

Assessing the circularity and sustainability of circular carpets – a demonstration of circular life cycle sustainability assessment

APPENDIX

Anna Luthin, Robert H. Crawford, Marzia Traverso

i Life cycle inventory data for the reference CE approach

Table I: Life cycle inventory data for the defined FU for the reference CE approach (recycled and bio-based content in production, disposal at EoL).

	Input / Output	Data source	Amount	Dataset used in GaBi	Assumptions and justification
Yarn production (primary nylon)					
Input	Nylon [kg]	EPD Interface (2020)	0.59091	<i>Process:</i> RoW: market for nylon 6 ecoinvent 3.8	
	Electricity [kWh]	Bressanelli & Saccani (2023)	0.32166	<i>Process:</i> US: Electricity from wind power Sphera	Electricity for extrusion (in reference for PP granulate, same amount of required energy assumed); Electricity consumption only applies for primary nylon as already included in EPD for recycled nylon
	Electricity from biogas [kWh]	Bressanelli & Saccani (2023)	0.032398	<i>Process:</i> US: Electricity from biogas Sphera	Electricity for extrusion (in reference for PP granulate, same amount of required energy assumed); biogas assumed because of bio focus of studied object; Electricity consumption only applies for primary nylon as already included in EPD for recycled nylon
	Recycled nylon [kg]	EPD Interface (2020) EPD AQUAFIL (2020)	0.40909	<i>Process:</i> SVN: Recycled nylon 6 yarn Aquafil	7% post- and 2% pre-consumer recycled nylon use of recycled yarn from carpets and fishing nets (stated as procedure by interface for reEntry program --> produced in Slovenia (Ajdovščina)) process created based on EPD from Aquafil (delivery excluded)
Output	Yarn mix for carpet [kg]		1		

	Input / Output	Data source	Amount	Dataset used in GaBi	Assumptions and justification
Transport of nylon 6					
	Distance [km]	Google Maps	150 km	GLO: Truck, Euro 5, 20 - 26t gross weight / 17.3t payload capacity Sphera; US: Diesel mix at filling station Sphera	Truck transport from Cartersville (Georgia, USA) to Troup County (Georgia, USA); 17.3t payload assumed
Transport of recycled nylon 6					
	Distance [km]	Google Maps https://www.fluentcargo.com/routes/slovenia/united-states#ocean-routes	65 km	GLO: Truck, Euro 5, 20 - 26t gross weight / 17.3t payload capacity Sphera EU-28: Diesel mix at filling station Sphera	Ajdovščina to Koper (Slovenia); 17.3t payload assumed
			10,571	GLO: Container ship, 5,000 to 200,000 dwt payload capacity, ocean going Sphera EU-28: Heavy fuel oil at refinery (1.0wt.% S) Sphera	Koper (Slovenia) to Miami (USA)
			1053	GLO: Truck, Euro 5, 20 - 26t gross weight / 17.3t payload capacity Sphera US: Diesel mix at filling station Sphera	Miami to Troup County (USA); 17.3t payload assumed
Primary backing (Pre- & post-consumer recycled polyester)					
Input	PET waste [kg]	EPD Inteface (2020)	1.32	USA: PET waste	Solely PET collection assumed; dummy created for modelling
	Water [kg]	Perugini et al. (2005)	2.96	US: water production, completely softened ecoinvent 3.8	
	Sodium hydroxide [kg]	Perugini et al. (2005)	0.003	EU-28: Sodium hydroxide, chlor-alkali production mix PlasticsEurope	EU dataset as not US data available
	Electricity [kWh]	Perugini et al. (2005)	0.2916667	Process: US: Electricity from wind power Sphera	For compaction and reprocessing
	Electricity from naural gas [kWh]	Perugini et al. (2005)	0.694444	US: Electricity from biogas gas Sphera	From Methan in original source but natural gas in two more recent studies; but bio focus for object of the studa --> biogas assumes

