Life Cycle Assessment of Underscreed U36 and U38

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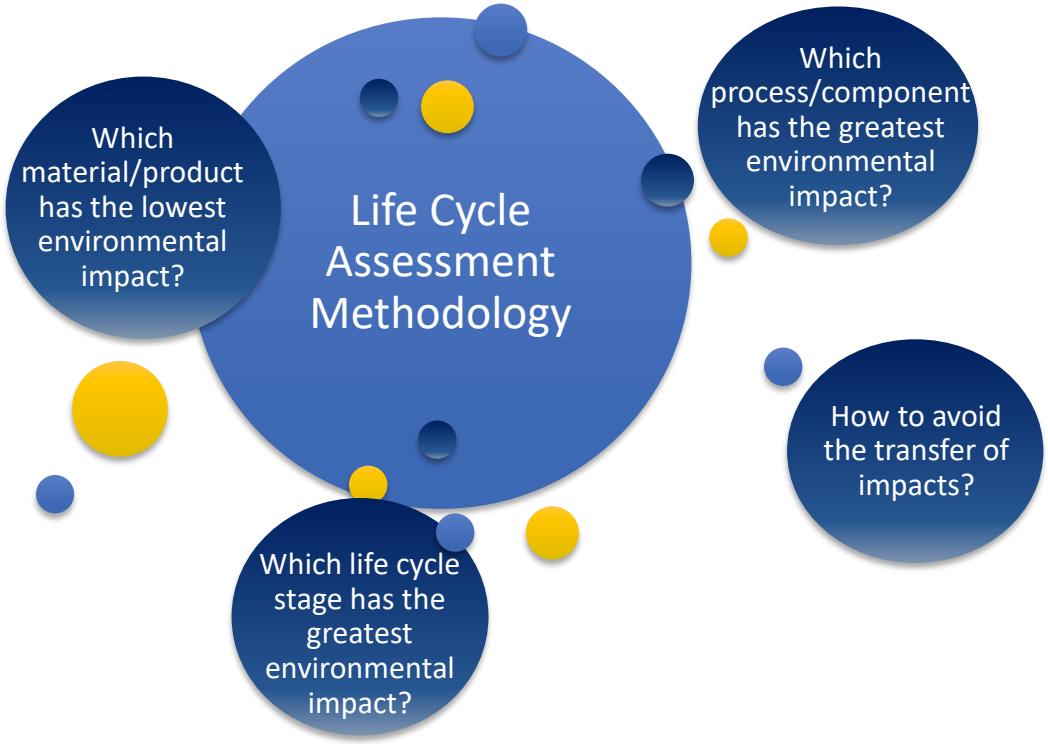
Introduction



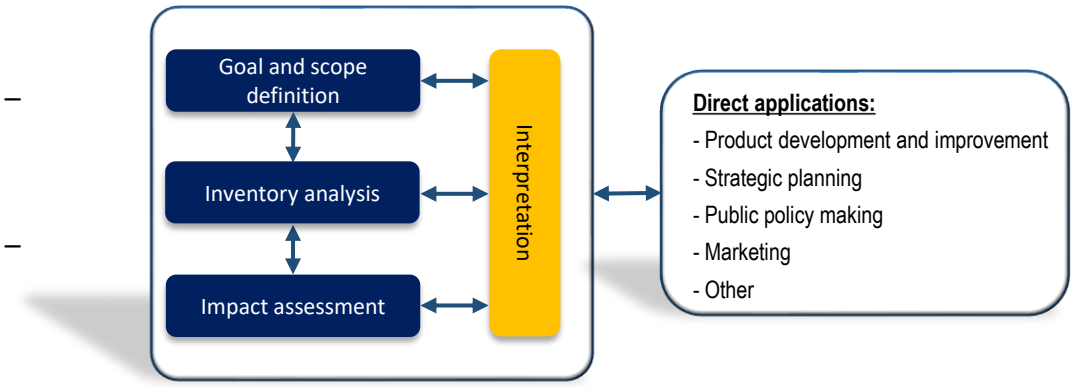
LCA Methodology

Definition

- Life cycle assessment (LCA) is a methodology that analyses input and output flows (mass and energy) during the life cycle (LC) of a product or service from cradle-to-grave, so as to quantify and assess their potential environmental impacts.

Standards:

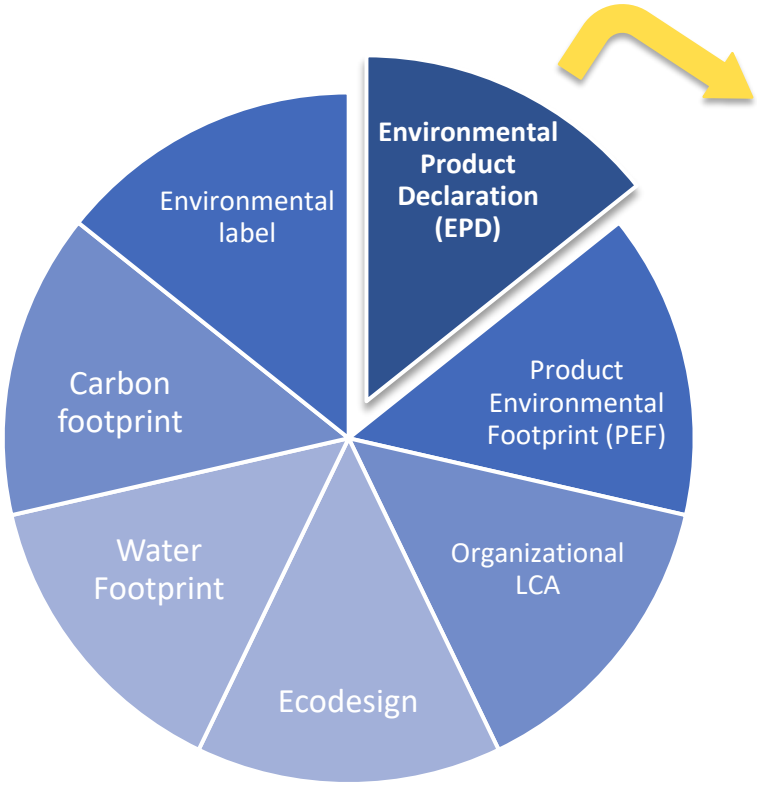
- **ISO 14040:2006** Environmental management – Life cycle assessment – Principles and framework
- **ISO 14044:2006** Environmental management – Life cycle assessment – Requirements and guidelines



