Report KA19-634_1
Year 2019

CO_2 footprint analysis

BioPanel vs. Trespa/HPL panel and aluminium panel

Document title:	CO_2 footprint analysis BioPanel from AbelLeisure vs. Trespa/HPL panel and aluminium panel
Document type:	[Categorie]
Project name:	CO_2 footprint BioPanel AbelLeisure
Project number:	KA19-634
Customer:	AbelLeisure
Authors:	Sven Jurgens and Helle Trapnes
Status:	Final

KNN Advies BV
Advies, Onderzoek & Projectontwikkeling
Duinkerkenstraat 13
9723 BN Groningen
tel.: 050 3175550

email: info@knnadvies.nl
internet: www.knnadvies.nl
Besloten Vennootschap
KvK: 57016712

Table of contents

1 INTRODUCTION AND SCOPE ... 3
2 FUNCTIONAL UNIT ... 4
3 INVENTORY ... 4
3.1 DATA COLLECTION ... 5
4 IMPACT ASSESSMENT AND INTERPRETATION ... 8
4.1 CO_2 FOOTPRINT "CRADLE TO GATE" BIOPANEL, TRESPA/HPL AND ALUMINIUMPANEEL ... 8
4.2 USE PHASE ... FOUT! BLADWIJZER NIET GEDEFINIEERD.
4.3 END-OF-LIFE SCENARIOS (RECYCLING AND COMBUSTION) ... 11
4.4 UNCERTAINTIES ... FOUT! BLADWIJZER NIET GEDEFINIEERD.
5 RESTRICTIONS ... 13
6 CONCLUSION ... 14
7 SOURCES ... FOUT! BLADWIJZER NIET GEDEFINIEERD.

1 Introduction and scope

AbelLeisure produces a biocomposite sheet material of hemp fibre and PLA, under the name 'BioPanel'. AbelLeisure wants to know how their product scores in terms of CO_2-emissions compared to two other materials:

1) The common material made of High Pressure Laminate (HPL; among others sold under the name 'Trespa'). Mentioned Trespa/HPL in this report.
2) Aluminium

The aim of this research is therefore to perform a CO_2 footprint analysis for all three of the products and to make a comparison of these. The outcome of the analysis will shed light on the potential environmental benefits of BioPanel compared to conventional products. The results of the analysis can be used for communication and substantiation in the tendering process for customers. The CO_2 analysis can also be used to identify the key hotspots within the production chain and to determine where the improvements in the CO_2 score are possible. And then view how action can be taken to realise these improvements.

2 Functional Unit

The functional unit (FU) of the products is 1 m^2. The products being compared are a shaped panel with the same foil as "sign" with similar strength and functional lifespan, in all cases, the pole or scaffold on which the sign is mounted is not part of the analysis.

The specifications of the three products are indicated in Table 1.

Tablel 1: Product specifications

Product		Functional Unit (FU)	Thickness	Density
BioPanel		1 m^2	8 mm	1270 kg/m^3
Trespa/HPL			8 mm	1350 kg/m^3
Aluminium			3 mm	2700 kg/m^3

3 Inventory

The approach on the CO_2 footprint analysis is based on the LCA methodology (of the Greenhouse gas protocol; WBSCD) (8) with Global Warming Potential (in CO2 equivalents) as the only indicator. The CO_2 analysis is an iterative process between the following 4 phases: delimitation, inventory, impact analysis, and interpretation. See Figure 1. It is important to remember that there are a series of uncertainties behind the amount of kg CO_2 eq. in the impact analysis. The numbers give an indication of the amount of CO_2 released, but it is not final. That is why the results in the rapport should be interpreted as an indication.

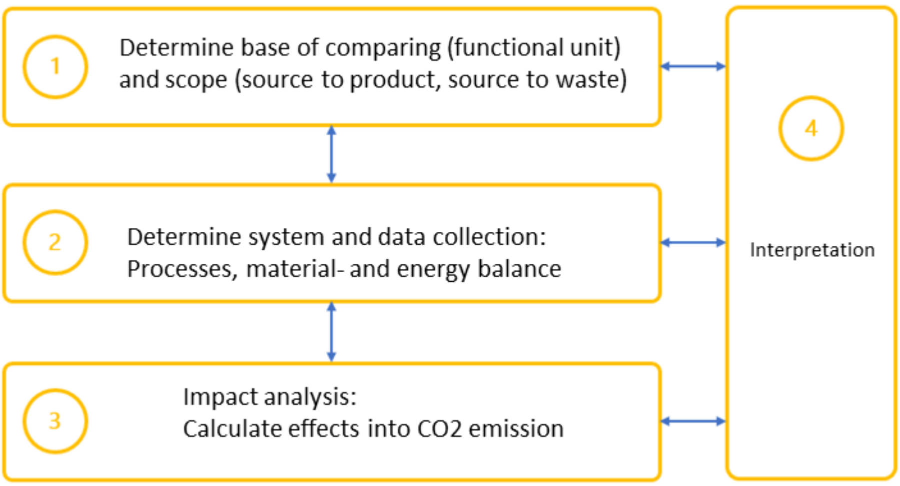


Figure 1: Representation of the process at a LCA/CO_2 footprint analysis.

