FOG & VENØ A/S

LCA Report

RAW panel, Skandinavian felt

Content

Introduction

This LCA assessment has been commissioned by FOG & VENØ products and is authored by Freya Majgaard Gøbel and Morten Carlsen. The report is dated 04-09-2023 and complies to the requirements set in the ISO 1404 [1], ISO 14044 [2], ISO 14025 [3] and, in case of construction materials, the EN-15804+A2:2019 [4]. The report can be verified by a qualified independent verifier, experienced in Life Cycle Assessment (LCA).

Ecochain version 3.2.12 has been used in the preparation of this report [5]. This report is valid until five years after initial publication. The results of the product assessments and resulting Life Cycle Assessment in this report are only comparable to others, if these others also comply with the norms and Swans used in this report, and as set out above.

The purpose of the life cycle analysis (LCA) is to provide quantitative environmental figures on products and resources for market information, environmental optimization, and as part of a company's corporate responsibility program. An LCA assessment delivers an increased understanding of the sources of pollution, priority setting for sustainable business practices and aids to the commercialization of sustainable products.

This LCA has been carried out in order to:

Apply environmental data in LCA calculations for sustainable construction works. This is essential to enable valid and verifiable comparability of environmental data.

The outcomes of this study will be used for both business-to-business and business-to-consumer communication. The intended company internal audience of this study consists of stakeholders, such as marketers, product innovators, purchasers and process managers. External stakeholders could be clients and suppliers with an interest in environmental profiling, governments and environmental NGO's.

This report has not been peer reviewed by third parties.

Scope

The reference unit for an LCA study can be presented in two ways: either as a functional unit or as a declared unit. A functional unit is a product unit that fulfils a specific function, e.g., a window, concrete beam, staircase, etc. For the product unit a precise product function or specific scenarios at the building level are known. A declared unit is a product unit where a specific function has not been indicated, e.g., a cubic metre of concrete, a square metre of wall panelling.

This LCA is based on a cradle-to-gate with options including modules A1-A3, C1-C4 and D, in which 100 weight-% has been accounted for. The general rules for the exclusion of inputs and outputs follows the requirements in EN 15804, 6.3.5, where the total of neglected input flows per module shall be a maximum of 5 % of energy usage and mass and 1 % of energy usage and mass for unit processes

The assessment covers the product. The packaging and cling film on the backside of the product has not been assessed in this LCA.

The declared unit / functional unit has been defined as the following: the production and waste processing of:

- 1m^2 of acoustic panel

The expected service life of the acoustic panels is 50 years.

Product Description

The product is a Swan acoustic panel used for improving indoor acoustics. It can be applied to walls and ceilings. It is made of PET felt with lamellas of MSD on which veneer, or linoleum has been applied. The veneer can be purchased with oil treatment or no treatment.

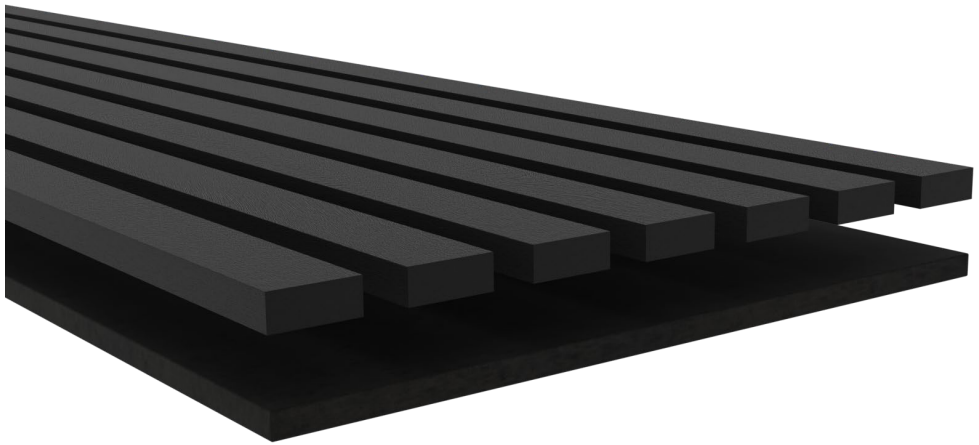
The felt is made of 50% recycled PET.