ISO 14040:2006

Environmental Communication Tools

Environmental Product Declaration



- Verified and registered document that communicates transparent and comparable data and other relevant environmental information about the life-cycle environmental impact of a product
- Based on the LCA methodology
- ISO 14025; ISO 21930; EN 15804; EN 15942

Environmental Product Declaration

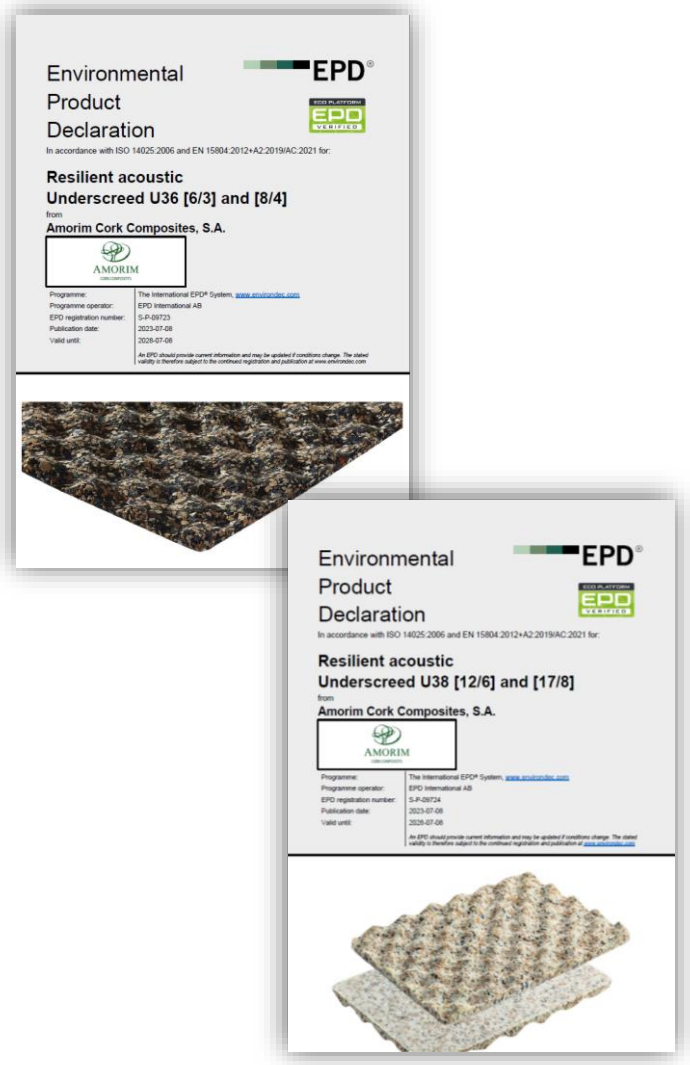
Type III

- Prepared in accordance with Rules for the Product Category (PCR) – common for products with the same functions
- Need to be verified by an independent third party
  (to be considered type III declarations)
- Can be made available in an EPD system

Environmental Product Declaration

Benefits

- Valorization of products based on objective criteria
- Comparison of the environmental impact of products in the same product category
- Possible improvement of negative aspects and objective valorization of positive aspects
- Increased competitiveness of national products
- Elimination of possible export barriers in demanding markets



Life cycle Model

Product Description – U36 [6/3] and [8/4]

Components	% Weight	Materials	% Weight
Product composition Confidential information			

	Underscreed U36 [6/3]	Underscreed U36 [8/4]	Observations
Reference	U36 [6/3]	U36 [8/4]	
Dimensions (m x m)	1X10	1X10	
Thickness (mm)	6/3	8/4	
Weight (kg/m²)	2,16	2,76	
Weight- packed (kg/m²)	2,28	2,89	
Impact noise reduction | ΔL_w (dB)	25	27	as per ISO 10140-3 and ISO 717-2
Impact insulation class | IIC (dB)	53	53	as per ASTM E2179-03, ASTM E492-09, ASTM E989-18 and ASTM E2235-04
Specific Weight (kg/m³)	370-500		as per ASTMF1315 and ISO 7322
Tensile Strength (KPa)	≥200		as per ASTMF152 and ISO 7322
Cp level (mm)	<1		as per ISO 092/19 and ISO 7322
Thermal Conductivity (W/mK)	0,0751		as per ASTM D297
Fire Classification	E/Efl		as per EN 13501-1 and ISO 11925

Life cycle Model

Product Description – U38 [12/6] and [17/8]

Components	% Weight	Materials	% Weight
Product composition Confidential information			

	Underscreed U38 [12/6]	Underscreed U38 [17/8]	Observations
Reference	U38 [12/6]	U38 [17/8]	
Dimensions (m x m)	1X11	1X8	
Thickness (mm)	12/6	17/8	
Weight (kg/m^2)	3,18	4,35	
Weight- packed (kg/m^2)	3,33	3,39	
Impact noise reduction | ΔL_w (dB)	29	31	as per ISO 10140-3 and ISO 717-2
Impact insulation class | IIC (dB)	61	63	as per ASTM E2179-03, ASTM E492-09, ASTM E989-18 and ASTM E2235-04
Specific Weight (kg/m^3)	274		as per ASTMF1315 and ISO 7322
Tensile Strength (KPa)	207		as per ASTMF152 and ISO 7322
Cp level (mm)	2		as per ISO 092/19 and ISO 7322
Thermal Conductivity (W/mK)	0,0546		as per ASTM D297
Fire Classification	E/Efl		as per EN 13501-1 and ISO 11925