3.1 Data collection

The CO_2 analysis is of the type "cradle-to-gate", i.e. from raw material to product, for all three products. In addition, for the BioPanel two different "End-of-life" (EoL) were taken into consideration, namely recycling and combustion. For the Trespa/HPL panel, only combustion is considered and EoL option. For the aluminium panel, 75 % is recycled at the EoL as given by the European Aluminium Association (9), and the remaining 25 % is landfilled.

3.1.1.1 BioPanel

As a starting point for the CO_2 footprint analysis, the entire chain of the BioPanel production process was mapped, with the help of AbelLeisure and the suppliers within the production chain. This gave insight into which raw materials and processes play a role in the entire life cycle of the BioPanel.

The chain within "cradle-to-gate" consists of raw material production (hemp and PLA), hemp pills production, compounding, extrusion, foil production, and processing to the panel. The user phase is not included as not many activities are expected to take place during this phase. Figure 2 provides an overview of the BioPanel production chain and the starting point for our CO_2 footprint analysis. The inputs that have an impact on the CO2 footprint of each step in the chain are explained in Table 2.

Table 2: The BioPanel production chain and associated inputs.

Steps	**Input (materials, resources, activities)**
Raw materials – and hemp pills production	Hemp seeds, PLA-granulated fertiliser (nitrogen, phosphorus, and potassium), packaging material (nylon, PE), electric power, diesel for land cultivations, transport of seeds and transport of finished products.
Compounding	Electrical energy, packaging materials (LDPE and cardboard), transport by truck
Extrusion	Electrical energy, packaging materials (PE), transport, incineration of waste
Foil	Production of 3M's "Envision 480" foil, transport by ship from the US to NL, and transportation by truck
Processing into panels	Printing, production laminate film (PE), laminating process, cutting, transportation
Use	Cleaning once a year
EoL (combustion)	Combustion (biogenic carbon emissions) + power generation
EoL (recycling)	Recycling panels (transport, cutting, extrusion, foil, processing)

