Duni Group

Product carbon footprint

Update on new packaging ranges and data

Appendix to the study of Bio Dunisoft and Bio Dunicel, 21 February 2022

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Appendix

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6 Annex – Update: New packaging ranges and new data on OrganoClick binder

6.1 Background

The goal of this study is to update the cradle-to-grave carbon footprint of Duni's paper-based products Bio Dunisoft and Bio Dunicel from February 2022. Since the original analysis, new packaging ranges have been developed. To evaluate the sustainability impacts of these new product ranges, Duni has asked South Pole to update the existing carbon footprint study.

The following six products have been added and/or updated within the scope of this update:

Table 22: Products under study

Product	Packaging type
Bio Dunisoft	PP packaging (60 pcs) (40x40cm)
Bio Dunisoft	Glassine paper packaging (40x40cm)
Bio Dunicel	Plastic window packaging (PP) (30x40cm)
Bio Duniletto	Plastic window packaging (PET) (40x33cm)
Bio Dunisoft	Cardboard packaging, packs of 50 and 100 pieces (20x20cm)
Bio Elegance	PP packaging (40x40cm)
Bio Dunisoft	PP packaging (12 pcs) (40x40)

Bio Dunisoft and Bio Dunicel are a new line of materials that differ from their predecessors by using bio-based binding agents rather than plastic-based ones. The difference between the bio and non-bio-based products was already assessed in the original study.

6.2 New data

The update from the original PCF study is necessary, as new packaging types have been developed for the Bio Dunisoft and Bio Dunicel products. In addition, new data on the bio-based binder from Duni's supplier OrganoClick is available.

6.3 Changes to the calculation

The methodology of the PCF calculation remains the same as in the original study.

The functional unit (FU) chosen was 1 m^2 of product. The packaging was also included within the system. The lifetime of the material is considered for one use since the material is only directed for single use.

The system boundary for the assessment covers the life cycle from cradle to grave. This includes the production of kraft pulp and other raw materials, the manufacturing process, the production of packaging materials, transportation between stages, and waste outputs. The use phase for the products under study was not evaluated. The distribution of the final products was estimated based on average transportation distances from freight in Europe, derived from Eurostat.

Some of the emission factors were updated. These updates include:

- Cardboard: refining recycled content modelling;
- More detailed information on Organoclick's binder composition was available; thus, emission factors were adapted accordingly.

The changes in the results due to the update of the cardboard emission factor are not significant. However, the impacts from the Organoclick binder noticeably decreased. The calculated emission factor for Organoclick's bio-based binder decreased from 0.93 to 0.45 kgCO_2e/kg of binder. This decrease is not due to changes in the manufacturing process, but because more detailed information was provided regarding the binder's composition and the raw materials used.

GHG emissions from the Bio Duniletto product were calculated based on data for Bio Dunisoft, and GHG emissions from Bio Elegance product were calculated based on data for Bio Dunicel. The different folding is assumed to have negligible impacts on the results.

6.4 Results and conclusions

6.4.1 Relative GHG emission reduction for bio-based products compared to original non-bio-based products

The following figure 8 shows the reduction in GHG emissions for the bio-based version of the studied products compared to the non-bio-based version with the same packaging.
Overall, bio-based products allow reducing lifecycle GHG emissions. For the Dunisoft products, the reduction is around 14.7% to 19.3%, while for the Dunicel products the reduction is up to 28.4%.