Life Cycle Model

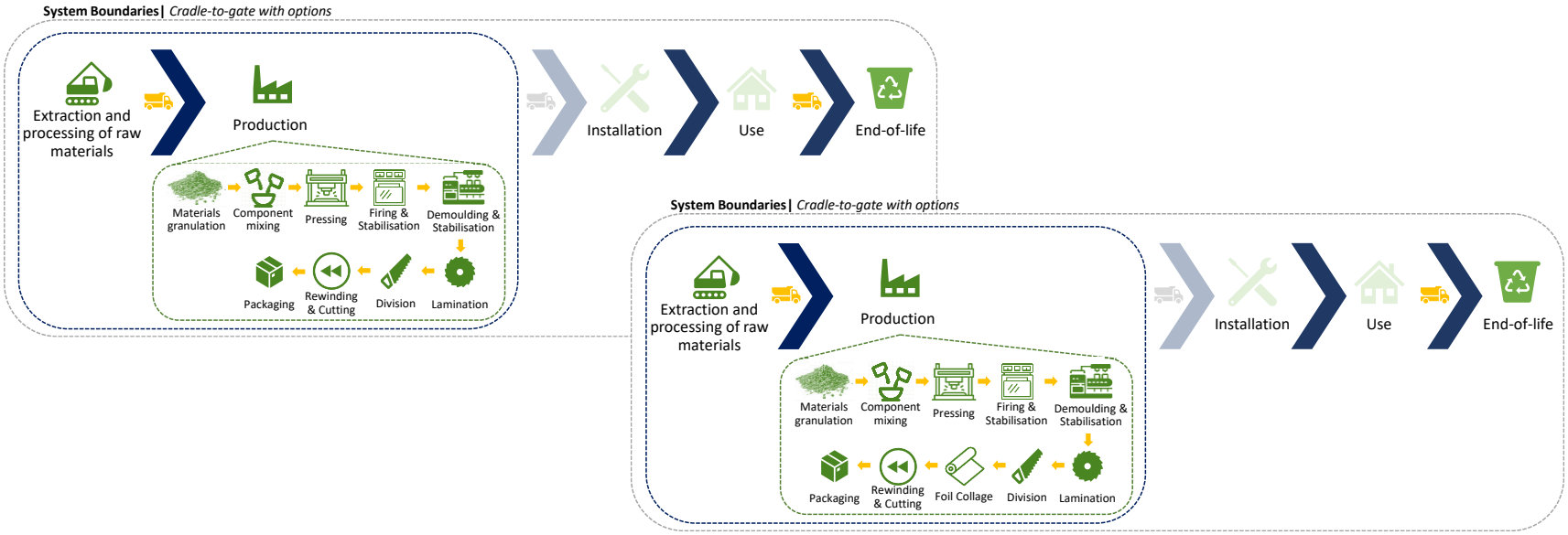
Context and Objective of the LCA Study

Goals:

- To determine the environmental impacts of the resilient acoustic Underscreeds – U36 [6/3], U36 [8/4] U38 [12/6] and U38 [17/8] produced by ACC in order to obtain EPD of these products on the basis of EN 15804:2012+A2:2019

Functional unit :

- 1 m^2 of resilient acoustic underscreed installed during 50 years with unclassified sound absorption (packaging included)



Life Cycle Model

System Boundaries

Product stage [A1-A3]:

Modules A1-A3 cover the extraction, production and acquisition of the main raw materials and pre-products, as well as electricity and fuel production. Transport of all raw materials considered in module A1 to the factory gate and production of the final products including waste and emissions.

Construction process stage [A4-A5]:

This study does not cover the construction process stage.

Use stage [B1-B7]:

This study does not cover the use stage.

End of life stage [C1-C4]:

- Module C1

The demolition of Underscreeds is associated with the demolition of the building, so the contribution of the demolition of this type of product was considered not relevant.

Life Cycle Model

System Boundaries

- Module C2

In the transport of the Underscreed U36 and U38 waste, it was considered that the waste operators are within a radius of 50 km.

- Module C3

It was considered that the residues of the system are not processed before their disposal.

- Module C4

At the end-of-life stage, a scenario of landfill (100 %) was considered, based on EUROSTAT 39/2019 report and primary information from the manufacturer.

Resource recovery stage [D]:

At present there are no processes for re-use or recovery and the potential benefits beyond the system boundaries (D) are therefore zero.

Life Cycle Model

Main Assumptions

ACV *cradle-to-gate with options*:

- To model the inputs of raw materials and pre-products, their composition was considered according to technical and safety data sheets of the suppliers
- A percentage of additional material (by mass) was considered, in order to include losses in the production process
- To model transportation to the factory, the information about the type of transport and the location of the supplier was considered
- For energy production, the Portuguese energy grid mix of Ecoinvent v3.9.1 was used
- To account for energy consumption, counters, point measurements and estimates based on the quantities produced, were taken into consideration

Life cycle Impacts Assessment

Methods

Impact Category	Indicator	Unit
Climate change – total	**GWP|T**	kg CO_2 eq.
Climate change – fossil	**GWP|F**	kg CO_2 eq.
Climate change – biogenic	**GWP|B**	kg CO_2 eq.
Climate change – land use and land use change	**GWP|L**	kg CO_2 eq.
Ozone Depletion	**ODP**	kg CFC-11 eq.
Acidification	**AP**	mol H+ eq.
Eutrophication aquatic freshwater	**EP|Fw**	kg P eq.
Eutrophication aquatic marine	**EP|M**	kg N eq.
Eutrophication terrestrial	**EP|T**	mol N eq.
Photochemical ozone formation	**POCP**	kg NMVOC eq.
Depletion of abiotic resources – minerals and metals	**ADP|MM**	kg Sb eq.
Depletion of abiotic resources – fossil fuels	**ADP|F**	MJ
Water use	**WDP**	m^3 world eq. deprived