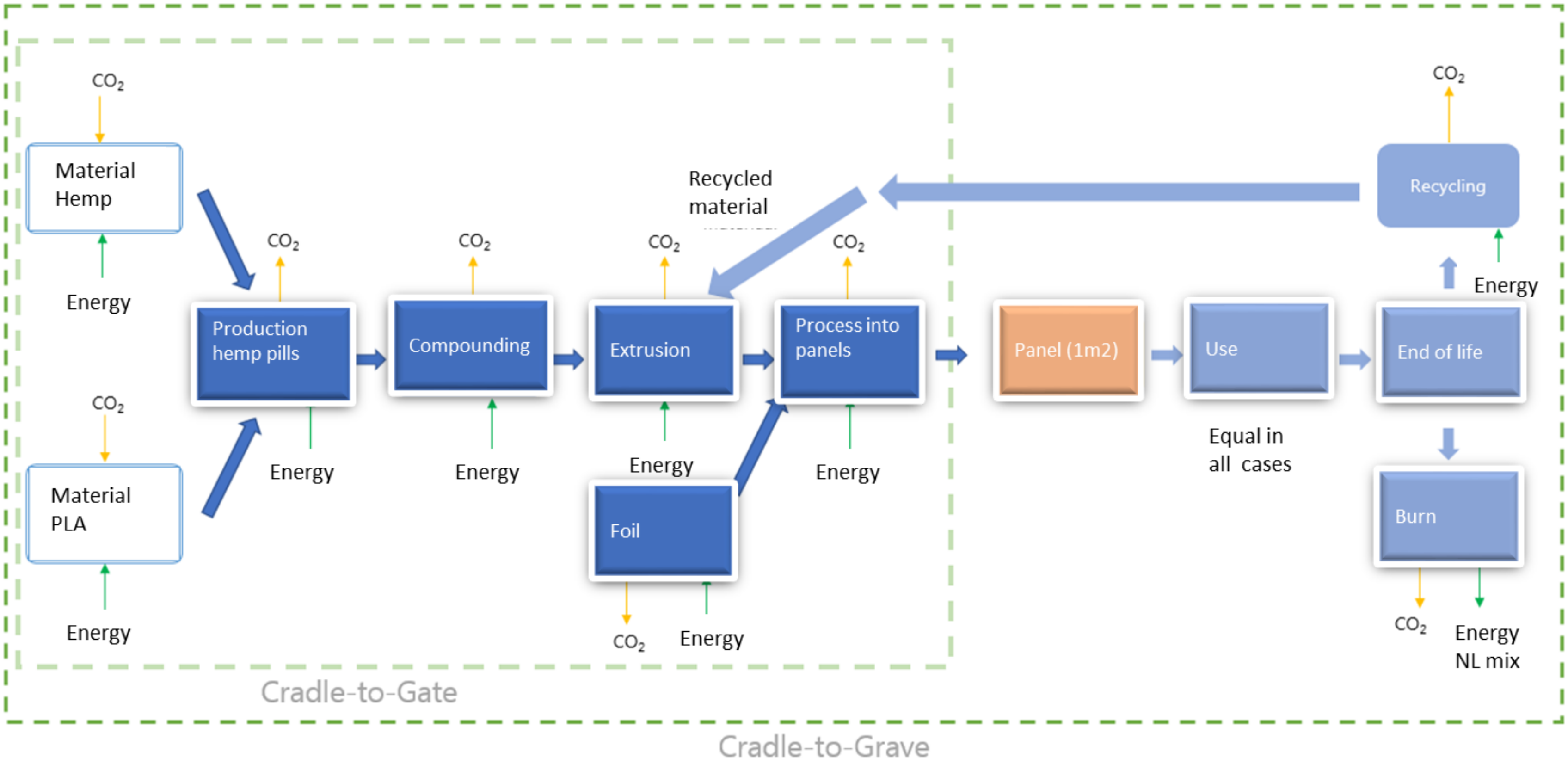


Figure 2: Diagram of the BioPanel chain.

Contacts were made with suppliers in the BioPanel production chain to obtain information on the entire production process, materials, energy consumption and material transport. Data that could not be obtained in this way were estimated from information and data in the literature on similar studies and databases (ecoinvent and idemat). Based on the suppliers' information and/or databases and literature, the CO2 emission values of each step in the chain were entered/calculated. The found values are translated into emission values per product (the functional unit).

Then, two different "End-of-life" scenarios were examined in which the amount of material recycled versus incinerated were varied and the corresponding CO2 emissions were calculated.

Within the duration of the project, sufficient primary information on certain processes in the chain had not been found or made available at all points, therefore some assumptions were made on these points. All assumptions are explained in Table 4 in the attachment.

3.1.1.2 Trespa/HPL:

The CO_2 footprint of the Trespa/HPL panel is based on the information from the Environmental Product Declaration (EPD) of Trespa® Meteon® (7). The Trespa® Meteon®-panel consists of individual wood-based fibre layers treated with thermosetting resins, which are pressed under high pressure. In addition, the same foil that is used for the BioPanel is also applied and calculated here. Figure 3 provides an overview of the Trespa/HPL production chain.

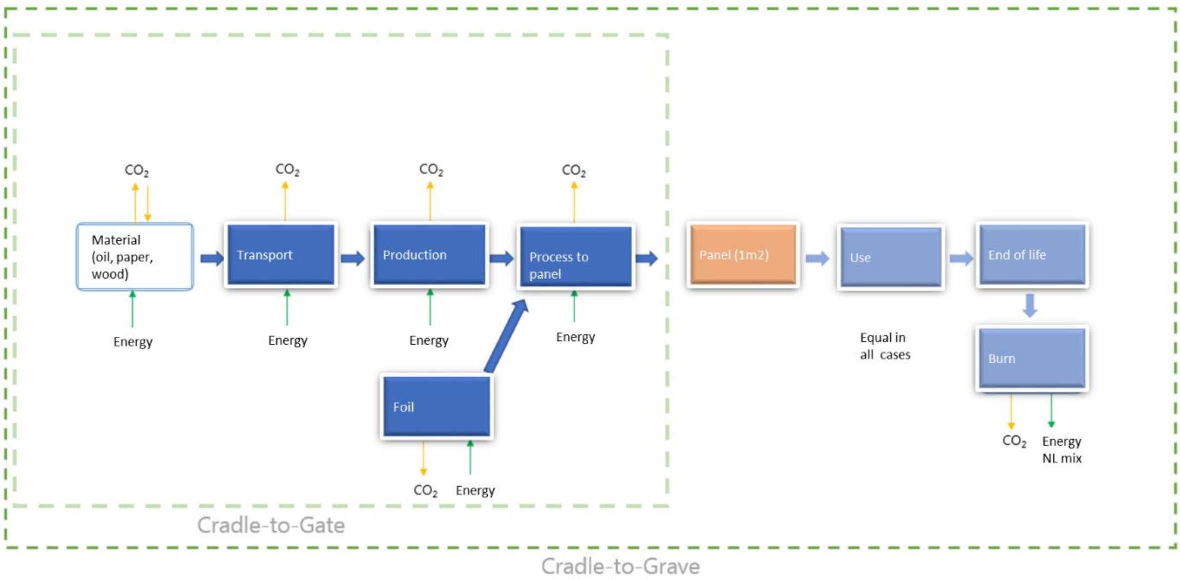


Figure 3: Diagram of the Trespa/HPL chain.

3.1.1.3 Aluminium:

The CO_2 footprint of the aluminium panel is based on the information from the European Aluminium Association (9). Again, the CO2 footprint of the same foil used for the BioPanel has been added. Figure 4 gives an overview of the aluminium panel production chain.

