissions from biomass energy production are considered neutral, due to the assumption that the CO_2 that is being released in the incineration process (biogenic CO_2) was captured in the previous product stage 1 - forest management and cork harvesting (uptake), as so, it is no more than a short term delayed emission, resulting in a net neutral balance of CO_2 emissions [2,3].
- **Accounting the use of materials from recycling**
  - By using materials that have been previously discarded by their first owner (EVA waste), not fit to be used in the primary product manufacturing at their source, Amorim Cork Composites becomes the secondary user and needs to account for the use of recycled material (as a flow from technosphere). This implies that from the moment the user of a secondary user pays for the material, this (secondary) product system will also be responsible for the environmental burden from that point on (also known as polluter-pays principle). As so these materials enter the product system as having zero burdens and benefits.

[1]Dias, A.C., Arroja, L., 2014. A model for estimating carbon accumulation in cork products. Forest Systems 2014 23(2): 236-246
[2]Demertzi, M., Paulo, J.A., Arroja, L., Dias, A.C., 2016. A carbon footprint simulation model for the cork oak sector. Science of the Total Environment 566-567 (2016) 499-511
[3]Rives, J., Fernandez-Rodriguez, I., Rieradevall, J., Gabarrel, X, 2013. Integrated environmental analysis of the main cork products in southern Europe (Catalonia - Spain). Journal of Cleaner Production 51 (2013) 289-298

About the study

Methodology (cont.)

- **Additional scenario analysis of the potential carbon sequestration at the forest stage**
  - A scenario analysis was performed, given past studies[3,4], where it is assumed that carbon sequestration of the cork oak forest can indirectly be attributed to cork products was simulated, as the cork transformation industry contribute to the exploitation and maintenance of the cork oak forest.
  - The analysis compares the GHG emissions of the studied cradle-to-gate system to the cork oak forest carbon uptake, considering the cork weight in the functional unit. The resulting carbon balance is presented as an additional environmental information, as should not be confused with the carbon footprint analysis, where GHG emissions and biogenic stored carbon by cork are addressed.
  - Carbon stored in cork, in the product, was excluded for this scenario to avoid double counting. Allocation of CO_2 uptake to the cork extracted from the cork oak stands follows the same premises of allocating environmental impacts in a previous study[5].
  - In this study, a **weight-based perspective for carbon sequestration at the forest stage was considered**: All CO_2 uptake by the cork oak forest is allocated to extracted cork, as cork production is the main economic activity of cork oak forest, considering the weight of cork present in the functional unit of the final product.
  - The analyzed scenarios consider carbon sequestration in well-managed cork oak forests, with a high tree coverage and good soil and climate conditions, to have an average CO_2 uptake of 11 t CO_2/ha[6] , reaching a maximum of 14,7 t CO_2/ha. Translating[7] these values in function of cork extraction, there is a CO_2 uptake of 55 t CO_2/t of cork extracted, reaching up to 73 t CO_2/t of cork extracted.

[4] EY, 2019. Environmental footprint of natural cork stoppers. Corticeira Amorim, Santa Maria de Lamas.
[5] Dias, A.C., Rives, J.S., González-García, S., Demertzi, M., Gabarrel, X., Arroja, L., 2014. Analysis of raw cork production in Portugal and Catalonia using life cycle assessment. International Journal of Life Cycle Assessment (2014) 19:1985–2000
[6] Figures considered in the "The value of cork oak montado ecosystem services" (EY, 2019c). Average ecosystem CO_2 uptake (11 t CO2/ha) considers wet and dry years in well managed forests, with a maximum of 14,7 t CO2/ha registered in optimal climatic conditions (Costa-e-Silva et al., 2015).
[7] Conversion of forest ecosystem uptake per tonne of extracted cork considers the total cork oak occupation area in Portugal (719 937 ha) (ICNF, 2019) and an average value of cork production (145 000 t cork) based on a nine-year series (2003-2011) (APCOR, 2011).

