Environmental Product Declaration
According to ISO 14025

Wood Wool Boards
Heraklith®

Heraklith® is a registered trademark of

Institut Bauen und Umwelt e. V.
www.bau-umwelt.com

Declaration number
EPD-KNI-2012511-E
**Institut Bauen und Umwelt e. V.**  
www.bau-umwelt.com

**KNAUF INSULATION**  
9702 Ferndorf 29  
Austria

**EPD-KNI-2012511-E**

**Wood Wool Boards**

This declaration is an Environmental Product Declaration in accordance with /ISO 14025/ and describes the environmental inputs of the stated building products. It is intended to promote the development of environmentally friendly and healthy building. All relevant environmental data has been disclosed in this validated declaration. The declaration was produced on the basis of the PCR document “Holzwerkstoffe [Wood Materials]”, 2011-11t.

This validated declaration entitles the holder to use the mark of the Institut Bauen und Umwelt e.V. It only applies for the stated products for a period of three years from its issue. The holder of the Declaration is liable for the data and certificates on which it is based.

The **Declaration** is complete and contains full details with regard to:
- Definition of the product and physical characteristics
- Details of the basic materials and their origin
- Descriptions of the manufacture of the product
- Information on processing the product
- Details of the condition of use, exceptional impacts and the end of life phase
- Results of the LCA
- Certificates and tests

**Validity**

31 January 2012

**Signatures**

Prof. Dr.-Ing. Horst J. Bossenmayer  
(President of the Institut Bauen und Umwelt)

This declaration and the rules on which it is based have been examined by the committee of independent experts in accordance with /ISO 14025/.

**Verification of the Declaration**

**Signatures**

Prof. Dr.-Ing. Hans-Wolf Reinhardt (Chairman of the SVA)  
Dr. Frank Werner (Inspector appointed by the SVA)
Heraklith Wood Wool lightweight building boards from Knauf Insulation consist of wood, water and the mineral binding agents magnesite or cement.

**Description of Product**

Heraklith products are basically used for the purpose of thermal insulation, fire protection and acoustical insulation.

Heraklith Standaardplaat M/CF: homogeneous Wood Wool board

Heraklith 35 mm: homogeneous Wood Wool board

The LCA was carried out according to /DIN EN ISO 14040/ and /DIN EN ISO 14044/ the requirements of the IBU Guidelines for Type III declarations and the specific rules for wood materials. Specific data for the examined product as well as data from the "GaBi 4" database were used as the basic data. The LCA includes the life cycle stages of the raw material and energy production as well as manufacture and packaging, transport to the customer, disposal of the packaging and the end of life. Two scenarios are considered for the end of life: 100% incineration in a waste incineration plant and 100% disposal as landfill.