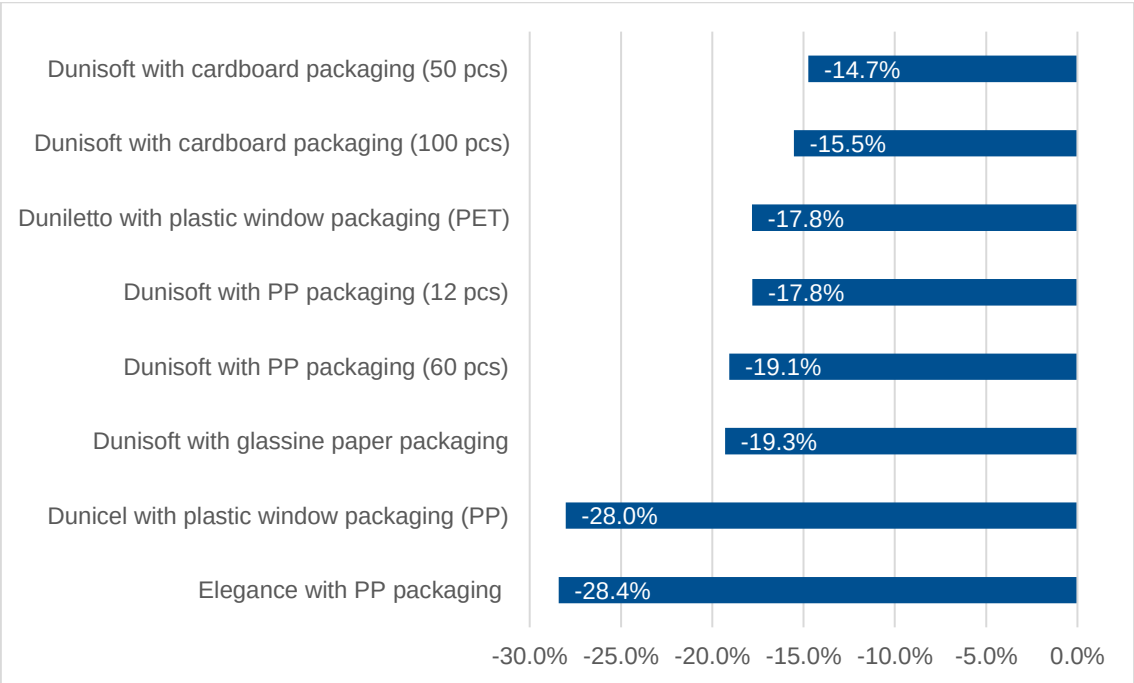

Figure 8: GHG emission reductions for bio-based products compared to non-bio-based products

6.4.2 Absolute GHG emissions of bio-based and non-bio-based products

Tables 23 and 24 below show the absolute GHG emissions of the studied Dunisoft products. As can be seen, the GHG emissions from the raw materials for Bio Dunisoft products are slightly lower than for non-bio-based Dunisoft products, with 46.8 gCO_2e/FU and 55.8 gCO_2e/FU, respectively, as the bio-based binder has a lower carbon footprint than the non-bio one. Plus, the disposal of the bio-products, which is assessed in an average scenario based on average waste management methods in Europe, also has lower GHG emissions. Only landfill, incineration and recycling are considered for non-bio-based products, while for bio-based products the disposal is

extended to composting and anaerobic digestion (see table 4 in the original study for more details).

Table 23: Comparison of bio-based and non-bio-based Dunisoft and Duniletto with plastic packaging

	PP packaging (60 pcs)		PP packaging (12 pcs)		Plastic window packaging (PET)	
Life cycle stage	GHG emissions (gCO2e)		GHG emissions (gCO2e)		GHG emissions (gCO2e)	
	BioDunisoft	Dunisoft	BioDunisoft	Dunisoft	BioDuniletto	Duniletto
Raw materials acquisition and processing	46.8	55.8	46.8	55.8	46.8	55.8
Transport - raw materials (retailer to factory)	9.1	9.1	9.1	9.1	9.1	9.1
Transport - raw materials - losses	0.0	0.0	0.0	0.0	0.0	0.0
Packaging materials acquisition and processing	5.9	5.9	12.2	12.2	11.0	11.0
Transport - packaging materials (retailer to factory)	0.1	0.1	0.4	0.4	0.6	0.6
Transport - packaging material - losses	0.0	0.0	0.0	0.0	0.0	0.0
Manufacturing process	0.711	0.7	0.711	0.7	0.711	0.7
Manufacturing waste	0.1	0.7	0.1	0.7	0.1	0.7
Distribution from Sweden to Germany	5.7	5.7	6.0	6.0	6.1	6.2
Disposal product	16.2	27.3	16.2	27.3	16.2	27.3
Disposal packaging	3.4	3.4	4.1	4.1	4.8	4.8
Total (with average disposal)	88.0	108.7	95.6	116.3	95.5	116.2
% lower life cycle emissions with bio-based materials	**-19.1%**		**-17.8%**		**-17.8%**	