The acoustic panels is available with different types of veneer and linoleum and in different sizes [6].

This LCA has been performed for wooden panels with dimensions 20x600x2400 mm [6]. There is no difference in size or weight with regards to the types of veneer and linoleum.

The LCI and LCIA results in this LCA relates to 1 m^2 of acoustic panels

Except for cleaning (with a damp cloth or vacuum cleaner) no maintenance is expected for the duration of the products lifetime. At the products End-of-Life is it dismantled from the original surface (wall or ceiling) and can be easily disassemble to material can be recycled.



Process Description

The process tree consists of all processes that cause environmental impacts, for example material extraction and the transportation of these resources to the production facility. The quantified impact flow of acoustic panel is visualized in figure 1. The processes and life cycle modules that are included in this study are defined by the system boundaries. In this LCA of the acoustic panels the following stages are covered:

- Raw material supply, transport and manufacturing (A1 – A3)
- Deconstruction, transport, waste processing and disposal (C1 – C4)
- Reuse, recovery or recycling potential (D)

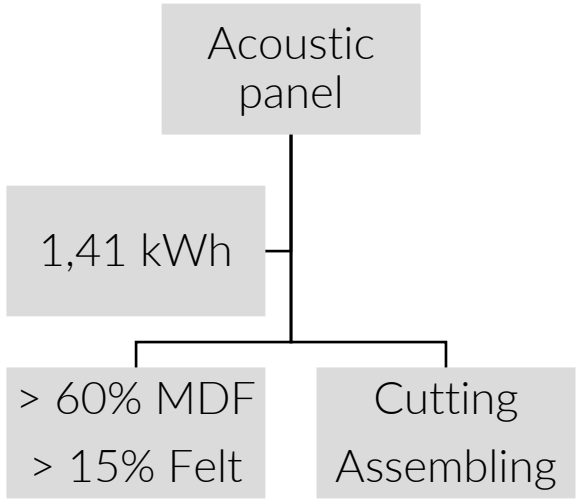


Figure 1: Process tree

The process tree above show the various processes, main components and the energy consumption that is necessary to produce the product

Process Description

	Stage; Production			Stage; Construction		Stage; Use							Stage; End of life				Stage; Ressource recovery
	Material supply	Transport	Manufacturing	Transport	Construction / Installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse/Recovery/Recycling Potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	MND	MND	MNR	MNR	MNR	MNR	MNR	MNR	MNR	X	X	X	X	X
Geography	Global	Global	Denmark	-	-	-	-	-	-	-	-	-	Denmark	Denmark	Denmark	Denmark	Denmark
Generic (G) or Specific (S) data use	G	G	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Included
MND = Module Not Declared
MNR = Module Not Relevant

Figure 2: LCA stages

Process Description

All relevant inputs and outputs – like emission, energy and materials – have been taken into account in this LCA. In accordance with EN15804+A2:2019 the total neglected input flows per module do not exceed 5% of energy usage and mass.

In this LCA, the waste processes are allocated in the relevant module. In the case of the use of secondary materials or energy recovered from secondary fuels, the system boundary between the system under study and the previous system (providing the secondary materials) is set where outputs of the previous system, e.g. materials, products, building elements or energy, reach the end-of-waste state.

Life Cycle Inventory Analysis

The life cycle inventory comprises data gathering and calculation procedures to quantify all relevant environmental impacts (inputs and outputs) of the product system. In this analysis all environmental inputs – such as resources, energy and waste – were qualified, quantified and translated to environmental impacts through the use of LCA background data from Ecoinvent.

Data Collection and Procedures

All relevant suppliers of FOG & VENØ A/S products have been requested to send LCA related product information for this assessment. In case such information was available, the suppliers delivered this data in the shape of an EPD, safety data sheets, certification or energy documentation. Based on this information, representative background data have been selected.

The data of products were derived from energy and resource administrations at the production site. Primary production data from the year 2022/2023 has been used. In the following, the quantity, quality and allocation of various materials, energy streams and emissions by processes and products are outlined. The system boundaries that have been adopted are in accordance with modular approach of EN 15084.