### Results of the LCA

<table>
<thead>
<tr>
<th>per m² of product</th>
<th>Heraklith Standardplaat/M/CF (incineration)</th>
<th>Heraklith Standardplaat/M/CF (landfill)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Manufacture</td>
<td>End of life</td>
</tr>
<tr>
<td>Use of non-renewable primary energy [MJ/m²]</td>
<td>69.97</td>
<td>1.24</td>
</tr>
<tr>
<td>Use of renewable primary energy [MJ/m²]</td>
<td>53.81</td>
<td>0.55</td>
</tr>
<tr>
<td>Global warming potential (GWP) [kg CO₂-eq./m²]</td>
<td>4.44</td>
<td>5.07</td>
</tr>
<tr>
<td>Ozone depletion potential (ODP) [kg R11-eq./m²]</td>
<td>2.80E-07</td>
<td>9.59E-08</td>
</tr>
<tr>
<td>Acidification potential (AP) [kg SO₂-eq./m²]</td>
<td>1.49E-02</td>
<td>1.08E-02</td>
</tr>
<tr>
<td>Eutrophication potential (EP) [PO₄³⁻-eq./m²]</td>
<td>2.39E-03</td>
<td>1.33E-03</td>
</tr>
<tr>
<td>Photo-chemical ozone creation potential (POCP) [kg C₂H₄-eq./m²]</td>
<td>1.84E-03</td>
<td>5.83E-04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>per m² of product</th>
<th>Heraklith (35mm) (incineration)</th>
<th>Heraklith (35mm) (landfill)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Manufacture</td>
<td>End of life</td>
</tr>
<tr>
<td>Use of non-renewable primary energy [MJ/m²]</td>
<td>85.48</td>
<td>1.52</td>
</tr>
<tr>
<td>Use of renewable primary energy [MJ/m²]</td>
<td>66.27</td>
<td>0.68</td>
</tr>
<tr>
<td>Global warming potential (GWP) [kg CO₂-eq./m²]</td>
<td>5.44</td>
<td>6.21</td>
</tr>
<tr>
<td>Ozone depletion potential (ODP) [kg R11-eq./m²]</td>
<td>3.38E-07</td>
<td>1.17E-07</td>
</tr>
<tr>
<td>Acidification potential (AP) [kg SO₂-eq./m²]</td>
<td>1.62E-02</td>
<td>1.33E-02</td>
</tr>
<tr>
<td>Eutrophication potential (EP) [PO₄³⁻-eq./m²]</td>
<td>2.93E-03</td>
<td>1.63E-03</td>
</tr>
<tr>
<td>Photo-chemical ozone creation potential (POCP) [kg C₂H₄-eq./m²]</td>
<td>2.29E-03</td>
<td>7.15E-04</td>
</tr>
</tbody>
</table>

The End-of-life column for the incineration scenario also contains credit. The column "Total" comprises the details for the manufacture and the End-of-life.

Produced by: Knauf Insulation Technology, Ferndorf in cooperation with PE INTERNATIONAL AG, Leinfelden-Echterdingen

- Formaldehyde
- MDI
- Examination of pre-treatment of the materials used
- Toxic nature of combustion gases
- VOC
- Lindan/PCP
**Scope of application**
This document refers to homogeneous Wood Wool boards made by the company Knauf Insulation. The LCA data were collected for the year 2010 by Knauf Insulation in the plants in Simbach (Germany), Oosterhout (Netherlands) and Zalaegerszeg (Hungary). The results are average results from all three plants. The weighting is relative to the quantity produced. The products declared here are exclusively produced in the three stated plants.

**1 Product Definition**

**Product Definition**
Heraklith boards are Wood Wool boards produced from Wood Wool and mineral binding agents. The abbreviation according to EN 13168 is WW (Wood Wool board).

The following boards are declared here:
- Heraklith Standaardplaat M/CF: homogeneous Wood Wool board
- Heraklith 35 mm: homogeneous Wood Wool board

**Purpose of use**
The products are basically used for thermal insulation, fire protection and acoustical insulation, for example in the following typical applications:
1) Parking decks
2) Basement ceilings
3) Loft conversions
4) Timber constructions / Timber frame constructions
5) Sound insulation walls

**Sale/Rules for use**
The products are manufactured in accordance with EN 13168. Further national certifications apply for the individual countries, e.g. the Komo Certificate for NL, the ABZ in combination with the Ü-Certificate for Germany.

Existing EU conformity certificates:
- Simbach: K1-0751-CPD-209.0-01-03/11; K1-0751-CPD-209.0-01-05/11
- Zalaegerszeg: K1-0751-CPD-222.0-01-02/11
- Oosterhout: KOMO 20889/10

**Quality Assurance**

**Internal quality control**
The factory production controls (FPC) are carried out in accordance with EN 13168 and apply for the tests which are specified in the product standards.

**External quality control**
The following institutes carry out examinations of the products once or twice per year:
- FIW (Germany, Hungary)
- Hungary: ÉMI Certificate for "U" elements (constructions) valid for 5 years
- SKH (Netherlands)

As a group, Knauf Insulation is certified according to the following standards:
- ISO 9001
- ISO 14001
- ISO 16001
- OHSAS 18001

Corresponding audits are performed at regular intervals.
Product group: Wood materials
Declared by: Knauf Insulation
Declaration number: EPD-KNI-2012511-E

Delivery conditions
Wood Wool products are only available as boards. The dimensions are usually:
- Width: 500 or 600 mm
- Lengths: 600, 1000, 1200, 2000 and 2400 mm
- Thicknesses: from 8 to 100 mm

Constructional data
Thermal insulation
Nominal value of the heat conductivity Lambda D in W/mK according to the relevant product standard and rated value λ, according to the building authority approval:
- Wood Wool: from 0.08 to 0.11

Humidity protection:
Water vapour diffusion resistance figures μ
- Wood Wool boards: from 2 to 5

Acoustical insulation:
The evaluated degree of sound absorption α_W is determined according to EN ISO 11654.
Acoustical insulation is determined for example according to EN ISO 140.