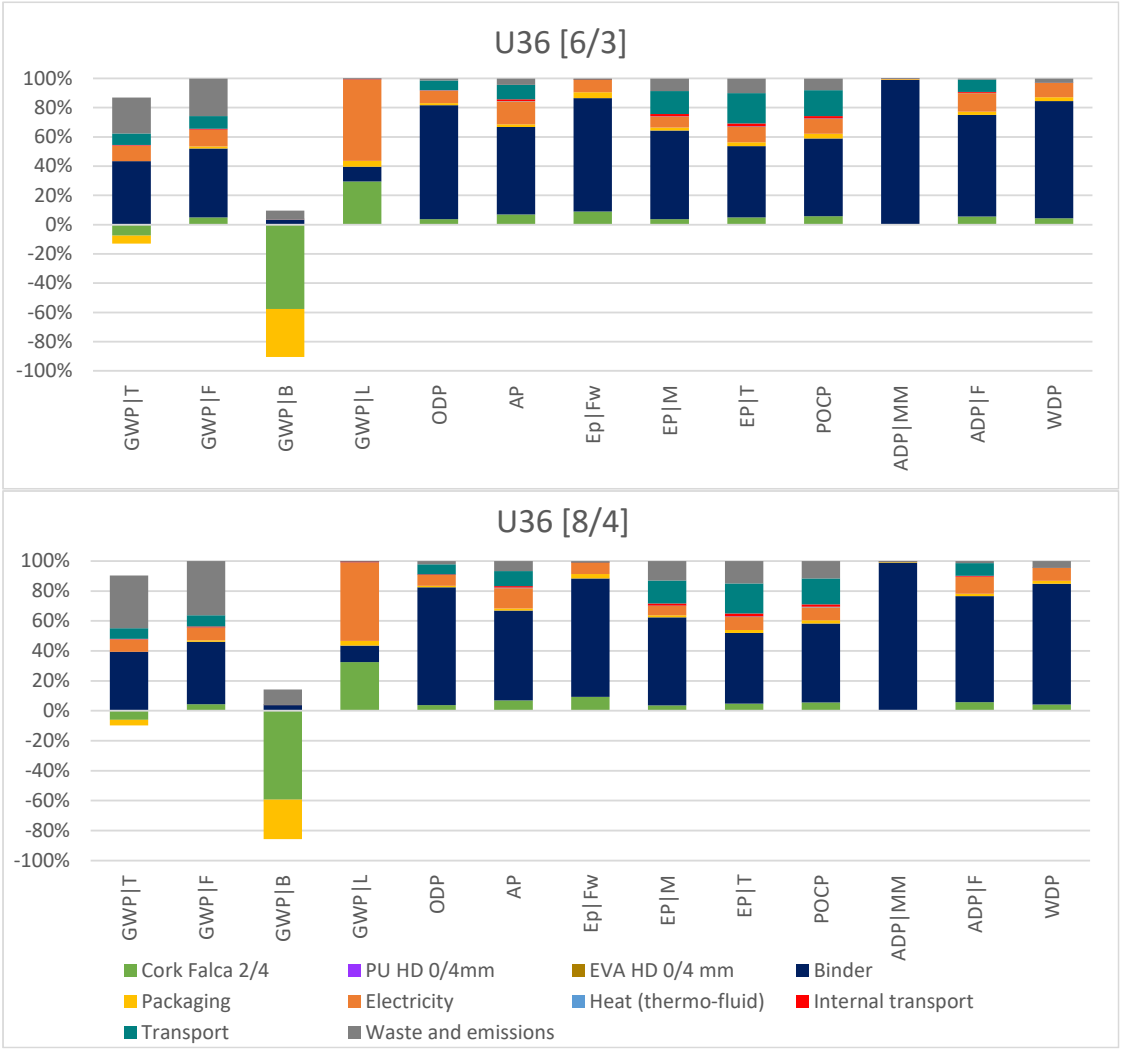
Database:
Ecoinvent v3.9.1 and EF Database v2.0

Software:
SimaPro v9.5

Results U36

- Cradle-to-gate | For Inventory Element

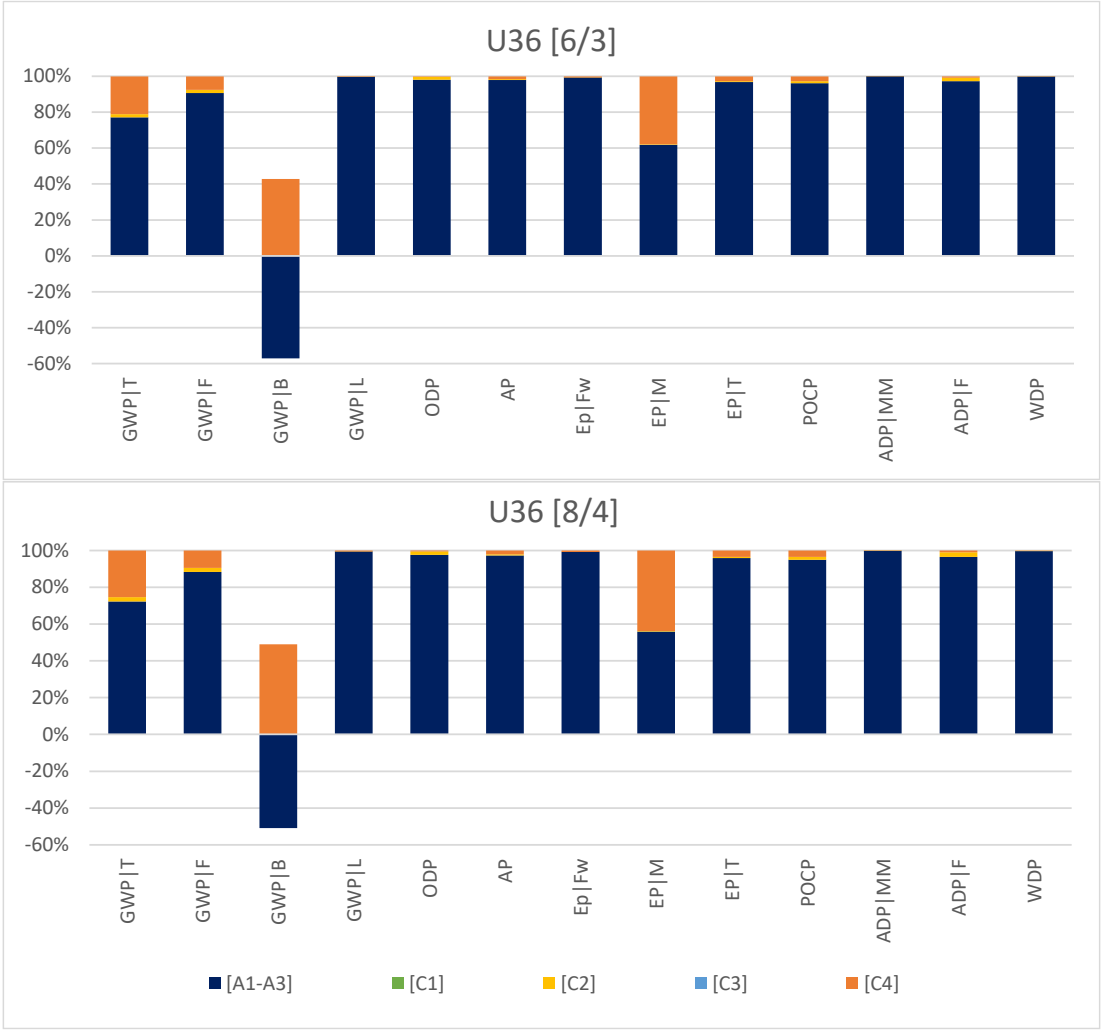
- Inventory elements that most contribute to the environmental impact are:
  - Binder (48.8 – 58.7% of GWP|T, 41.7 – 47.1% of GWP|F, 78.0 – 78.7% of ODP, 59.9 – 60.0% of AP, 77.5 – 79.2% of EP|Fw, 58.9 – 60.7% of EP|M, 47.3 – 48.8% of EP|T, 53.2 – 54.0 of POCP, 99.0% of ADP|MM, 69.4 – 70.9% of ADP|F and 80.2 – 80.7% of WDP)
  - Electricity (52.5 – 55.7% of GWP|L)
  - Transport
  - Waste and emissions
- GWP|B: Cork Falca 2/4 (as a benefit), since the cork oak stores CO_2 during the photosynthesis process