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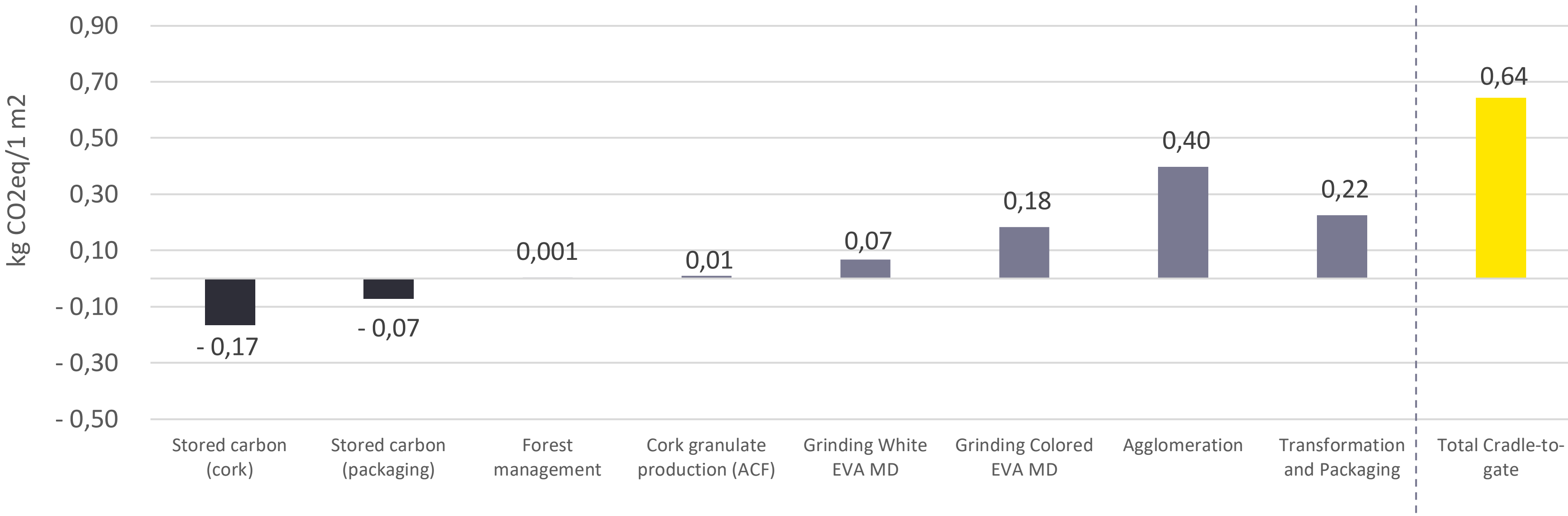
Carbon footprint