Compressive strength:
The compressive strength is determined according to EN 826.

Weight per unit area:
The surface-related weight of Wood Wool boards is determined from measurements of the weight and according to EN 1602.

Tensile strength:
The tensile strength perpendicular to faces of the board is determined according to EN 1607.

Bending strength:
The bending strength is determined according to EN 12089.

Specific values for the declared products can be found in the relevant data sheets:
- http://www.knaufinsulation.de/de/holzwolle
- http://www.knaufinsulation.nl/nl/products/overview/houtwol
- http://www.knaufinsulation.hu/hu/termekke/fagyapot_termekkeink

2 Basic materials
According to the type of binder, Wood Wool boards consist of the following components. Usual compositions are:

<table>
<thead>
<tr>
<th>Component</th>
<th>Function</th>
<th>Proportion [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>Substrate material</td>
<td>25 - 35</td>
</tr>
<tr>
<td>Caustic calcined magnesia</td>
<td>Binding agent</td>
<td>30 - 40</td>
</tr>
<tr>
<td>Magnesium sulphate</td>
<td>Co-binding partner</td>
<td>3 - 6</td>
</tr>
<tr>
<td>Water</td>
<td>Carrier for co-binding partner</td>
<td>30 - 40</td>
</tr>
</tbody>
</table>
2) Grey cement binding

<table>
<thead>
<tr>
<th>Component</th>
<th>Function</th>
<th>Proportion [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>Substrate material</td>
<td>20 - 30</td>
</tr>
<tr>
<td>Cement</td>
<td>Binding agent</td>
<td>40 - 50</td>
</tr>
<tr>
<td>Calcium formate</td>
<td>Setting accelerator</td>
<td>0,5 - 5</td>
</tr>
<tr>
<td>Water</td>
<td>Carrier for setting accelerator</td>
<td>25 - 35</td>
</tr>
</tbody>
</table>

3) White cement binding

<table>
<thead>
<tr>
<th>Component</th>
<th>Function</th>
<th>Proportion [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>Substrate material</td>
<td>25 - 35</td>
</tr>
<tr>
<td>White cement</td>
<td>Binding agent</td>
<td>25 - 35</td>
</tr>
<tr>
<td>Lime hydrate</td>
<td>Co-binding partner</td>
<td>10 - 20</td>
</tr>
<tr>
<td>Water glass</td>
<td>Setting accelerator</td>
<td>0,3 - 5</td>
</tr>
<tr>
<td>Water</td>
<td>Carrier for setting accelerator</td>
<td>20 - 30</td>
</tr>
</tbody>
</table>

Auxiliary materials

No further auxiliary materials are used other than the substances listed in the table above.

- Spruce, poplar: Spruce is obtained from regional forestry operations and is used as a substrate material.
- Caustic calcined magnesia: Caustic calcined magnesia is produced from the material raw magnesite.
- Cement, white cement: Cement is a finely ground hydraulic binding agent for mortar and concrete, which sets both in air as well as under water.
- MgSO₄: Magnesium sulphate is used as a fertiliser as well as for various industrial applications, for example in the manufacture of Wood Wool boards and Wood Wool cover layers of Wood Wool composite boards and serves as a co-binding partner for caustic calcined magnesia.
- Water: Water is contained in the product both as crystalline bound water and residual moisture.
- Water glass: Water glass is the term for glass-like, i.e. amorphous, water-soluble sodium and potassium silicates or their aqueous solutions, which have solidified from a molten mass. Water glass is used as a setting catalys t where cement is used as a binding agent.
- Lime hydrate: Calcium hydroxide is produced with great release of heat during the decomposition of calcium oxide with water.
- Magnesium chloride: The technical production of magnesium chloride is performed by evaporation of the final solutions from the production of potassium chloride.
- Calcium formate can be produced by the reaction of carbon monoxide with calcium hydroxide or the reaction of formaldehyde with a calcium compound in an aqueous solution.
- Paint: If necessary, water-soluble dyes are used to colour Wood Wool products.