Data Collection and Procedures

All relevant resources, materials and services in production phase A1 have been included in this study. The composition of the products is given in kg.

The compositions are based on the Bills of Materials supplied by FOG & VENØ products manufactured in 2022.

Example of Bill of material can be seen in the table on the right

Raw material	Swan Wood panel [kg]
MDF	6,36
Veneer	0,97
Adhesive	0,18
Felt	2
Clamps	0,19

Data Collection and Procedures

All relevant transport to FOG & VENØ A/S product's production plant has been included in this study. The references for transport are according to EN15804+A2:2019. These LCA database references calculate with an average load factory of 50%, in other words fully loaded transport towards the customer with empty returns.

The transport of raw materials to FOG & VENØ A/S have been by truck from suppliers in Denmark and Sweden as well as ship from China and ferry from Sweden. The transport distances are calculated from the location of the supplier to FOG & VENØ A/S production site in Denmark. The distances have been calculated using Ecochain references for freight per truck, container ship and ferry respectively.

Supplier	Country	Truck [km]	Ship [km]
Riisfort A/S	Denmark	99,8	-
Sommer Savex A/S	Denmark	137	-
Keflico A/S	Denmark	118	-
CE Produkter AB	Sweden	230	131
BeA Denmark	Denmark	306	-

Data Collection and Procedures

All relevant processes in production phases A3 have been included in this study.

The production processes are modelled using specific values from primary data collection at the production site. All relevant processes in module A3 have been included in this assessment. Production losses have not been included.

Process	Energy [kWh]
Cutting + assembling	1,4

Data Collection and Procedures

The demolition and waste stages C1-C4 of the product is taken into account in the study. These phases encompass demolition (C1), transport to the waste processing site (C2), waste processing, until waste status is lost (C3) and waste disposal (C4).

The products are panels applied to wall or ceilings. For this study the demolition phase is likely going to be removal of the panels using a power drill of a duration of approximately 5 minutes. C1 has therefor been analysed using impact for power drills at low voltage for 5 minutes.

The products can be used by various consumer types. Therefor a distance to a waste processing facility has been estimated to 50 km. This distance has been chosen since the product is sold in Denmark and an average distance to a waste processing site is expected to be no greater than 50 km.

It is assumed that the waste treatment of the products will be primarily reuse with some also going to incineration. It is estimated that 95% will go to reuse and 5% will go to incineration. The LCA references for these treatments are derived from Ecoinvent.

Module D contains the impacts and benefits of recycling, reuse or energy recovery from incineration. During the End-of-Life phase the product is used to generate energy. Since it is estimated that 5% will go to incineration at the end-of-life stage, module D covers the energy recovery from incineration of 5% of the product. The energy production in the waste incineration installation has been included in module D.

The phase C4 has been estimated not be of great significance since the waste disposal of this type of product will be minimal and therefore provide minimal impact to the LCA study.

Data Validation

In this study the data flows have been modelled as realistic as possible within the practical feasibility of the LCA practitioner. The data quality is based on the principle that the primary data used for processes, occurring at the production site, must be of higher quality than background data of other processes.

In this LCA the data relating to the manufacturing of the product and the background processes for environmental impacts are recent (< 2 years).

LCA data refers to: the used LCA references from databases such as Ecoinvent. The processes used in the production of the product is geographically representative, meaning that the production location of the product lies within the region for which relevant Ecoinvent environmental records have been selected. The dataset is up-to-date and representative for the current technology used in the processes of manufacturing of the product.

All environmental impacts and economic flows – from sources such as resources, energy, emission and waste – were quantified and qualified in environmental effects. There is no presumption that relevant inputs or outputs have been omitted. All identified environmental impacts have been translated into environmental impact categories. Direct emission from the inventory have been characterized by the characterization factors of CML. The used LCA references were derived from accepted databases such as Ecoinvent, which ensures that all relevant environmental impacts were characterized.

Data Validation

The process descriptions and quantities in this study are entirely quantitatively reproducible in accordance with the reference Swans that have been used. The references of all sources, both primary and public sources and literature, have been documented in the chapter “References”. Additionally, in order to guarantee the reproducibility, a project dossier has been composed which can be consulted via the Ecochain tool. This project dossier contains a summary of all the data used in the FOG & VENØ A/S product Ecochain account, and in this LCA.