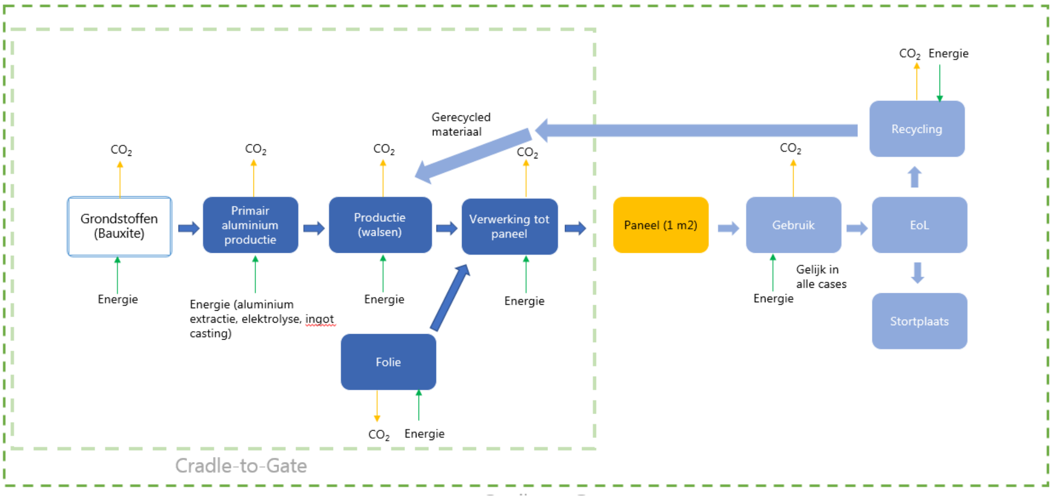


Figure 4: Diagram of the aluminium panel production chain.

4 Impact assessment and interpretation

4.1 CO_2 footprint "cradle to gate" Biopanel, Trespa/HPL and aluminiumpaneel

Figure 5 shows the CO_2 footprint ("cradle to gate") of each individual parameter respectively for Biopanel, Trespa/HPL and aluminium. The underlying data regarding CO_2 emissions of each individual parameter are given in Table 3.

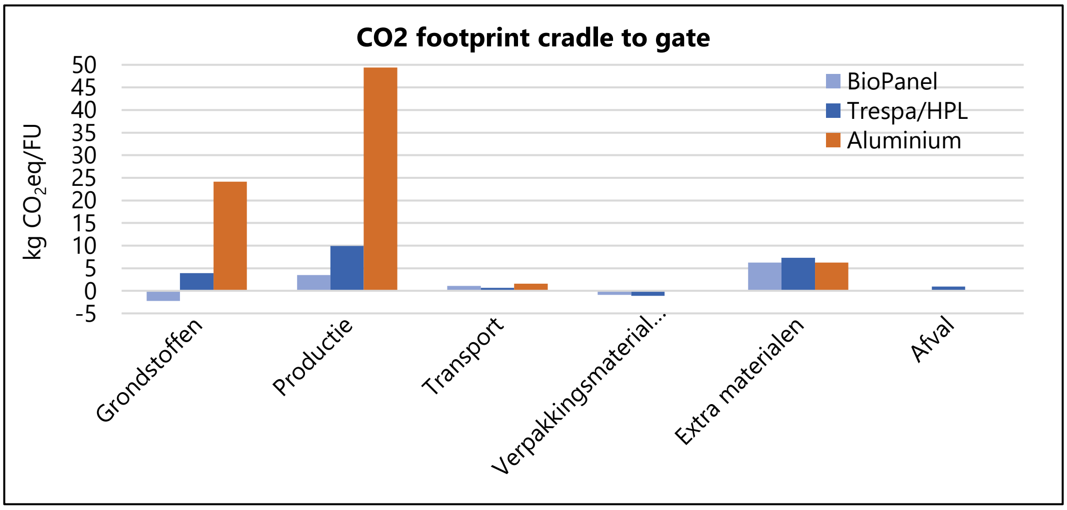


Figure: 5: CO_2 footprint ("cradle to gate") for BioPanel, Trespa/HPL and aluminium.

Table 3: CO_2 data for BioPanel, Trespa/HPL and aluminium panel; cradle-to-gate

Steps	**BioPanel (kg CO_2/FE)**			**Trespa/HPL (kg CO_2/FU)***		**Aluminium (kg CO_2/FU)**	
		Fossiel	**Biogeen**				
Raw materials	Hemp	2,51	-6,24	Resin (on formaldehyde basis)	7,76	Production (bauxite and alumina)	22,7
	PLA	7,03	-5,24	Paper	1,93	Energy** (mainly electrolysis)	44,7
				Wood	-5,78		
Production	Compounder	1,15		Production	0,04	Production (rollers)	2,31
	Extrusion	0,84		Energy**	8,38	Energy**	2,41
	Processing panels	1,46		Processing panels	1,46	Processing panels	1,46
Transport	Transport of materials between all suppliers in the chain	1,05		Transport processes to factory gate	0,57	Transport processes to factory gate	1,50
Packaging materials	Nylon, LDPE, cardboard, wooden pallets		-0,91	Wooden pallets, paper sheets, PP, PE, steel strip	-1,13	Included in the production step	--
Extra materials	Foil (3M™ Envision™ Print Wrap, Film LX480mC)***	6,22		Foil (3M™ Envision™ Print Wrap, Film LX480mC)*** + auxiliary materials, resources, additives	7,45	Folie (3M™ Envision™ Print Wrap, Film LX480mC)***	6,22
Waste	Waste combustion	0,019		Unknown	0,94	Included in the	--

	extrusion process					production step	
Subtotal		**20,28**	**-12,39**				
Total (Fossil and biogenic CO_2)		**7,90**			**21,62**		**81,30**