Spruce, poplar: Only regionally available wood is used for the manufacture of Wood Wool boards and the Wood Wool cover layers of Wood Wool composite boards. Only PEFC-certified wood is used at the Oosterhout and Simbach sites.
3 Manufacture of the product

1. Raw material

The raw material wood plays an important part in the production of Wood Wool boards. Various types of wood can be used for the production of the boards. Spruce and poplar are used for Wood Wool products from Knauf Insulation. Magnesite (MgO) and cement are used as binding agents.

2. Storage of the logs

As an example, spruce is stored in the form of 2 m long logs. Depending on the climatic conditions, these are stored for about 6-12 months.

3. Wood cutting

The 2 m long logs are transported to a multiple saw by means of a conveyor belt and are cut into pieces. These wooden blocks are fed to a planing machine, which produces the Wood Wool.

4. Mixer

As well as the Wood Wool, a binding agent and a solution are required to produce the mixture for the Wood Wool boards. These components are transported to a mixer, where they are processed into the required mixture.

5. Spreading

The Wood Wool mixture is fed to a spreading machine, where it is divided into two portions. One portion is for the lower layer and the other for the cover layer. The mixture is transported through several separating units.

6. Moulding

This stage enables the production of single layer or composite boards. For the production of homogeneous products the Wood Wool mixture is only spread into the
moulds from a single spreading machine.

The endless Wood Wool string is divided with a flying saw and the individual moulds can be stacked at the end of the production line. In order to ensure the form of the material, suitable concrete weights are placed on the stacked moulds.

7. Demoulding

The stacks with the filled moulds are transported to the drying store, where they have to be dried for between 12 and 24 hours. After this time the boards can be processed and the moulds are turned 180° so that the boards fall out of the moulds. The empty moulds are returned to the production process. The finished boards pass through a dryer, which removes the moisture from the surface. After this stage the edges are trimmed or the boards are cut to the required format.

8. Finishing

Depending on customers' requirements, various processes can be used in order to finish the boards. The double end profiler is an automatic system consisting of two separate machines, on which two different processes can be carried out. The first step is to cut the boards to smaller sizes the second step is to form the edges.

The most usual forms of edge processing are shiplap, tongue and groove, bevel or combinations of these variants.

After passing through the profiler, the boards can be painted. For this, the boards are transported from the profiler to the painting equipment. First of all the boards pass through a surface cleaning station before they reach the painting equipment. Here, painting is carried out. The colour can be selected by the customer and is sprayed onto the surface with nozzles. After this the boards pass through the dryer and the packaging system. The stacks are packaged and transported to the warehouse.
Health protection
Manufacture

Safety data sheets exist for all raw and auxiliary materials. The actual status and
any problem areas are analysed in the annual environmental report.
Appropriate measures for the remedy of problems are suggested.
Due to the residual moisture, there is no significant production of dust during cutting
in the production phase.

Environmental protection
Manufacture

The exhaust air from the extraction systems is returned to the production area in the
context of an exhaust air return.
All sites are certified according to ISO 14001 in the context of the group certification.

4 Processing of the product

Recommendations for processing

The processing guidelines for the particular products must be observed. In addition,
the recognised rules of technology apply.

Industrial health and safety

Industrial health and safety:

Dust may be produced during sawing in the installation phase. Adequate ventilation
must be provided, or the worker must wear respiratory protection. Special protective
measures over and beside the generally valid regulations for industrial health and
safety are not required.

Environmental protection:

According to present knowledge there is no hazard to water, air or soil if the boards
are processed as intended.