In accordance with the Ecochain methodology, the energy usage of the production facility has been allocated to all processes and products at the production location of the FOG & VENØ A/S product. Therefore, the energy balance is by definition 100% closed. In other words, the total energy consumption at the production site is allocated to all produced products.

The mass balance checks whether the provided (theoretical) composition of the product correlates to the actual purchased resources for this product. The LCA calculations have been performed based on the actual amount of materials used.

In this section the used background processes and databases from which these processes derive are discussed. The data for the upstream supply chain derives from Ecoinvent (version 3.8) and, when possible, are modelled according to the EN15804+A2:2019in the Ecochain application. According to the Ecoinvent Swans, the background process data ("LCA references") includes infrastructure and capital goods.

Life Cycle Impact Assessment

In this chapter the results of the LCA calculations of the products are presented and discussed. The environmental profile consists of 37 impact categories and a number of parameters. Both groups differ from each other. Use of energy, for example, is an input to the parameter 'Energy' (primary) and contributes to the score of (among others) the impact categories ‘depletion of abiotic resources (fossil)’ and ‘global warming’.

The LCA profile of the products is presented in the following. The values of the impact categories are calculated in the following manner: all environmental emissions from the inventory are multiplied by the characterization factors from the CML-VLCA impact assessment method, after which these values are added up to provide the total environmental impact per impact category. These LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Table 1; Environmental impact

Swan Raw panel

Parameters

GWP-t = Climate Change [kg CO2 eq]
GWP-f = Climate change - Fossil [kg CO2 eq]
GWP-b = Climate Change - Biogenic [kg CO2 eq]
GWP-luluc = Climate Change Land use & change [kg CO2 eq]
ODP = Ozone depletion [kg CFC11 eq]
AP = Acidization [mol H+ eq]
EP-fw = Eutrophication, freshwater [kg P eq]
EP-m = Eutrophication, marine [kg N eq]
EP-T = Eutrophication, terrestrial [mol N eq]
POCP = Photochemical ozone formation [kg NMVOC eq]
ADP-mm = Resource use, minerals and metals [kg Sb eq]
ADP-f = Resource use, fossils [MJ]
WDP = Water use [m3 depriv.]
PM = Particulate matter [disease inc.]
IR = Ionizing radiation [kBq U-235 eq]
ETP = Ecotoxicity, freshwater [CTUe]
ETF-i = Ecotoxicity, freshwater – inorganics [CTUe]
ETF-o = Ecotoxicity, freshwater – organics [CTUe]
ETF-m = Ecotoxicity, freshwater - metals [CTUe]
HTNC-m = Human toxicity, non-cancer – metals [CTUh]
HTC-m = Human toxicity, cancer – metals [CTUh]
HTC = Human toxicity, cancer [CTUh]
HTNC = Human toxicity, non-cancer [CTUh]
HTNC-i = Human toxicity, non-cancer – inorganics [CTUh]
HTNC-o = Human toxicity, non-cancer – organics [CTUh]
HTC-i = Human toxicity, cancer – inorganics [CTUh]
HTC-o = Human toxicity, cancer – organics [CTUh]
SQP = Land use [Pt]