Results U36

- Cradle-to-gate with options

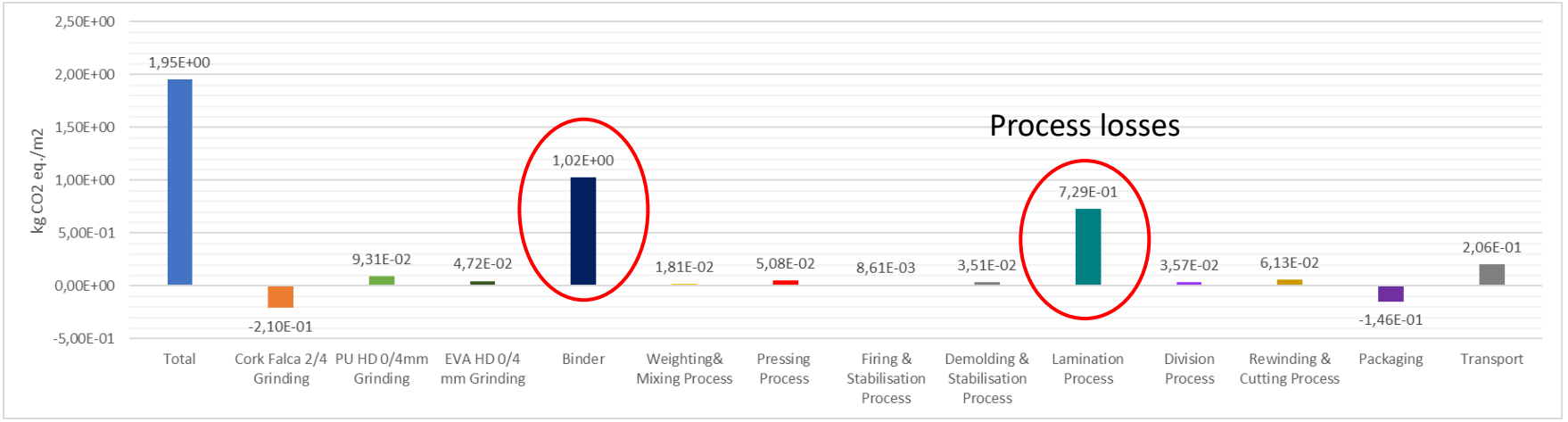
- Product stage [A1-A3] has the highest impact
- GWP|B: Disposal [C4] has a significant contribution - due to the release of CO_2 sequestered in the product
- EP|M: [C4] has a significant contribution



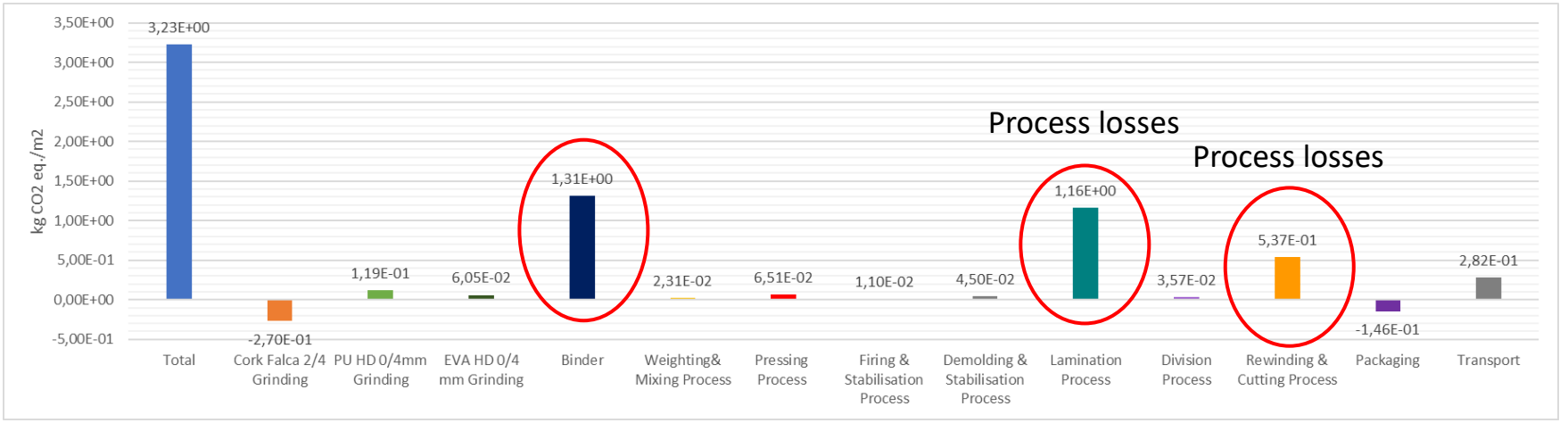
Results U36

Cradle-to-gate | GWP

U36 [6/3]



U36 [8/4]