Residual material

The board offcuts and packaging material must be separately recorded and collected
on the construction site. The legal regulations and the information stated under
Item 7 “Post usage phase” must be observed for disposal.

Packaging

Untreated disposable wooden pallets, packaging bands, edge protectors and stretch
films are used for packaging and protection against damage during transport. Care
must be taken that the packaging materials are separately recorded and disposed of
at the place where the waste occurs.

EWC numbers:

- Wooden pallets: 150103
- Packaging bands: 150102
- Edge protectors: 150101
- Stretch film: 150102

5 Condition in use

Constituent materials

The proportions of constituent materials correspond to those in the composition of
the basic materials (refer to Item 1 “Basic materials”).
In the case of cement binder the binding process is irreversible. Under the continu-
ous effect of water, the magnesite binding reacts with a reduction in strength. In the
condition in use, the constituent materials are firmly bound. According to present
knowledge there is no hazard to water, air or soil if the described products are pro-
cessed as intended.

Interactions

According to present knowledge there is no hazard to water, air or soil if the
described products are processed as intended. In the condition in use, the constitu-
ents of the products are firmly bound.

Environment

Health

Durability in use conditions

The service life of the products corresponds to the life of the building.
6 Exceptional influences

Fire
Wood Wool boards are categorised into the building materials classes
- B or A2
- s1 low production of smoke
- d0 no burning droplets.

Wood Wool boards increase the duration of fire resistance of building components and therefore make a considerable contribution to constructional fire protection.

Water
After long periods of wetting (e.g. floods) the product must be replaced.

Growth of mould
Mineral bound Wood Wool boards are resistant to mould.

Mechanical destruction
No smooth fracture surfaces occur at the edges of fractures.

7 Post-usage phase

Re-use
In their uncoated (e.g. not plastered) and undamaged form, Wood Wool products can be re-used.

Further use
In their uncoated (e.g. not plastered) and undamaged form, Wood Wool products can be re-used. For example, after removal from a parking deck, the Wood Wool products can be used for a cellar ceiling.

Recycling
If fully separated, the products can be recycled and re-used as additional material for the production of WW boards.

Recovery
The following recycling possibilities exist:

Composting:
Mechanically shredded Wood Wool boards without a plaster coating can be converted to compost material by enrichment with appropriate bacteria. This material can then be used for soil improvement in agriculture.

Incineration:
For mechanically shredded Wood Wool boards, there is also the possibility of energy recovery by incineration.

Disposal
If the aforementioned recycling possibilities are not practical, board residues on construction sites and boards from demolition work can be disposed of without problems as landfill due to their primarily mineral constituents.

Waste materials code, EWC code:
Homogeneous products: 17 01 07
8 Life Cycle Assessment

The following presents the LCA, its background and the results.

8.1 Details of the system definition and modelling of the life cycles

Declared Unit

The declared unit is 1 m² of Wood Wool board. The following table lists the products which are considered in the LCA.

The calculation includes the data from three plants, (Simbach – Germany, Zalae-gerszeg – Hungary, Oosterhout – Netherlands) weighted according to the production quantities. The data from the plants are modelled so that they provide an average Wood Wool board with an average mixture of binding agent.

Table 8-1: Overview of declared products

<table>
<thead>
<tr>
<th>Thicknesses</th>
<th>R-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>[mm]</td>
<td>[m²K/W]</td>
</tr>
<tr>
<td>Heraklith Standardplaat ¹</td>
<td>25</td>
</tr>
<tr>
<td>Heraklith M ¹</td>
<td>25</td>
</tr>
<tr>
<td>Heraklith CF ¹</td>
<td>25</td>
</tr>
<tr>
<td>Heraklith</td>
<td>35</td>
</tr>
</tbody>
</table>

System boundaries

The LCA refers to the production or supply and transportation of the Basic materials and the manufacture of the final products. The packaging materials, their transportation and their end of life (incineration) are also taken into account as part of the manufacture. Transport to the customer and to the end of life, as well as the end of life in the form of landfill disposal or incineration are also considered.

Assumptions and estimates

As far as possible, data specific to the country (e.g. the Hungarian electricity mixture) were used for the specific modelling of the three plants. Otherwise, as far as possible, European data, ultimately German data was used.