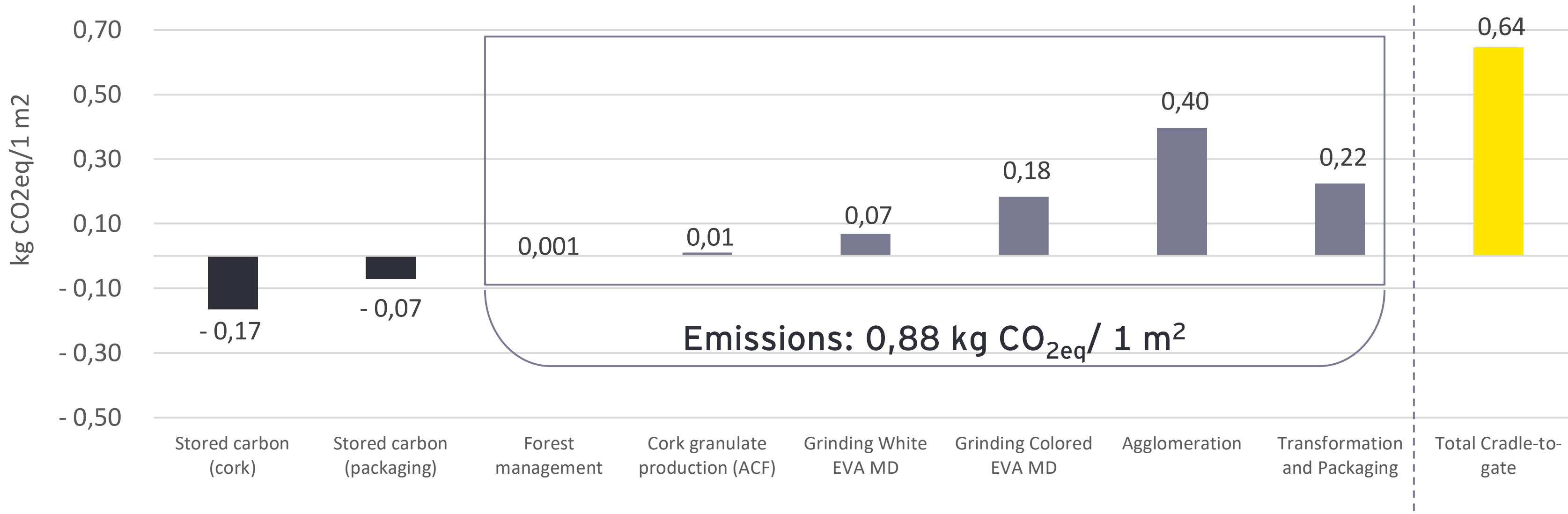
Carbon footprint: results



Underlay 5156 carbon footprint:

- Carbon stored in cork : **-0,17** kg CO_2 /1 m^2
- Cradle to gate: **0,64** kg CO_{2eq} /1 m^2

Carbon footprint: results



45% emissions associated with agglomeration process, 25% emissions associated with transformation and packaging process and 21% emissions associated with grinding colored EVA process

- Most upstream value chain activities carbon impacts (e.g. production and purchase of customized products and other materials and transport of raw materials) are reflected in these stages

3
Carbon balance

Carbon balance: results

Scenario analysis with carbon sequestration in the cork oak montado

For the average weight Underlay 5156 VB when considering carbon sequestration in the cork oak* montado:

There is a **forest storage up to:**

- 6,4

kg CO_2/1 m^2

Therefore, the **carbon balance reaches up to**

-5,6

kg CO_{2eq}/1 m^2

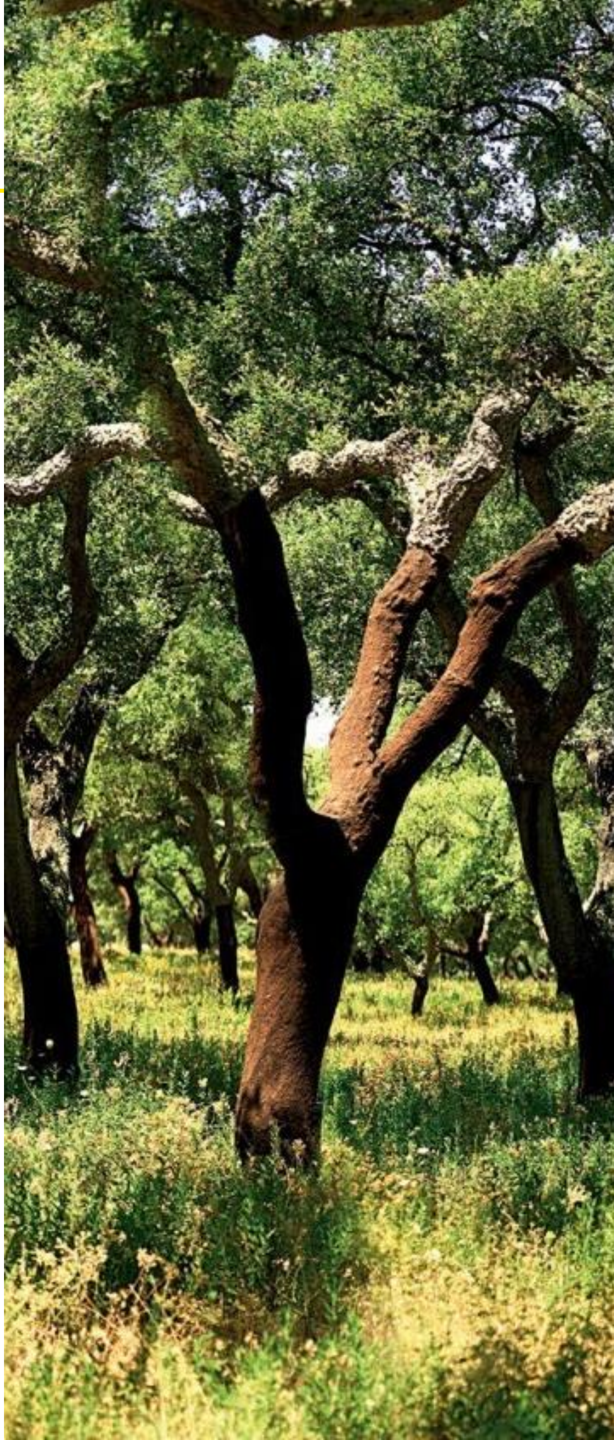
* scenario analysis based on well-managed cork oak montado

- 73 t CO_2/t cork

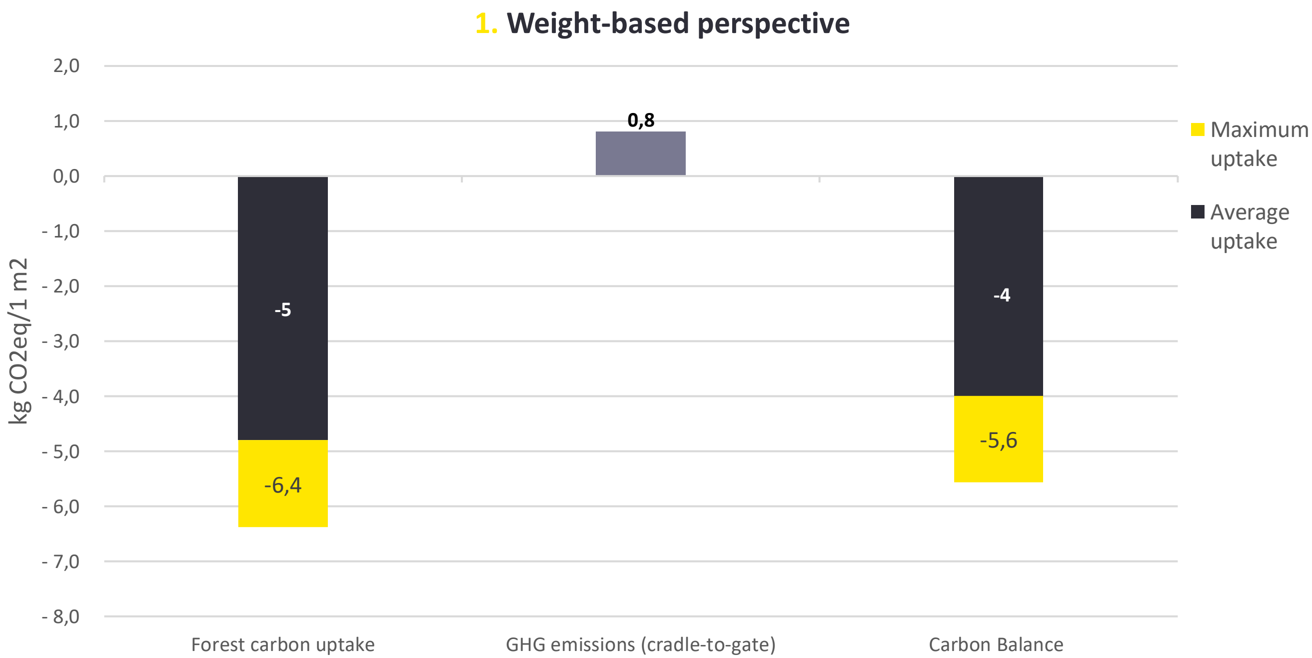
Maximum ecosystem CO_2 uptake registered (14,7 tCO_2/ha) (Costa-e-Silva et al., 2015).