	Input / Output	Data source	Amount	Dataset used in GaBi	Assumptions and justification
Output	Primary backing [kg]		1		Data refers to the production of recycled PET; the further processing into backing is neglected
Precoat backing					
Input	Vinyl acetate emulsion [kg]	EPD Inteface (2020)	0.45455	Process: GLO: market for vinyl acetate ecoinvent 3.8	
	Limestone [kg]	EPD Inteface (2020)	0.27273	DE: Limestone flour (0.1mm) Sphera	Pre-consumer recycled limestone according to EPD but no data found for recycled limestone and production outside Germany
	Alumina trihydrate [kg]	EPD Inteface (2020)	0.27273	Process: GLO: market for aluminium hydroxide ecoinvent 3.8	
	Electricity [kWh]	Estimation	0.3857	Process: US: Electricity from wind power Sphera	
Output	Precoat backing [kg]		1		Estimation: similar for kWh/kg as other processes: average of energy required for yarn production, primary backing, and carpet production
Stabilization layer					
Input	Fiberglass mat [kg]		1	RER: Continuous filament glass fibre (assembled rovings) APFE/ELCD	
Output	Stabilization layer [kg]		1		Data refers to the production of glass fiber rovings; the further processing into mats is neglected
Secondary backing					
Input	Bio-based filler [kg]	EPD Inteface (2020)	0.444444444	DE: Fleece from mixed fibre (Flax, Hemp, Sisal) Sphera	
	Bioester [kg]	EPD Inteface (2020)	0.253968254	US: esterification of soybean oil ecoinvent 3.8	
	Ethylene vinyl acetate [kg]	EPD Inteface (2020)	0.174603175	RoW: market for ethylene vinyl acetate copolymer ecoinvent 3.8	
	Biobased oil [kg]	EPD Inteface (2020)	0.031746032	RoW: market for rape oil, crude ecoinvent 3.8	

	Input / Output	Data source	Amount	Dataset used in GaBi	Assumptions and justification
	Limestone [kg]	EPD Inteface (2020)	0.063492063	DE: Limestone flour (0.1mm) Sphera	Pre-consumer recycled limestone according to EPD but no data found for recycled limestone and production outside Germany
	Antioxidant [kg]	EPD Inteface (2020)	0.015873016	GLO: market for pentaerythritol ecoinvent 3.8	
	Polypropylene [kg]	EPD Inteface (2020)	0.015873016	EU-28: Polypropylene (PP) - fabric Sphera	
	Electricity [kWh]	Estimation	0.3857	Process: US: Electricity from wind power Sphera	Estimation: similar for kWh/kg as other processes: average of energy required for yarn production, primary backing, and carpet production
Output	Precoat backing [kg]		1		
Carpet production					
Input	Yarn [kg]	EPD Inteface (2020)	0.616	created plan	
	Primary backing [kg]	EPD Inteface (2020)	0.084	created plan	
	Precoat backing [kg]	EPD Inteface (2020)	0.308	created plan	
	Stabilization layer [kg]	EPD Inteface (2020)	0.028	created plan	
	Secondary backing [kg]	EPD Inteface (2020)	1.746	created plan	
	Energy [kWh]	Bressanelli & Saccani (2023)	0.071	Process: US: Electricity from wind power Sphera	Same amount as for carding & needling assumed
	Packaging [kg]	EPD (2020)	0.018	Process: US: Containerboard Sphera/AF&PA	Remaining 0.018kg assumed to be packaging
Output	Carpet tile [kg]	EPD Inteface (2020)	2.8		
Transport of carpet tiles					
	Distance [km]	EPD Inteface (2020)	805	GLO: Truck, Euro 5, 20 - 26t gross weight / 17.3t payload capacity Sphera US: Diesel mix at filling station Sphera	Information according to given EPD: Truck34-40 tonnes, 85% capacity utilization --> 14.7 t payload assumed