With regard to the end of life of the products, instead of disposal in a biomass power station, disposal in a waste incineration plant as well as disposal as landfill were assumed, as due to the high mineral content, disposal in a biomass power station was considered to be unlikely. The choice of the disposal scenarios was made in consultation with the manufacturer. The effects of landfill disposal and incineration were calculated in a generic model on the basis of the elementary composition of the Wood Wool boards. The boiler efficiency of the incineration plant was assumed to be 0.8.

Cut-off criteria

All data from the operational data records, i.e. according to the mixture of the initial substances used, the thermal energy used and the electricity consumption; all direct production waste and all available emission measurements were taken into account in the balance. For all of the inputs and outputs considered, assumptions for the transportation were made. With this, material and energy flows with a portion of less than 1% were considered.

It can be assumed that the processes which were not considered made a contribution of less than 5% each of the impact categories which were considered.

The machinery and facilities used for manufacture were not considered.

¹ In the ecological balance sheet Heraklith Standardplaat, M and CF were calculated as a single board, as they have the same dimensions and weight per unit area.
Transportation
Transportation of both the Basic materials and the packaging materials as well as for the final product (transport to the construction site) and the waste product (transport to end of life) were included in the calculation.

For the Basic materials a transport distance (by road) of between 42 to 1160 km or (by ship) of up to 900 km as well as a utilisation of the cargo capacity of the truck of 85% was considered. The average transportation distance of the Basic materials is approx. 300 km. An average distance of approx. 175 km results for the packaging material. A Class 34 - 40t / Euro 3 truck was assumed as the means of transport.

For the transport to the construction site, average distances of maximum 460 km by road and 175 km by train were taken into account. A truck with a 25t payload and 85m³ cargo volume was assumed. The utilisation is 85%.

For the transportation from the building to the “end of life” an average distance of 50 km was included in the calculation and a utilisation of the cargo capacity of the truck of 50% was assumed (with this assumption, the truck travels full to the landfill site and returns empty to the construction site). A Class 34 - 40t / Euro 3 truck was assumed as the means of transport.

Period considered
The period considered covers 12 months: January 2010 – December 2010.

Background data
The calculation of the LCA was performed on the basis of data from the LCA database /Ga 4 2010/.

Most of the data for the basic products chains, including the raw materials originates from industrial sources, which were recorded under consistent time and methodological conditions.

Data quality
Most of the data originates from the data collection and relates to the time period stated above. The background data used are not older than 9 years.

Allocation
In the forestry chain the allocation is according to weight. Allocations in a sawmill are not present in this case, as the Wood Wool plants are supplied with whole logs without bark. Recycled wood is not used.

The data which is specific to the plant relates to the plant as a whole and was obtained via specific weight information for the individual products.

Waste is produced in the Oosterhout plant, which is sold as "B Choice" - i.e. second class goods. For these waste quantities an allocation was performed according to the market price.

Incineration of waste and packaging
Packaging and to some extent waste are incinerated. The resulting credits for electricity and thermal energy are integrated into manufacturing balance sheet. The energy which is subsequently obtained as a result of incineration is offset by means of an equivalence process. For the incineration of product waste, the relevant country-specific electricity or thermal energy is offset. The European electricity mix is used for the incineration of packaging.

Information about the usage stage
The use of the Wood Wool board in the building is not considered in the LCA.

Choice of end of life scenario
The following two disposal scenarios were assumed for the Wood Wool boards:

- 100% in a waste incineration plant
- 100% as landfill

Both scenarios were modelled on the basis of the elementary composition of the boards.
Credits

For the incineration of the Wood Wool board in a waste incineration plant an additional electricity consumption must be taken into account, as due to the lower calorific value (higher proportion of minerals in the board) the electricity which is generated is not sufficient to cover the consumption by the waste incineration plant. In this case, although there are credits for thermal energy, there are no credits for electricity.

For disposal as landfill, no credit is given for any resulting landfill gas and the possible generation of electricity from this. This approach is conservative and reflects the "worst case".