* *It is not possible to separate biogenic and fossil CO_2 emissions for the Trespa/HPL panel due to lack of available information*

** F*or the Trespa/HPL panel and the aluminium panel, energy is its own parameter while for the BioPanel, the energy consumption is included in each step.*

*** *The foil used for the BioPanel is the "**3M-Envision-Print-Folie-48-Serie"**. However, currently the CO_2 emissions of the "**3M-Envision-Print-Folie-480**" are used since there is no information about "Envision-48" available. De "Envision-48" is the little brother of the "Envision-480" and it is assumed that the CO_2 footprint of both is about the same.*

**** *The processing of panels applies to the placement of foil on the panel. As soon as no foil is applied to the panel, these emissions expire.*

Figure 5 and Table 3 show that the BioPanel scores much better than the Trespa/HPL panel and the aluminium panel. The CO_2 footprint of the BioPanel is about a third of the Trespa/HPL panel. The aluminium panel has a large CO_2 emission; about ten times larger than the BioPanel. The factors with the biggest impact on the CO_2 footprint are:

- The production of raw materials (bauxite) to aluminium "ingots" (primary aluminium production) has the biggest impact on the CO_2 emissions of the aluminium panel.
    - Especially the electrolysis step is energy intensive and contributes heavily to CO_2 emissions.
- Energy and resin have the biggest impact on the CO_2 emissions of Trespa/HPL.
    - The energy consumption is higher for the Trespa/HPL panel similar to the BioPanel. This may be due to the fact that more power is required to press and form this material.
- The foil made by 3M has a major impact in all three production chains.
    - According to information from 3M, the foil's impact on the CO_2 emissions is high due to the raw materials used (PE and an undisclosed polymer type; PVC-free) and the production of the foil.
- Transport, waste, and packaging materials generally give little impact on the CO_2 footprint.

In hemp, PLA, and wood (used as raw material and/or packaging material for BioPanel and Trespa/HPL) contains "biogenic" carbon, i.e. carbon absorbed by plants during its growth. Therefore, negative CO_2 emissions are included in these materials. The negative CO_2 emissions of packaging materials for the Trespa/HPL panel compared to the BioPanel is due to the fact that more than 90 % of the packaging material consists of wood. Note, upon eventual combustion, the biogenic CO_2 is released again and the netto CO_2 balance for the absorbed and emitted biogenic CO_2 is zero again. However, a cradle-to-gate analysis does not include the end-of-life phase.

The CO_2 emissions for transport are reasonably close to each other for the three materials. The differences can be explained by the assumptions made regarding transport distance and means of transport.

4.2 Use phase

The CO_2 emissions form the use phase are the same in all cases and include transport from AbelLeisure in Lochem to the use site and back, as well as cleaning the panels. Cleaning is likely to contribute minimally to CO_2 emissions, because it is a manual process with only water and a small amount of detergents as consumables. The operating location varies, but in this example, 20 km has been assumed as the distance travelled. This is approximately the largest average distance travelled within a municipality to maintain signs. The CO_2 emissions from transport to the use site and back is 0.066 kg CO_2/FU with the panel. If the transport is necessary once a year for 10 years (assumed lifetime of a panel), this gives a total CO_2 emission of 0.13 kg CO_2/FU. For the BioPanel, this contributes about 1-2 % to the total CO_2 footprint (`cradle to gate`), thus it is not a very large contribution. Maintenance is obviously not done specifically for 1 board, instead in one round many objects are maintained. With that, the impact for 1 sign becomes lower. This report has assumed the value mentioned above, which is probably on the conservative side.

4.3 End-of-Life scenarios (recycling and combustion)

Figure 6 illustrates the average CO_2 emissions of the BioPanel, the Trespa/HPL panel, and the aluminium panel for an increasing number of recycling trips (total 10 trips) with 0 % and 100 % recycling (BioPanel), 100 % combustion (Trespa/HPL), and 75 % recycling (aluminium panel). The proportion going to incineration thus also generates energy and thus provides CO_2 credits (reduces CO_2 emissions) as it replaces the largely fossil energy mix. This is also included in the calculations (for the scenarios Trespa/HPL, BioPanel 0 % recycling, and foil for all three panels).