Impact	Unit	A1	A2	A3	C1-C4	D	Total
GWP-t	kg CO2 eq.	2,27E+00	1,27E-01	1,06E-01	5,26E-01	6,36E-01	3,66E+00
GWP-f	kg CO2 eq.	7,32E+00	1,27E-01	1,02E-01	9,45E-02	6,38E-01	8,29E+00
GWP-b	kg CO2 eq.	-5,06E+00	1,10E-04	3,73E-03	4,32E-01	-1,98E-03	-4,63E+00
GWP-luluc	kg CO2 eq.	7,67E-03	5,53E-05	2,55E-04	3,22E-05	4,34E-04	8,44E-03
EDP	kg CFC11 eq.	6,39E-06	2,94E-08	5,19E-09	1,12E-08	4,42E-08	6,48E-06
AP	mol H+ eq.	4,59E-02	1,10E-03	5,27E-04	3,86E-04	1,95E-03	4,98E-02
EP-fw	kg P eq.	8,96E-04	8,80E-07	1,15E-05	1,00E-06	1,33E-05	9,22E-04
EP-m	kg N eq.	1,05E-02	3,45E-04	6,76E-05	1,42E-04	5,02E-04	1,16E-02
EP-t	mol N eq.	1,23E-01	3,81E-03	7,82E-04	1,57E-03	5,46E-03	1,35E-01
POCP	kg NMVOC eq.	4,10E-02	1,05E-03	2,14E-04	4,34E-04	1,76E-03	4,45E-02
ADP-mm	kg Sb eq.	1,16E-04	3,97E-07	2,48E-07	2,37E-07	7,25E-06	1,24E-04
ADP-f	MJ	1,32E+02	1,92E+00	2,17E+00	8,44E-01	6,49E+00	1,43E+02
WDP	m3 depriv.	5,81E+00	6,01E-03	2,42E-02	9,92E-03	1,21E-01	5,97E+00
PM	disease inc.	6,20E-07	1,30E-08	1,41E-09	5,83E-09	3,56E-08	6,76E-07
IR	kBq U235 eq.	4,30E-01	8,34E-03	1,98E-02	4,10E-03	2,16E-02	4,84E-01
ETF	CTUe	1,95E+02	1,49E+00	1,09E+00	8,94E-01	7,01E+00	2,05E+02
ETF-i	CTUe	1,08E+01	3,97E-01	5,88E-02	3,32E-01	1,24E+00	1,28E+01
ETF-m	CTUe	1,37E+02	9,76E-01	1,03E+00	5,19E-01	5,60E+00	1,45E+02
ETF-o	CTUe	1,24E+00	1,16E-01	5,71E-03	4,23E-02	1,67E-01	1,57E+00
HTC	CTUh	3,85E-08	6,29E-11	2,92E-11	1,02E-09	6,29E-10	4,02E-08
HTC-i	CTUh	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
HTC-m	CTUh	3,06E-09	2,90E-11	1,99E-11	9,40E-10	3,82E-10	4,43E-09
HTC-o	CTUh	3,39E-08	3,39E-11	9,32E-12	8,51E-11	2,47E-10	3,43E-08
HTNC	CTUh	1,31E-07	1,66E-09	9,48E-10	1,38E-09	9,01E-09	1,44E-07
HTNC-i	CTUh	2,13E-08	3,36E-10	9,38E-11	2,42E-10	1,44E-09	2,34E-08
HTNC-m	CTUh	8,39E-08	1,14E-09	8,46E-10	1,06E-09	7,38E-09	9,43E-08
HTNC-o	CTUh	4,01E-09	1,89E-10	1,52E-11	7,79E-11	2,46E-10	4,53E-09
SQP	Pt	3,77E+02	1,51E+00	3,34E-01	6,13E-01	4,69E+00	3,84E+02

Table 2; Ressource use

Swan Raw panel

Parameters

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials [MJ];
PERM = Use of renewable primary energy resources used as raw materials [MJ];
PERT = Total use of renewable primary energy resources [MJ];
PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials [MJ];
PENRM = Use of non-renewable primary energy resources used as raw materials [MJ];
PENRT = Total use of non-renewable primary energy resources [MJ];
PET = Total energy [MJ];
SM = Use of secondary material [kg];
RSF = Use of renewable secondary fuels [MJ];
NRSF = Use of non-renewable secondary fuels [MJ];
FW = Use of net fresh water [m3]

Impact	Unit	A1	A2	A3	C1	D	Total
PERE	MJ	1,25E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,25E+00
PERM	MJ	3,61E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,61E+00
PERT	MJ	6,85E+01	2,62E-02	4,16E-01	3,51E-02	1,13E-01	6,91E+01
PENRE	MJ	2,13E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,13E+01
PENRM	MJ	2,79E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,79E+01
PENRT	MJ	1,42E+02	2,04E+00	2,28E+00	8,95E-01	6,91E+00	1,54E+02
PET	MJ	1,59E+02	2,07E+00	2,69E+00	9,30E-01	7,02E+00	1,72E+02
SM	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	m3	1,33E-01	2,18E-04	1,97E-03	4,00E-04	3,59E-03	1,39E-01