	Input / Output	Data source	Amount	Dataset used in GaBi	Assumptions and justification
Installation into building					
Input	Carpet tile [kg]	EPD Inteface (2020)	2.8		
	Ancillary materials [kg]	EPD Inteface (2020)	0.107	EU-28: Water-based acrylic adhesive for PVC flooring (approximation) Sphera	Pressure sensitive adhesive
Output	Installed carpet tile [kg]	EPD Inteface (2020)	2.58		
	Waste [kg]	EPD Inteface (2020)	0.22	EU-28: Textiles on landfill (no credit for energy recovery from landfill gas) Sphera	Value slightly adapted from EPD; no energy credit assumed for energy recovery from landfill gas
Maintenance (0.004 kg other resources per year neglected)					
Input	Installed carpet [kg]	EPD Interface (2020)	2.58		
	Water consumption [kg]	EPD Interface (2020)	28.95	US: water production, completely softened ecoinvent 3.8	1.93 kg/year
	Cleaning agent [kg]	EPD Interface (2020)	0.105	Process: GLO: Soaping agent (fatty etholxylate amines solution) Sphera	0.007 kg/year
	Energy input [kWh]	EPD Interface (2020)	6.66667	US: Electricity grid mix Sphera	1.6 MJ/year
Output	Maintained carpet [kg]	EPD Interface (2020)	2.58		
Transport of carpet waste					
	Distance [km]	EPD Interface (2020)	32	GLO: Truck, Euro 5, 20 - 26t gross weight / 17.3t payload capacity Sphera US: Diesel mix at filling station Sphera	14.7 t payload assumed
Carpet EoL					
Input	Maintained carpet [kg]	EPD Interface (2020)	2.58		
Output	Waste (landfill) [kg]	EPD Interface (2020)	2.4721	EU-28: Textiles on landfill (no credit for energy recovery from landfill gas) Sphera	3 kg according to EPD; recalculated according to tile weight; no energy credit assumed for energy recovery from landfill gas
	Waste (incineration) [kg]	EPD Interface (2020)	0.1079	EU-28: Waste incineration of textile fraction in municipal solid waste (MSW) ELCD/CEWEP	0.131 kg according to EPD; recalculated according to tile weight

ii Cost data for the different CE approaches for of the defined FU

Table II: Cost data used for the life cycle costing of the defined FU for the reference CE approach (recycled and bio-based content in production, disposal at EoL). Future costs which are not included in the table can be obtained by using the inflation rate on the related values in the table.

	Costs [\$] per unit	Data source	Assumption and justification
Alumina trihydrate [kg]	0.8	https://joyreach-china.en.made-in-china.com/product/vFXABJgMErGZ/China-H-Wf-25-50-Chalco-Ath-Filler-Alumina-Trihydrate-for-Acrylic-Solid-Surface-Pantry-Tops-Kitchen-Tops.html	Price for October 2023 in China: 400 - 900 USD/t → higher end assumed for US
Ancillary materials [kg]	2.021	http://www.yourvirtualwarehouse.com/Sundries-Tools/Carpet-Adhesives/Adhesive-Carpet-AAT-275-Ultra-Premium-4-gallon	18.64 USD/ Gallon & 1 Gallon for 11yd ² → 1.69 USD per yd ² → 1yd ² = 0.836127m ² → 2.021 USD/m ²
Antioxidant [kg]	2.3	https://www.chemanalyst.com/Pricing-data/pentaerythritol-1147	Price Q3 2023
Bio-based filler [kg]	0.64	https://www.globalsources.com/Sisal-fiber/sisal-fiber-1196194675p.htm	Many different options
Biobased oil [kg]	1.026	https://ycharts.com/indicators/rapeseed_oil_price	Price for rapeseed oil in the US from September 2023
Bioester [kg]	1.44	https://www.indiamart.com/proddetail/methyl-soyate-soybean-oil-methyl-ester-19694119873.html	120 Rupie/kg for industry in India November 2023 converted to USD on 6 November 2023
Cargo (Ship) [km]	4	https://www.freightos.com/freight-resources/ocean-freight-explained/#:~:text=Sea%20Freight%20Rates%20per%20kg,-With%20the%20exception&text=Ocean%20freight%20is%20around%20%242,days%20quicker%2C%20but%20more%20expensive.	2-4 \$ per kg (all way) → as from Europe, higher end of price range assumed
Cleaning agent [kg]	14.31901983	https://www.lowes.com/pl/Carpet-cleaning-solution-Floor-cleaning-Cleaning-supplies/4294598981	Price October 2023 USA: 12.99 USD per 0.907185 kg ESTIMATE PRICE FOR EACH YEAR IN 15 YEARS → average inflation rate last 15 years: 2.33 → $0.007 \cdot 14.32 + 0.007 \cdot 14.32 \cdot (1.0233^1) + 0.007 \cdot 14.32 \cdot (1.0233^2) + \dots + 0.007 \cdot 14.32 \cdot (1.0233^{14})$
Electricity [kWh]	0.1171	Choose Energy – Electricity Rates by State https://www.chooseenergy.com/electricity-rates-by-state/	Price for business electricity rate in Georgia from July 2023 (Price per state also given)
Electricity from biogas [kWh]	0.195	https://iea.blob.core.windows.net/assets/03aeb10c-c38c-4d10-bcec-de92e9ab815f/Outlook_for_biogas_and_biomethane.pdf https://www.aqper.com/en/how-much-energy-is-there-in-biogas#:~:text=Each%20cubic%20meter%20of%20biogas,and%20applied%20to%20other%20uses. https://www.irena.org/news/articles/2017/Mar/Biogas-Cost-Reductions-to-Boost-Sustainable-Transport#:~:text=Typically%20the%20price%20of%20producing,industrial%20waste%2Dbased%20biogas%20production.	Prices for electricity from biogas higher than regular electricity mix; estimated production costs 2017 0.22-0.39 USD per m ³ ; 1m ³ biogas results in 2 kwh electricity; assumption → as price higher as costs, the higher end of the given range assumed as price