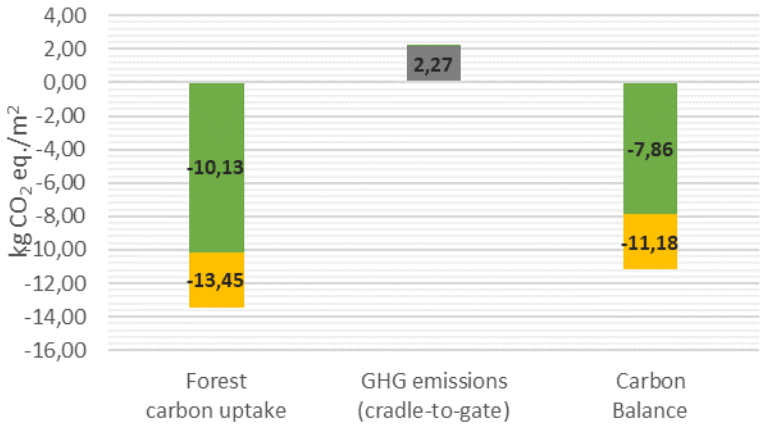


Results U36

Carbon Balance

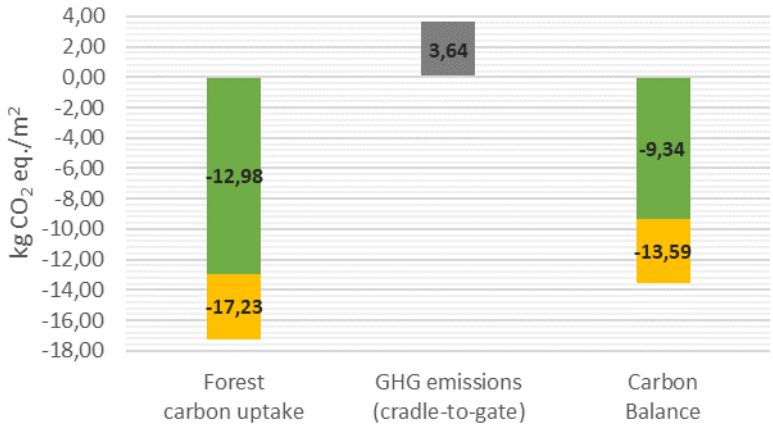
U36 [6/3]

	1 m2 U36 [6/3] - cradle-to-gate		
	Forest carbon uptake	**GHG emissions (cradle-to-gate)**	**Carbon Balance**
Average uptake (using -55 t CO_2/t of cork extracted)	-10,13	2,27	-7,86
Maximum uptake (using -73 t CO_2/t of cork extracted)	-13,45	2,27	-11,18



U36 [8/4]

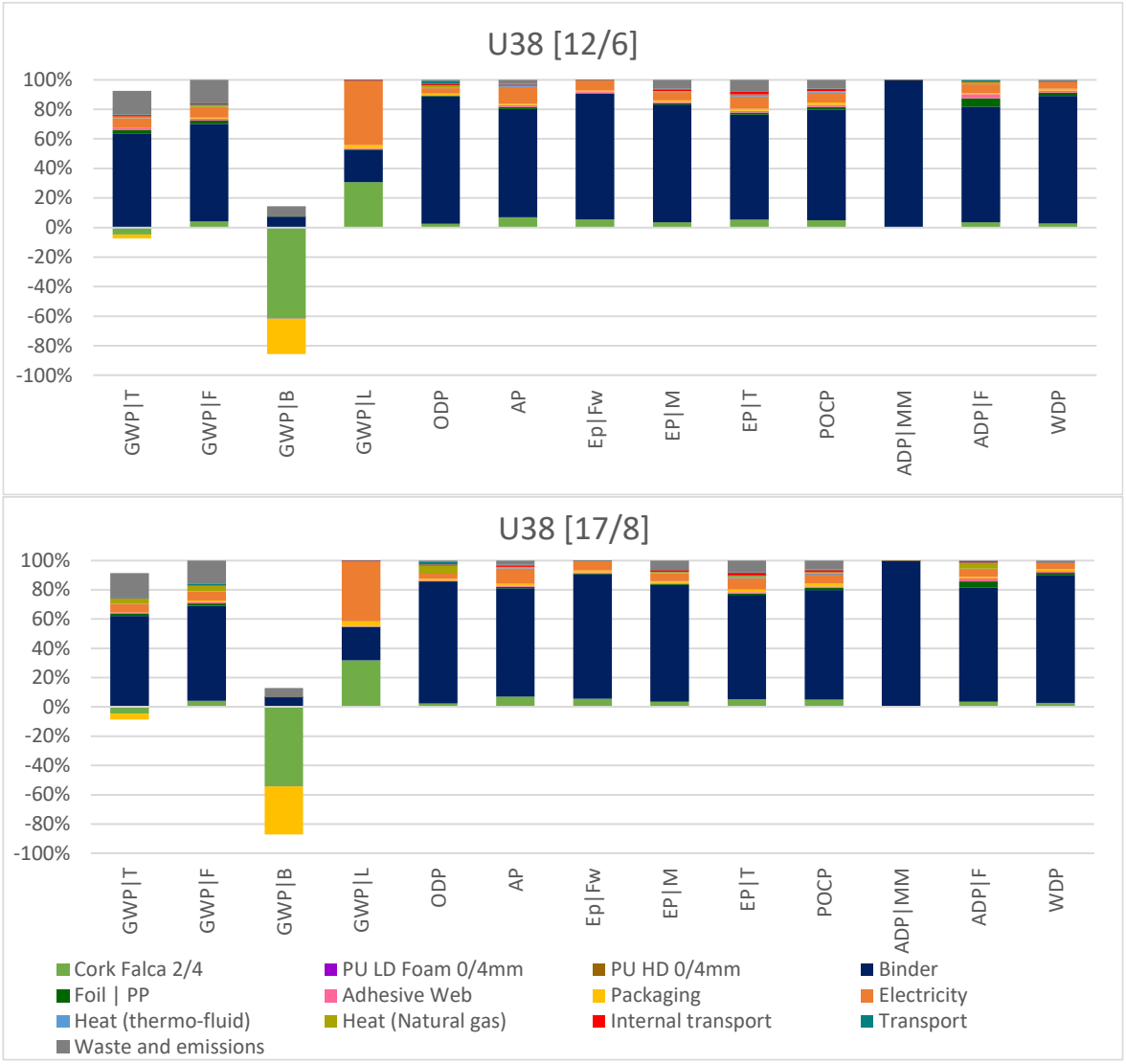
	1 m2 U36 [8/4] - cradle-to-gate		
	Forest carbon uptake	**GHG emissions (cradle-to-gate)**	**Carbon Balance**
Average uptake (using -55 t CO_2/t of cork extracted)	-12,98	3,64	-9,34
Maximum uptake (using -73 t CO_2/t of cork extracted)	-17,23	3,64	-13,59