Table 3; Output flows and waste categories

Swan Raw panel

Parameters

HWD = Hazardous waste disposed [kg]
NHWD = Non-hazardous waste disposed [kg]
RWD = Radioactive waste disposed [kg]
CRU = Components for re-use [kg]
MFR = Materials for recycling [kg]
MER = Materials for energy recovery [kg]
EET = Exported energy thermic [MJ]
EEE = Exported energy electric [MJ]

Impact	Unit	A1	A2	A3	C1	D	Total
HWD	kg	1,09E-04	4,61E-06	7,70E-07	2,05E-06	8,72E-06	1,26E-04
NHWD	kg	8,01E-01	1,17E-01	7,26E-03	5,22E-02	1,68E-01	1,15E+00
RWD	kg	2,03E-04	1,30E-05	1,62E-05	5,58E-06	2,50E-05	2,63E-04
CRU	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EET	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EEE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

Life Cycle Interpretation

On page 18 – 20 the results of Swan acoustic panels with varies surface finish have been presented.

The total amount of global warming potential (GWP) from entire life cycle, including all phases A1-A3, C1-C4+D. for the Swan acoustic panels are,

Variant	kg CO_{2eq}. per. m^2
Raw	3,66
Wood	3,53
Wood oil treated	3,60
Linoleum	8,74

The main contributor is the felt made from PET polyester. The contribution of the felt is 2,08 kg CO2 eq. This contribution is for the material itself without transportation included. If Linoleum is used it is the main contributor with 4,81 CO2 eq. Besides the felt and linoleum, relative to the quantity used for Swan panels the glue also contributes to a notable amount of the total GWP with 0,29 kg CO2 eq,.

The waste treatment (C1-C4) of the product contributes with a total GWP of 0,53 CO2 eq,.

Here the incineration of the wooden parts (MDF and veneer) creates the biggest impact even though only 5% of the product is assumed incinerated as part of the waste treatment.

Reuse of the product creates a minor negative CO2 eq impact due to the energy gained from the incineration which is then reused as electricity.

The reuse of the product generates an impact of 0,64 CO2 eq, with the non-wooden parts (glue, felt, clams) contributing to the main part.

Striving to reduce the impact of the Swan panels an area of focus could be looking at the backside of the panel, the felt made of PET polyester. Exchanging the PET polyester with another type of felt or another material could potentially lower the CO2 eq impact of the product.

References

[1] ‘ISO 14040: Environmental management – Life cycle assessment – Principles and Framework’, International Organization for Swanization, ISO14040:2006.

[2] ‘ISO 14044: Environmental management – Life cycle assessment – Requirements and guidelines’, International Organization for Swanization, ISO14044:2006.

[3] ‘ISO 14025: Environmental labels and declarations – Type III environmental declarations – Principles and procedures’, International Organization for Swanization, ISO14025:2006.

[4] ‘EN 15804+A2:2019: Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

[5] Ecochain 3.2.12, 2021, web http://app.Ecochain.com.

[6] FOG & VENØ 2023, web https://byveno.com/

Appendix

Variant	Standard	Greenoption	Swan
	kg CO_{2eq}. per. m^2		
Raw	7,33	3,12	3,66
Wood	7,22	3,01	3,53
Wood oil treated	7,27	3,06	3,60
Linoleum	12,43	8,22	8,74

Variant	Standard	Greenoption	Swan
	percentage CO_{2eq}. Change		
Raw	0%	0%	0%
Wood	-2%	-4%	-4%
Wood oil treated	-1%	-2%	-2%
Linoleum	70%	163%	139%

Variant	Raw	Wood	Wood oil treated	Linoleum
	percentage CO2eq. Change			
Standard	0%	0%	0%	0%
Greenoption	-57%	-58%	-58%	-34%
Swan	-50%	-34%	-50%	-30%

Mediator A/S

Ansvarlighed, Balance, Tryghed

Udarbejdet af:

Mediator A/S
CVR: 31 61 24 38
Centervej 2
DK-6000 Kolding
T: 75 54 08 24
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