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Table 24: Comparison of bio-based and non-bio-based Dunisoft with paper and cardboard packaging

	Glassine paper packaging		Cardboard packaging (50 pcs)		Cardboard packaging (100 pcs)	
Life cycle stage	GHG emissions (gCO2e)		GHG emissions (gCO2e)		GHG emissions (gCO2e)	
	BioDunisoft	Dunisoft	BioDunisoft	Dunisoft	BioDunisoft	Dunisoft
Raw materials acquisition and processing	46.8	55.8	46.8	55.8	46.8	55.8
Transport - raw materials (retailer to factory)	9.1	9.1	9.1	9.1	9.1	9.1
Transport - raw materials - losses	0.0	0.0	0.0	0.0	0.0	0.0
Packaging materials acquisition and processing	5.2	5.2	26.5	26.5	22.0	22.0
Transport - packaging materials (retailer to factory)	0.1	0.1	0.3	0.3	0.2	0.2
Transport - packaging material - losses	0.0	0.0	0.0	0.0	0.0	0.0
Manufacturing process	0.711	0.7	0.711	0.7	0.711	0.7
Manufacturing waste	0.0	0.7	0.1	0.7	0.1	0.7
Distribution from Sweden to Germany	5.7	5.7	7.8	7.9	7.3	7.4
Disposal product	16.2	27.3	16.2	27.3	16.2	27.3
Disposal packaging	2.8	2.8	12.4	12.4	10.3	10.3
Total (with average disposal)	86.7	107.4	119.9	140.6	112.7	133.4
% lower life cycle emissions with bio-based materials	**-19.3%**		**-14.7%**		**-15.5%**	

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Table 25 shows the results for Dunicel and Elegance products. The bio-based products perform significantly better in terms of GHG emissions. This is partly because of the disposal, but also thanks to the updated raw material composition which amounts to 102.8 gCO_2e/FU compared to 123.4 gCO_2e/FU.

Table 25: Comparison of bio-based and non-bio-based Dunicel and Elegance

	Dunicel, plastic window packaging (PP)		Elegance, PP packaging	
Life cycle stage	GHG emissions (gCO2e)		GHG emissions (gCO2e)	
	BioDunicel	Dunicel	BioElegance	Elegance
Raw materials acquisition and processing	102.8	123.4	102.8	123.4
Transport - raw materials (retailer to factory)	11.4	11.4	11.4	11.4
Transport - raw materials - losses	0.0	0.0	0.0	0.0
Packaging materials acquisition and processing	15.5	15.5	15.0	15.0
Transport - packaging materials (retailer to factory)	0.2	0.2	0.3	0.3
Transport - packaging material - losses	0.0	0.0	0.1	0.1
Manufacturing process	13.4	15.8	13.4	15.8
Manufacturing waste	0.3	1.0	0.3	1.1
Distribution from Sweden to Germany	14.0	13.7	13.4	13.1
Disposal product	38.9	95.2	38.9	95.2
Disposal packaging	8.6	8.6	5.7	5.7
Total (with average disposal)	205.0	284.8	201.2	281.0
% lower life cycle emissions with bio-based materials	**-28.0%**		**-28.4%**	

6.4.3 Comparison of analysed packaging types

Figure 9 below shows the total GHG emissions for each Bio Dunisoft product assessed. The PP packaging and the paper packaging perform better than the cardboard packaging. The 50 pieces cardboard packaging increases the GHG emissions by 25.4 % compared to the PP packaging and 38.4 % compared to the paper packaging. However, the 100-pack cardboard packaging

allows to slightly decrease the GHG emissions per functional unit of 1 m2 product compared to the 50-pack.