Results U38

- Cradle-to-gate | For Inventory Element

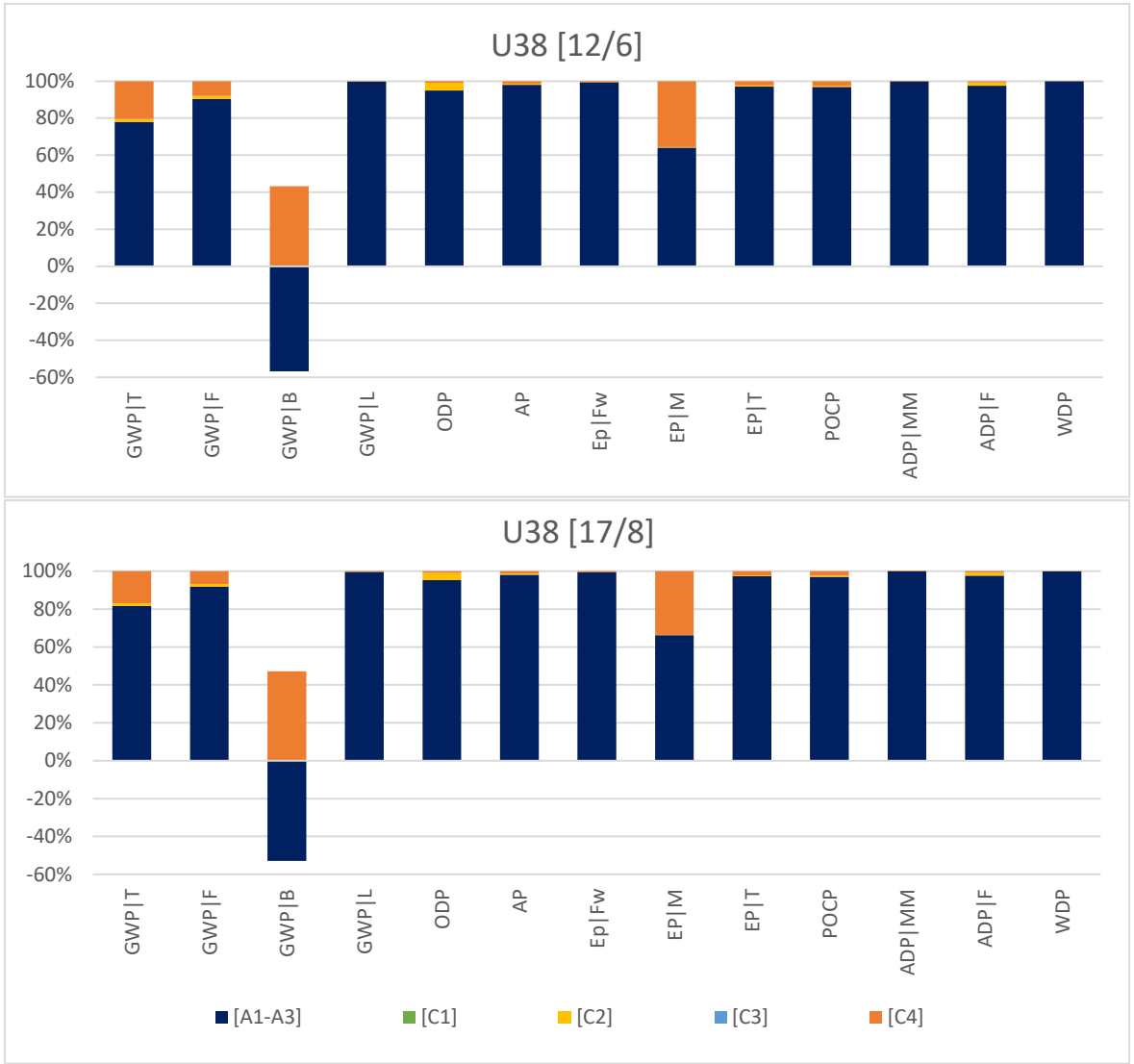
- Inventory elements that most contribute to the environmental impact are:
  - Binder (74.6 – 74.7% of GWP|T, 63.5 – 64.8% of GWP|F, 85.5 – 88.7% of ODP, 77.6 – 78.3% of AP, 86.9% of EP|Fw, 80.9 – 81.1% of EP|M, 72.6 – 72.8% of EP|T, 74.3 – 74.8% of POCP, 99.5% of ADP|MM, 77.7 – 77.9% of ADP|F and 87.0 – 88.1% of WDP)
  - Electricity (41.3 – 44.0% of GWP|L)
  - Waste and emissions
- GWP|B: Cork Falca 2/4 (as a benefit), since the cork oak stores CO_2 during the photosynthesis process



Results U38

- Cradle-to-gate with options

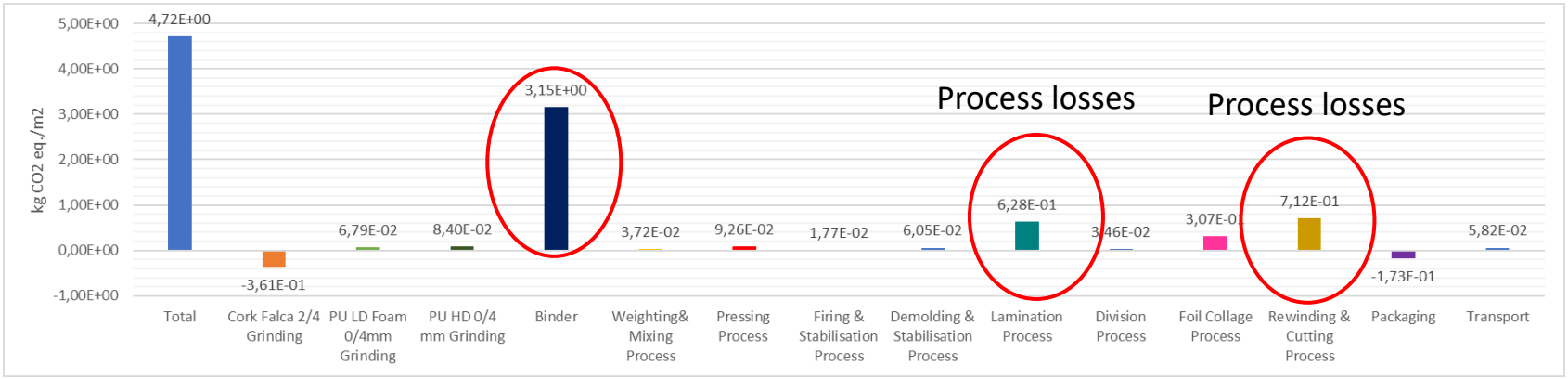
- Product stage [A1-A3] has the highest impact
- GWP|B: Disposal [C4] has a significant contribution - due to the release of CO_2 sequestered in the product
- EP|M: [C4] has a significant contribution