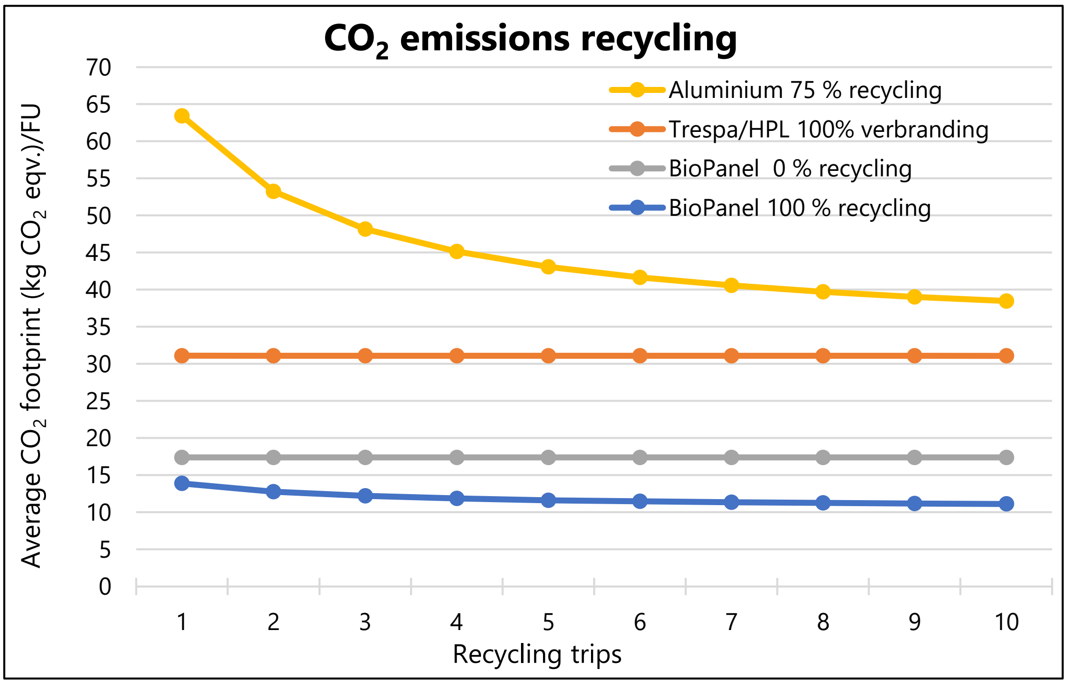
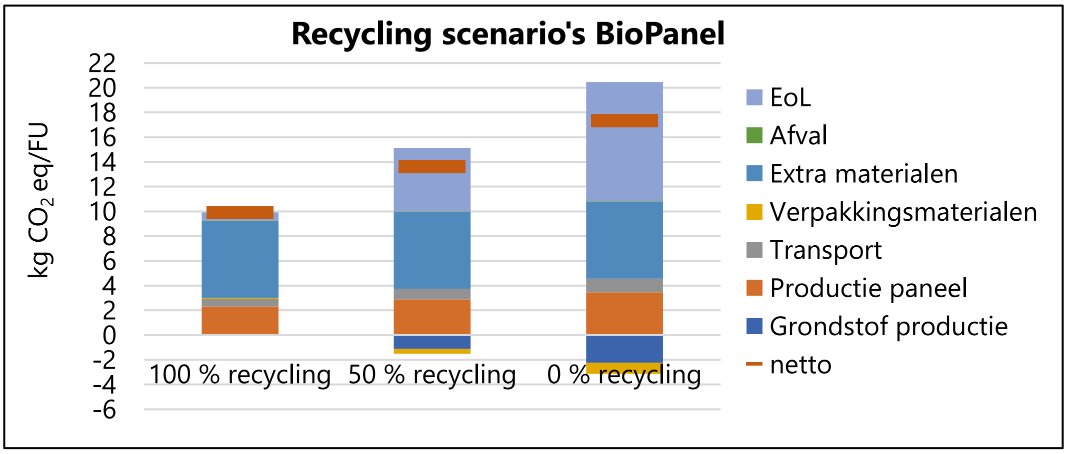


Figure 6: Average CO_2 emissions with an increasing number of recycling/combustion trips: 0 % and 100 % recycling of BioPanel, 100 % combustion of Trespa/HPL and 75 % recycling of the aluminium panel.

Figure 6 shows that:

- There is a fairly large difference in CO2 emissions between the three materials during EoL. Aluminium has the biggest impact, followed by Trespa/HPL and then the BioPanel. This is because:
  - The CO_2 emissions from primary aluminium production are very high. But because 75% is recycled, CO2 emissions are reduced fairly quickly (~after 4 times recycling).
  - The CO_2 footprint "cradle to gate" for Trespa/HPL is fairly large due to energy and resin use. In addition, a new Trespa/HPL panel must be produced after each life cycle due to combustion as an EoL option.
- The difference between the 100% recycling and 0% recycling scenarios is about 30%. This does add something to the overall picture. This is even more so after multiple recycling trips.
- he CO_2 emissions of the two scenarios "Trespa/HPL 100% combustion" and "BioPanel 0% recycling" remain the same after each life cycle. For the two remaining scenarios, CO_2 emissions become higher after the first life cycle and then levels off. This is as expected because the first life cycle includes the production step (from raw material to product) + the recycling process.
- One recycling cycle is not enough for a big impact on reducing CO_2 emissions. After 4-5 times of recycling, we can see a difference. After that, the trend flattens out.
- The question remains whether the BioPanel can be recycled properly - is the quality the same/good enough after recycling? How many times can the material be recycled?

Figure 7 shows the BioPanel's CO_2 emissions broken down by scenarios based on three different waste treatment options: 100%/0% recycling/combustion, 50%/50% recycling/combustion and 0%/100% recycling/combustion. The blue dash in the three columns shows the net value of CO_2 emissions, i.e. after the negative values of the raw materials have been netted out.