	Costs [\$] per unit	Data source	Assumption and justification
Electricity from natural gas [kWh]	0.032	https://www.eia.gov/outlooks/steo/report/elec_coal_renew.php	Estimated for 2024
Energy [kWh]	0.1171	Choose Energy – Electricity Rates by State https://www.chooseenergy.com/electricity-rates-by-state/	Price for business electricity rate in Georgia from July 2023 (Price per state also given)
Energy input [kWh]	0.1171	Choose Energy – Electricity Rates by State https://www.chooseenergy.com/electricity-rates-by-state/	Price for business electricity rate in Georgia from July 2023 (Price per state also given)
Ester [kg]	2.3	https://tianmagroup.en.made-in-china.com/product/csNTDyklrOta/China-Bisphenol-a-BPA-Epoxy-Vinyl-Ester-Resin.html	ESTIMATE PRICE FOR EACH YEAR IN 15 YEARS → average inflation rate last 15 years: 2.33 → $0.4444*0.1171+0.4444*0.1171*(1.0233^1)+0.4444*0.1171*(1.0233^2)+0.4444*0.1171*(1.0233^14)$ lower price range, Noveber 2023
Ethylene vinyl acetate [kg]	1.862	https://www.chemanalyst.com/Pricing-data/ethylene-vinyl-acetate-74	Price for Q2 in Asia (assumed to be representable for USA in relation to prior values)
Fiberglass mat [kg]	1.35	https://zhongshengglassfiber.en.made-in-china.com/product/YEiRQMwLsphF/China-Factory-Price-225g-Chopped-Strand-Fiberglass-Mat-Filament-Fiber-Glass-Mats.html	Price from October 2023 in China
Filler [kg]	0.39	https://businessanalytiq.com/procurementanalytics/index/calcium-carbonate-price-index/	Calcium carbonate price US, September 2023
Limestone [kg]	0.188	https://www.indexbox.io/blog/lime-price-per-ton-may-2022/	Price for US May 2022
Natural gas [kWh]	0.043	https://www.globalpetrolprices.com/USA/natural_gas_prices/#	For business in US, March 2023
Nylon [kg]	2.6	https://businessanalytiq.com/procurementanalytics/index/pa6-price-index/	Price from October 2023 for USA
Packaging [kg]	0.865	https://www.wsj.com/livecoverage/stock-market-news-today-03-20-2023/card/cardboard-box-prices-stop-falling-for-now-OZrRIGjsLrrypjMaWhmD	Benchmark grade of containerboard in March 2023
Personnel (Cleaner, US) [h]	39	https://www.maintenance-one.com/commercial-cleaning-rates-chart-2022-2023/	Average 39 USD/h; estimation 2 sec / m ² & 5 times per week for 50 week per year → 0,139h / year
Personnel Slovenia [h]	25.22	https://data.si/en/blog/labor-cost-per-hour-slovenia-is-below-the-european-average/	ESTIMATE PRICE FOR EACH YEAR IN 15 YEARS → average inflation rate last 15 years: 2.33 → $0.139*39+0.139*39*(1.0233^1)+0.139*39*(1.0233^2)+0.139*39*(1.0233^14)$ 23.1 € in USD (25.22 USD (18.11.23))