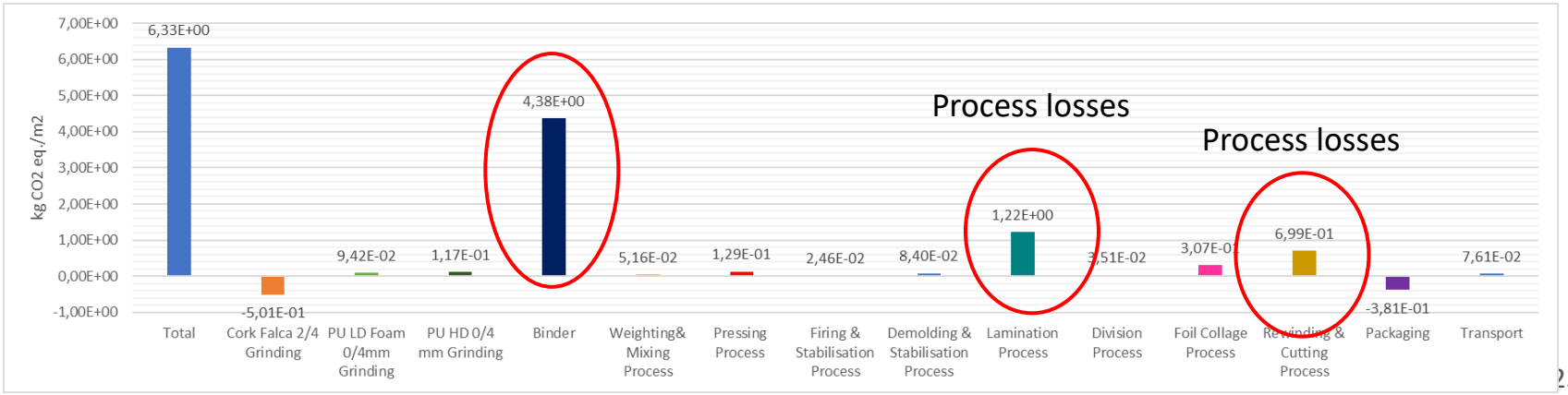
Results U38

Cradle-to-gate | GWP

U38 [12/6]



U38 [17/8]

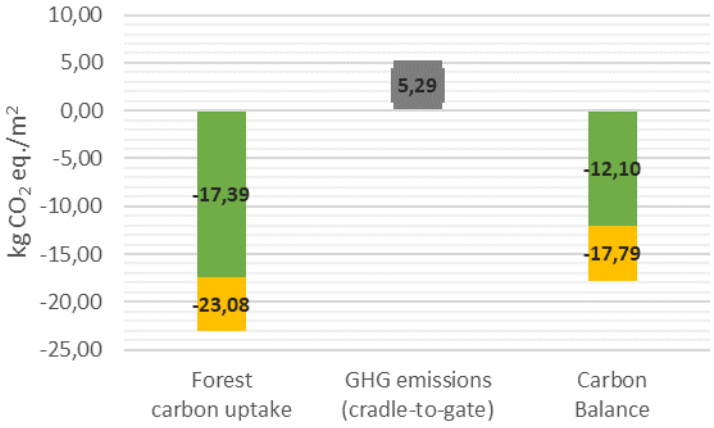


Results U38

Carbon Balance

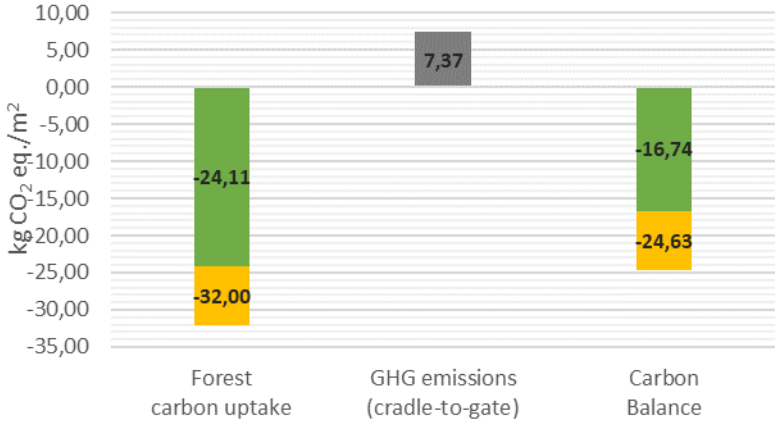
U38 [12/6]

	1 m2 U38 [12/6] - cradle-to-gate		
	Forest carbon uptake	**GHG emissions (cradle-to-gate)**	**Carbon Balance**
Average uptake (using -55 t CO_2/t of cork extracted)	-17,39	5,29	-12,10
Maximum uptake (using -73 t CO_2/t of cork extracted)	-23,08	5,29	-17,79



U38 [17/8]

	1 m2 U38 [17/8] - cradle-to-gate		
	Forest carbon uptake	**GHG emissions (cradle-to-gate)**	**Carbon Balance**
Average uptake (using -55 t CO_2/t of cork extracted)	-24,11	7,37	-16,74
Maximum uptake (using -73 t CO_2/t of cork extracted)	-32,00	7,37	-24,63



Conclusions

With this study it was concluded that:

- Cork used in the production of Underscreeds U36 [6/3], U36 [8/4], U38 [12/6] U38 [17/8] contributes with a negative impact (benefit) to GWP (-0.32, -0.41, -0.55 and -0.76 kg CO_2 eq., respectively), due to the storage of carbon throughout its life cycle, until its final disposal;
- The inventory elements that most contribute to the environmental impact of the Underscreeds U36 and U38 in study are binder, electricity, transport and waste and emissions;
- The product stage [A1-A3] has the highest impact for Underscreeds U36 and U38 and for all categories.