Figuur 7: Recycling/verbranding scenario's van de BioPanel; 100/0, 50/50, en 0/100 recycling/verbranding.

Figure 7 shows that:

- From the net value of the three scenarios, it seems that 100% recycling is the best option in terms of CO_2 emissions. This is because the production step gives less impact on the CO_2 footprint and none of the stored CO_2 is released during EoL.
- In addition, another advantage of recycling is that the raw materials do not have to be produced from scratch. This reduces the dependence on land use and other resources.
- For 50% and 0% recycling and combustion are in the "EoL" parameter. Therefore, the CO_2 emissions for the "EoL" parameter are larger for these two scenarios than for the recycling

scenario. Moreover, the efficiency of combustion is assumed to be 20%. So, the energy credit during "EoL" is therefore very low.

- In the scenario 100% recycled raw materials have no CO_2 emissions, as raw materials are completely reused in the process. This also minimises the use of packaging materials and waste in the raw material phase. (These thus fall below 1 % of the total CO_2 footprint).
- Generally (in the bigger picture), recycling is desirable because it requires fewer resources. As mentioned earlier, recycling reduces dependence on land use. The land used to grow, for example, hemp can then be used for other plants/trees that captures even more CO_2 and/or captures CO_2 for a longer time. Furthermore, the stored CO_2 is in the products longer if it is recycled.

4.4 Uncertainties

There are different levels of uncertainty regarding the CO_2 emissions of the different steps in the chain. For example, the production of hemp pills is assumed to be quite accurate because the values are provided by the supplier in a detailed format. For the processing process from extruded material and foil to the finished BioPanel, on the other hand, no direct numbers were obtained from the supplier. As a result, numbers from databases and information from the literature were used, which are not always specific, but are more applicable to standard processes. That is why it is better to replace secondary data with primary data when these are available, e.g. replacing the estimated electricity consumption factor with actual measurements during production. When primary data were not available, reliable databases such as Ecoinvent were used. The most up-to-date data were used and the data used were always compared with multiple sources to check the reliability of the data.

The parameters that are most sensitive to change (because they have high CO_2 emissions per kg/unit) are:

- Packaging materials (nylon, PE)
- Manure sued during hemp production
- Production of foil

The first two parameters do not have a very large impact on the CO_2 footprint because the volumes are low. Other uncertainties are associated with the assumptions made, see Table 4 in the attachment. These include, for example, the amount of packaging material or the amount of electricity used (where this was not directly given). In general, the data quality can be described as good. The data collection was carried out thoroughly, which is also thanks to the suppliers.

5 Restrictions

The CO2 footprint provides results that can be communicated to stakeholders in a clear and simple way. However, it is important to remember that the CO_2 footprint does not necessarily reflect the overall environmental performance of the product(s). Examples of other potentially important parameters include ecosystem degradation, resource exhaustion, ozone depletion and negative impacts on human health.

A full LCA provides an overview of the most relevant parameters, so an LCA analysis is needed for a complete picture of environmental performance.

It is assumed that the lifetime is the same for all three products. If it differs significantly, this will have to be reflected in the CO_2 footprint.

There are different mindsets about the attribution of biogenic CO_2 to the product or process. For instance, EPDs do include the uptake of CO_2 by biomass, while the IPCC (Intergovernmental Panel on Climate Change) assumes a 100-year time horizon in calculating climate impact. When biogenic carbon is stored in a product and released back into the atmosphere within 100 years, it is considered carbon neutral and therefore not included. We show biogenic carbon in the Biopanel separately in this report.

Finally, as mentioned earlier, the results of this CO_2 footprint should be seen as indicative and not definitive as there are various assumptions behind the figures with varying levels of uncertainties.

6 Conclusion

Compared to the Trespa/HPL panel and the aluminium panel, the BioPanel scores very well on the CO_2 footprint. The main reasons for this are the use of hemp and PLA as raw materials instead of resin and paper (Trespa/HPL) and aluminium. Furthermore, the energy consumption is much higher for Trespa/HPL and aluminium compared to the BioPanel. This is mainly because of:

- Trespa/HPL - the production of the raw materials, with almost 50% and 20% of energy consumption linked to resin and paper production respectively.
- Aluminium panel – the primary aluminium production and in particular the electrolysis step.

Another parameter with a large impact on the carbon footprint is 3M's foil. This is linked to the production of raw materials (such as PE and an unknown polymer) and the production of the foil itself. An alternative to this foil, for example from bioplastics, could make a big difference on the CO_2 footprint of the panels.

Besides, this study shows that it makes sense to recycle the BioPanel after the use phase. It is recommended to further investigate recycling options, given their impact on the CO_2 footprint.