with the average ecosystem CO_2 uptake being - 55 t CO_2/t cork, considering wet and dry years in well managed forests (11 t CO_2/ha).[9]

[9] figures used in "The value of cork oak montado ecosystem services, EY 2019"



Carbon balance: weight-based perspective



Underlay 5156 VB **carbon balance** reaches up to:

-5,6 kg CO_{2eq}/1 m2

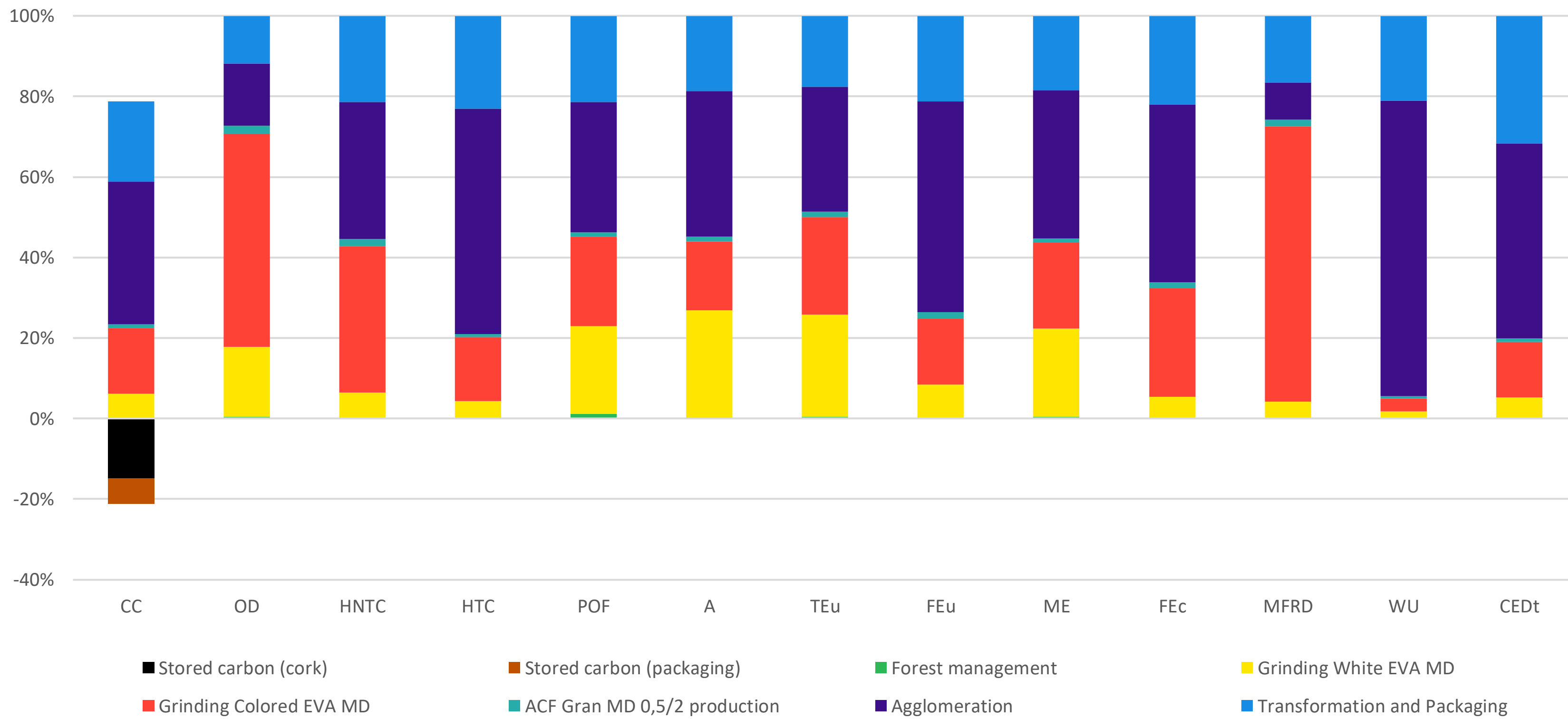
considering maximum ecosystem CO_2 uptake registered in a well managed cork oak montado **-73 t CO_2/t cork**