	Costs [\$] per unit	Data source	Assumption and justification
Personnel US [h]	47.68	https://www.bls.gov/regions/southwest/news-release/employercostsforemployeecompensation_regions.htm#:~:text=Overall%2C%20compensation%20costs%20among%20private,up%20the%20remaining%2029.4%20percent.	Georgia: Middle Atlantic (47.68 AUD)
PET waste [kg]	0.454	https://www.scrapmonster.com/scrap-yard/price/plastic-scrap/337#google_vignette	0.453592 USD /kg
Polyester [kg]	1.35	https://businessanalytiq.com/procurementanalytics/index/polyester-price-index/	Price US September 2023
Polypropylene [kg]	1.13	https://businessanalytiq.com/procurementanalytics/index/polypropylene-price-index/	Price from October 2023 in USA
Recycled nylon [kg]	1.75	Price received via Mail on the 23.10.2023	Price obtained from China for USA; price would include shipment to any port in USA - however, as price for Europe is estimated to be higher, shipment costs are added to this price 443.12 EUR for 12t for total distance → 0.037€/kg Conversion to USD 6/11/2023
Road transport Slovenia [km]	0.04	https://app.zipmend.com/v2/en/booking/full-truck-24-t/price	1.04 - 2.45 USD per mile per truckload carrier → 1.674 - 3.945 USD per km 0.00023 USD per kg per km (high end)
Road transport US [km]	0.00023	https://www.freightwaves.com/news/understanding-total-operating-cost-per-mile	
Sodium hydroxide [kg]	0.37	https://businessanalytiq.com/procurementanalytics/index/sodium-hydroxide-price-index/	Price from October 2023 for USA
Vinyl acetate emulsion [kg]	2.46	https://www.intratec.us/chemical-markets/ethylene-vinyl-acetate-price	2.01 USD/kg in Nov. 2018 → cumulative inflation rate USA 2018-2023: 22,6% → 2.01*1,226
Waste (incineration) [kg]	0.1111	https://www.energyjustice.net/incineration/expensive-waste	2019 - Incineration (Pennsylvania): incineration \$64.43/ton vs landfill \$47.86/ton → ratio for cost assumed (1.3462)
Waste (landfill) [kg]	0.05847	https://resource-recycling.com/recycling/2023/06/12/us-landfilling-costs-jumped-sharply-last-year/	Price for landfill for unweighted average in 2022 ESTIMATE PRICE FOR IN 15 YEARS → average inflation rate last 15 years: 2.33 -- >>0.05847*(1.0233^15)
Water [kg]	0.0026	https://www.statista.com/statistics/1232861/tap-water-prices-in-selected-us-cities/	Price for Atlanta (2021) assumed

iii **Environmental impacts related to the different CE concepts for 1 m² carpet tile as floor covering**

Table III: Global warming potential of the defined FU for the different CE approaches for carpet tiles in kg CO₂ eq.

	S1_rb_dis	S2_rb_rec	S3_rb_dis_ex	S4_nm_dis	S5_nm_rec	S6_nm_dis_ex
Yarn production	3.6608	3.6608	3.6608	5.7041	5.7041	5.7041
Primary backing	0.0118	0.0118	0.0118	0.4421	0.4421	0.4421
Precoat backing	0.3319	0.3319	0.3319	0.3319	0.3319	0.3319
Stabilization layer	0.0562	0.0562	0.0562	0.0562	0.0562	0.0562
Secondary backing	-0.0833	-0.0833	-0.0833	2.8406	2.8406	2.8406
Carpet production	-0.0207	-0.0207	-0.0207	-0.0207	-0.0207	-0.0207
Carpet installation	0.3363	0.3363	0.3363	0.3363	0.3363	0.3363
Maintenance	3.2570	3.2570	3.2570	3.2570	3.2570	3.2570
Disposal (EoL)	3.0114	0.0000	0.6023	3.0114	0.0000	0.6023
Transport	0.2365	0.9224	0.2755	0.2365	0.9224	0.2755
Carpet tile exchange	0.0000	0.0000	0.8586	0.0000	0.0000	1.9381
Total	10.7979	8.4724	9.2863	16.1953	13.8698	15.7632

Table IV: Acidification potential of the defined FU for the different CE approaches for carpet tiles in kg SO₂ eq.