7 Sources

1) Shpendi G., 2018, Environmental Impact of Industrial Hemp, Bachelor thesis, retrieved from https://www.theseus.fi/bitstream/handle/10024/159616/Envrionmental%20Impact%20of%20Industrial%20Hemp%20.pdf;jsessionid=E09002B52091DB5C395DB05694BD19AA?sequence=1
2) Zitzen M., Afman M., Herberigs M.,2017, Voorstel tot actualisatie van de CO2-emissiefactor stroomverbruik, retrieved from https://www.co2emissiefactoren.nl/wp-content/uploads/2017/12/CO2-factor-stroomverbruik-20-11-2017.pdf
3) Umwelt Bundesamt, 2019, CO2-Emissionen pro Kilowattstunde Strom sinken weiter, retrieved from https://www.umweltbundesamt.de/themen/co2-emissionen-pro-kilowattstunde-strom-sinken
4) Groot W.J., Borén T., 2010, Life cycle assessment of the manufacture of lactide and PLA biopolymers from sugarcane in Thailand, retrieved from https://www.corbion.com/media/442658/purac-lca-publication.pdf
5) Technicak Editorial Department Zünd Systemtechnik AG, 2009, Digital flatbed cutter G3 series operating manual, retrieved from http://fab.cba.mit.edu/content/tools/zund/manual.pdf
6) van Oudheusden A.A., 2019, Recycling of composite materials, retrieved from http://resolver.tudelft.nl/uuid:0749ed5c-7aeb-4275-abee-0f904a08ea4d
7) Trespa International B.V., 2019, Environmental Product Declaration Trespa® Meteon®, retrieved from https://www.trespa.info/en/documents/Meteon/Panel-&-fixing-system-certificates?r=12
8) World Resources Institute and World Business Council for Sustainable Development, 2011, Greenhouse Gas Protocol – Product Life Cycle Accounting and Reporting Standard, retrieved from http://ghgprotocol.org/sites/default/files/standards/Product-Life-Cycle-Accounting-Reporting-Standard_041613.pdf
9) Environmental Profile Report for the European Aluminium Industry, 2013, European Aluminium Association, retrieved from https://www.european-aluminium.eu/media/1329/environmental-profile-report-for-the-european-aluminium-industry.pdf

ATTACHMENT

Table 4: Assumptions

Steps	**Comments**	**Assumptions**
Hemp pill production	For necessary information that could not be provided by the supplier, the following assumptions were made:	<u>Raw material hemp straw:</u> • Corporate waste from nylon was not included because it involves very small volumes (0,0033 kg nylon times 8,24 kg CO_2/kg according to idemat), so the CO_2 emissions from nylon are negligible. • The uptake of CO_2 from hemp straw is included in the calculations. The information on uptake comes from source (1). <u>Hemp fibre:</u> • Packaging material iron wire is negligible given its low volume (0,0018 kg). <u>PLA:</u> • The CO_2 footprint of PLA is derived from figures from Corbion (4). • It has been assumed that the PLA granulate is delivered to the supplier from Rayong in Thailand (location of Corbion's PLA factory) • The CO_2 uptake of hemp straw was included in the calculations. The information on uptake comes from source (4). <u>General:</u> • Waste in the production process is not included due to small volumes or recycling in production.
Extrusion process	For necessary information that could not be provided by the supplier, the following assumptions were made:	• PE foil and stretch foil (packaging material) are assumed to be LDPE (the difference in CO_2 emissions between LDPE and HDPE is not significant anyway). • For the amount of PE foil and stretch foil, the amount needed to wrap the foils three times (in total) around the size of a Europallet in width and length is assumed, and the height is assumed to be the same size as a panel. • The electrical energy in the calculations includes the extrusion process and excludes cutting and milling. • Production waste from supplier has been assumed to be incinerated in Kempten, Germany. Source: personal communication from supplier.
Foil production		<u>Transport:</u> • The 3M foil is produced in Nevada, Missouri (US), it is assumed that the foil is transported by truck from Nevada, Missouri to Baltimore, Maryland in US and then transported by ship from Baltimore to Rotterdam.

Processing into panels	Supplier did not provide any figures regarding the use of electrical energy in their production process, but information on which machines they use were available. Based on this, the following assumptions were made:	• The electrical energy required for cutting is based on calculations of speed (the lowest speed, 0.04 in/s) and power provided in the paper of (5). • The CO_2 footprint of the lamination process and printing process is based on data from Ecoinvent. • Waste from supplier is about 10 %. But the residual material (foil and sheet material) is returned to AbelLeisure for making new sheets. CO_2 emissions from this step are therefore not included.
EoL		Shredding the used panel: • Shredded by a machine with electricity consumption based on (6). The highest electricity use was chosen. Foil: • It is assumed that the foil goes to combustion after the use phase Energy credits combustion: • It is assumed that only 20 % of the energy generated by combustion of the BioPanel replaces NL mix (energy)

General		• All electrical energy is based on NL-mix (grey electricity) from (2), except for the electrical energy of the extrusion process which takes place in Germany (3). In this case, the DE mix was used.
		• Transport CO_2 footprint is taken from the Ecoinvent database. Unless otherwise given, the following category is assumed for truck and ship respectively (as given in Ecoinvent):
		  o "transport, freight, lorry 16-32 metric tons, EURO6"
		  o "transport, freight, sea, transoceanic ship"
		• All transport distances are calculated based on routes given in google maps.