8.2 Presentation of the balances and assessment

The following section presents the material balance assessment with regard to the material and energy resources as well as the waste which is produced.

The evaluation is divided into binding agent, wood, (other) Basic materials incl. transport, production, packaging, EoL 100% incineration, EoL 100% landfill disposal and credits. The Basic materials including transport includes all Basic materials and their transportation. Other Basic materials including transport includes all Basic materials (and their transport) except for the binding agent and the wood. This categorisation is only made for the use of primary energy and the effect categories.

Primary energy

The following illustrates the use of primary energy for the Wood Wool boards under consideration, taking into account the two end of life scenarios.

Table 8-2: Use of primary energy for both Wood Wool boards related to 1 m²

<table>
<thead>
<tr>
<th>Product</th>
<th>Basic materials incl. transport</th>
<th>Production</th>
<th>Packaging</th>
<th>Transport</th>
<th>EoL 100% incineration</th>
<th>Credit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HeraklithStandardplaat/M/CF</td>
<td>Binding agent</td>
<td>Wood</td>
<td>Other Basic materials incl. transport</td>
<td>Production</td>
<td>Packaging</td>
<td>Transport</td>
<td>EoL 100% incineration</td>
</tr>
<tr>
<td>Use of non-renewable primary energy [MJ]</td>
<td>26.82</td>
<td>0.73</td>
<td>13.23</td>
<td>30.52</td>
<td>-1.33</td>
<td>2.69</td>
<td>16.25</td>
</tr>
<tr>
<td>Use of renewable primary energy [MJ]</td>
<td>0.54</td>
<td>-0.49</td>
<td>0.11</td>
<td>2.70</td>
<td>2.00</td>
<td>3.98E-03</td>
<td>0.59</td>
</tr>
<tr>
<td>HeraklithStandardplaat/M/CF</td>
<td>Binding agent</td>
<td>Wood</td>
<td>Other Basic materials incl. transport</td>
<td>Production</td>
<td>Packaging</td>
<td>Transport</td>
<td>EoL 100% incineration</td>
</tr>
<tr>
<td>Use of non-renewable primary energy [MJ]</td>
<td>26.82</td>
<td>0.73</td>
<td>13.23</td>
<td>30.52</td>
<td>-1.33</td>
<td>2.69</td>
<td>16.25</td>
</tr>
<tr>
<td>Use of renewable primary energy [MJ]</td>
<td>0.54</td>
<td>-0.49</td>
<td>0.11</td>
<td>2.70</td>
<td>2.00</td>
<td>3.98E-03</td>
<td>0.59</td>
</tr>
<tr>
<td>Heraklith (35mm)</td>
<td>Binding agent</td>
<td>Wood</td>
<td>Other Basic materials incl. transport</td>
<td>Production</td>
<td>Packaging</td>
<td>Transport</td>
<td>EoL 100% incineration</td>
</tr>
<tr>
<td>Use of non-renewable primary energy [MJ]</td>
<td>32.45</td>
<td>0.94</td>
<td>16.21</td>
<td>37.39</td>
<td>-1.86</td>
<td>3.29</td>
<td>19.49</td>
</tr>
<tr>
<td>Use of renewable primary energy [MJ]</td>
<td>0.69</td>
<td>59.29</td>
<td>0.21</td>
<td>3.37</td>
<td>2.80</td>
<td>4.98E-03</td>
<td>0.09</td>
</tr>
<tr>
<td>Heraklith (35mm)</td>
<td>Binding agent</td>
<td>Wood</td>
<td>Other Basic materials incl. transport</td>
<td>Production</td>
<td>Packaging</td>
<td>Transport</td>
<td>EoL 100% incineration</td>
</tr>
<tr>
<td>Use of non-renewable primary energy [MJ]</td>
<td>32.45</td>
<td>0.94</td>
<td>16.21</td>
<td>37.39</td>
<td>-1.86</td>
<td>3.29</td>
<td>19.49</td>
</tr>
<tr>
<td>Use of renewable primary energy [MJ]</td>
<td>0.69</td>
<td>59.29</td>
<td>0.21</td>
<td>3.37</td>
<td>2.80</td>
<td>4.98E-03</td>
<td>0.09</td>
</tr>
</tbody>
</table>

The largest proportion of the non-renewable energy which is used is for the basic materials and the production of the Wood Wool boards. In the case of the basic materials, the primary role is played by the binding agent. In the case of renewable primary energy, the basic materials including the wood have the greatest effect. This is due to the energy content of the wood. In the consideration of the end of life scenarios, it is noticeable that there is a credit for the thermal energy produced by incineration. The use of energy for the end of life comprises the transport for disposal and the energy consumed by the incineration plant or the landfill.