	S1_rb_dis	S2_rb_rec	S3_rb_dis_ex	S4_nm_dis	S5_nm_rec	S6_nm_dis_ex
Yarn production	0.0140	0.0140	0.0140	0.0186	0.0186	0.0186
Primary backing	0.0005	0.0005	0.0005	0.0020	0.0020	0.0020
Precoat backing	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019
Stabilization layer	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Secondary backing	0.0085	0.0085	0.0085	0.0135	0.0135	0.0135
Carpet production	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Carpet installation	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Maintenance	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Disposal (EoL)	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000
Transport	0.0005	0.0082	0.0006	0.0005	0.0082	0.0006
Carpet tile exchange	0.0000	0.0000	0.0051	0.0000	0.0000	0.0073
Total	0.0313	0.0389	0.0364	0.0426	0.0501	0.0499

Table V: Eutrophication potential of the defined FU for the different CE approaches for carpet tiles in kg Phosphate eq.

	S1_rb_dis	S2_rb_rec	S3_rb_dis_ex	S4_nm_dis	S5_nm_rec	S6_nm_dis_ex
Yarn production	0.0035	0.0035	0.0035	0.0045	0.0045	0.0045
Primary backing	0.0001	0.0001	0.0001	0.0010	0.0010	0.0010
Precoat backing	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Stabilization layer	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Secondary backing	0.0093	0.0093	0.0093	0.0142	0.0142	0.0142
Carpet production	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Carpet installation	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Maintenance	0.0012	0.0012	0.0012	0.0012	0.0012	0.0012
Disposal (EoL)	0.0041	0.0000	0.0008	0.0041	0.0000	0.0008
Transport	0.0002	0.0012	0.0002	0.0002	0.0012	0.0002
Carpet tile exchange	0.0000	0.0000	0.0029	0.0000	0.0000	0.0042
Total	0.0199	0.0168	0.0195	0.0267	0.0236	0.0276

Table VI: Photochemical ozone creation potential of the defined FU for the different CE approaches for carpet tiles in kg ethene eq.

	S1_rb_dis	S2_rb_rec	S3_rb_dis_ex	S4_nm_dis	S5_nm_rec	S6_nm_dis_ex
Yarn production	0.0013	0.0013	0.0013	0.0019	0.0019	0.0019
Primary backing	0.0000	0.0000	0.0000	0.0003	0.0003	0.0003
Precoat backing	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Stabilization layer	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Secondary backing	0.0010	0.0010	0.0010	0.0018	0.0018	0.0018
Carpet production	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Carpet installation	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Maintenance	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Disposal (EoL)	0.0007	0.0000	0.0001	0.0007	0.0000	0.0001
Transport	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002
Carpet tile exchange	0.0000	0.0000	0.0005	0.0000	0.0000	0.0009
Total	0.0035	0.0028	0.0035	0.0051	0.0045	0.0054

iv Selected results of the sensitivity analysis

Table VII: MCI of the defined FU for the different CE approaches for carpet tiles.

	S1_rb_dis	S2_rb_rec	S3_rb_dis_ex	S4_nm_dis	S5_nm_rec	S6_nm_dis_ex
Use of cut-off approach and consideration of L/L_{av}	0.36	0.76	0.71	0.11	0.51	0.60
Use of cut-off approach and consideration of L/L_{av} – no sustained production of bio-based materials	0.15	0.56	0.62	0.11	0.51	0.60
Use of cut-off approach and exclusion of L/L_{av}	0.36	0.76	0.57	0.11	0.51	0.41

Exemplary, the MCI was calculated using the 50:50 approach instead of the cut-off approach for two selected scenarios (chosen as recycling at the EoL and recycled content for one of these scenarios). Using the traditional MCI formula would lead to a value of 0.74 for S2_rb_rec and a value of 0.49 for S5_nm_rec.