4

LCA environmental footprint

LCA results: 1m² Underlay 5156 VB

Environmental footprint for 1 m² of Underlay 5156



Stages with higher environmental impacts

- Agglomeration, due to customized products and other materials use
- Grinding colored EVA, due to long distance transportation

LCA Indicators : CC=Climate Change; OD=Ozone Depletion; HTCN = Human Toxicity: Non-Cancer Effects; HTC=Human Toxicity: Cancer Effects; POF= Photochemical Ozone Formation; A=Acidification; TEu=Terrestrial Eutrophication; FEu=Freshwater Eutrophication; ME=Marine Eutrophication; FEc=Freshwater Ecotoxicity; MFRD=Mineral and Fossil Resource Depletion; WU=Water use; CEDt=Cumulative Energy Demand - Total

5
Conclusions

Conclusions

Environmental and carbon footprint

- Overall results for year 2021 show that, under a cradle-to-gate approach, the highest environmental impacts are associated with the processes where the use of customized products and other materials is higher and where the long distance transport of raw materials from suppliers take place, as a result, the impact of Underlay 5156 VB grinding colored EVA and agglomeration stage across all LCA impact categories is significant.

- By using natural raw materials, such as EVA wastes, that would otherwise be disposed, Amorim Cork Composites is able to lower the potential environmental impacts stemming from its product, opposed to a scenario where these main inputs would be sourced in the transformation industry, as they are the sole main components of the final product.

- Relevant sources of overall impacts in the carbon footprint are related to the manufacture of purchased customized products and other materials (43% of total GHG emissions), such as binding agents, used in the agglomeration processes, and the transport of raw materials (29%), mainly due to the transport of colored and white EVA. Additionally, the use of polyethylene film and polyurethane glue, used in the transformation and packaging stage, contributes for 18% of the impact.

- Total emissions account for an overall climate change impact of 0,9 kg CO_{2eq} per 1 m^2. Considering the carbon stored in the cork and packaging materials used to produce Underlay 5156 VB (0,2 kgCO_2/ 1 m^2), the carbon footprint of the product is +0,6 kgCO_{2eq} per 1 m^2, under a cradle-to-gate approach.

Carbon sequestration of the cork oak forest

- Considering a scenario analysis, where the carbon sequestration of the cork oak forest can indirectly be attributed to cork products, based on well-managed cork oak forests, a forest carbon uptake up to -6,4 kg CO_2 per 1 m^2 can be observed. Considering both the forest carbon uptake and the GHG emissions of maximum weight Underlay 5156 VB production (0,8 kgCO_2/ 1 m^2), there is a carbon balance up to -5,6 kg CO_{2eq} per 1 m^2. This balance illustrates the differentiating factor between cork and other products.

- As the cork oak tree retains carbon for over 100 years, regardless of cork harvesting, cork exploitation supports the maintenance of the ecosystem, thus having a positive contribution to global climate regulation.

Technical sheet

Technical sheet

Title "Carbon footprint of Underlay 5156 VB : Executive summary"

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