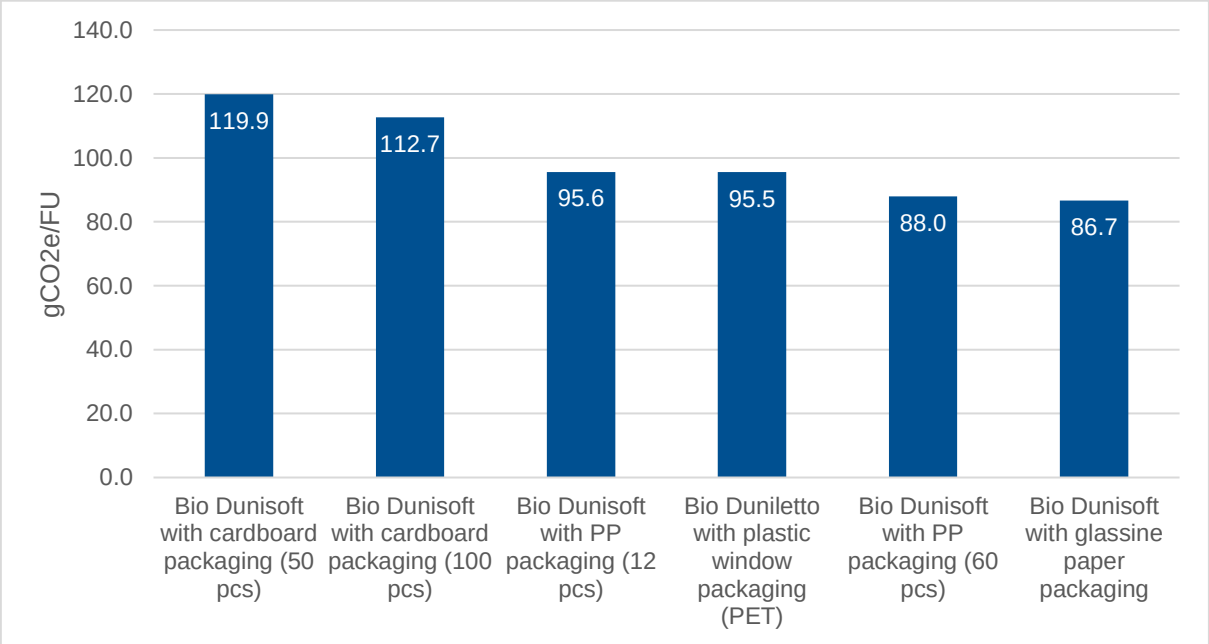

Figure 9. Lifecycle GHG emissions of Bio Dunisoft products for the different packaging types under study

Figure 10 shows the total GHG emissions for Bio Dunicel and Bio Elegance. The Bio Elegance with a PP cast performs slightly better than Bio Dunicel, however the impacts are close as the difference between both is less than 2 %.

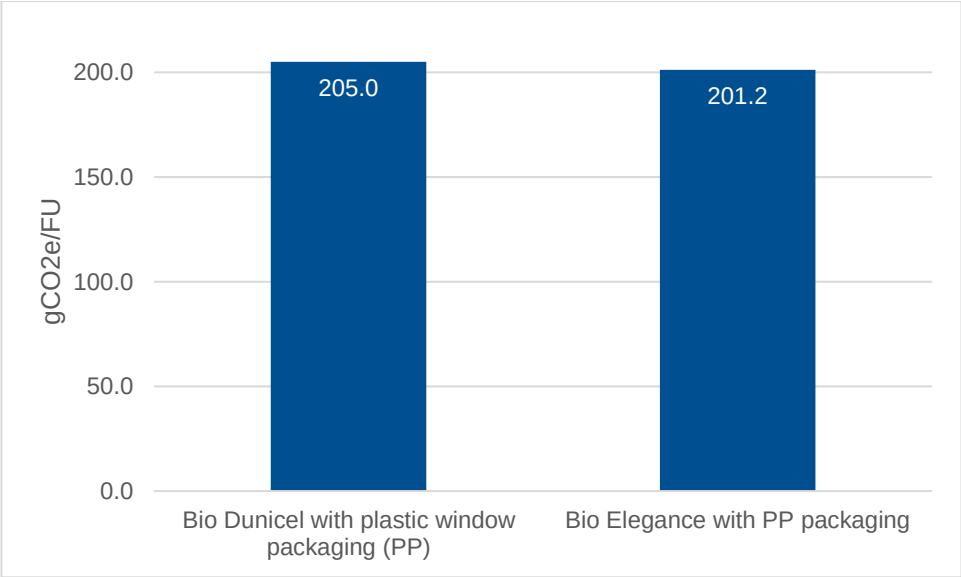

Figure 10. Lifecycle GHG emissions of Bio Dunicel and Bio Elegance


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