The following illustrates the distribution of energy sources in percent, related to MJ. The percentage distribution for the HeraklithStandardplaat/M/CF and the Heraklith (35mm) is the same, so that no distribution for the specific product was carried out.
It is apparent that the proportion for natural gas is greater in the landfill scenario than in the incineration scenario. This is due to the credits which are awarded in the incineration scenario.

In the case of renewable energy sources, the greatest proportion is in the scenarios for solar energy. This is stored in the wood. Over the life cycle of the Wood Wool boards, secondary fuels are also used. This primarily occurs in the basic-material chain for the binding agent cement.
Table 8-3: Use of secondary fuels over the life cycles considered for Wood Wool boards related to 1m²

<table>
<thead>
<tr>
<th>Heraklith Standardplaat/M/CF</th>
<th>Total (incineration)</th>
<th>Total (landfill)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary fuels [MJ]</td>
<td>1.42</td>
<td>1.43</td>
</tr>
<tr>
<td>Use of renewable secondary fuels [MJ]</td>
<td>5.53E-04</td>
<td>6.90E-03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heraklith 35mm</th>
<th>Total (incineration)</th>
<th>Total (landfill)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary fuels [MJ]</td>
<td>1.74</td>
<td>1.75</td>
</tr>
<tr>
<td>Use of renewable secondary fuels [MJ]</td>
<td>6.77E-04</td>
<td>8.49E-03</td>
</tr>
</tbody>
</table>

**CO₂ balance**

For wood products, the CO₂ balance shows how carbon dioxide is absorbed and emitted over the lifetime of the product. During the growth of the wood CO₂ is absorbed and converted in the course of photosynthesis. The carbon remains stored in the wood. The inclusion of the packaging has the same background: Among other things, wooden pallets are used to package the product, so that here too, the absorption of carbon dioxide during the growth of the wood is considered.

The emissions during the production of the wooden pallets occur due to the production of the Basic materials and ancillary materials, the processing of the wood into wood fibre and ultimately the production of the pallet. All of these stages require energy, during the provision of which carbon dioxide is emitted.

The End of Life, incineration of the product or disposal as landfill shows the following emissions:

In the case of incineration the carbon stored in the wood is mainly oxidised to carbon dioxide and emitted. In addition, CO₂ emissions are also caused by the combustion of other substances which contain carbon. As the energy produced by incineration of the Wood Wool board is a substitute for the thermal energy from natural gas, a credit is obtained for CO₂ emissions.

![CO₂ balance graph](image)

**Fig. 8-3: CO₂ balance for Heraklith Standardplaat/M/CF Wood Wool boards (incineration)**

In the case of disposal as landfill there are less CO₂ emissions, as in this case methane is also produced as an emission from the carbon. No credits are awarded.
Environmental Product Declaration
Wood Wool Boards

Product group: Wood materials
Declared by: Knauf Insulation
Declaration number: EPD-KNI-2012511-E

Fig. 8-4: CO₂ balance for Heraklith (35mm) Wood Wool boards (incineration)

Fig. 8-5: CO₂ balance for Heraklith Standardplaat/M/CF Wood Wool boards (disposal as landfill)

Fig. 8-6: CO₂ balance for Heraklith (35mm) Wood Wool boards (landfill scenario)
The balance for the overall life cycle is positive, as the emissions from production and the end of life exceed the storage of carbon in the wood and the credits. This means that in total more carbon dioxide is emitted than is absorbed or is credited for.

**Use of water**

The use of water for Wood Wool boards is illustrated in the following table.

**Table 8-4: Use of water over the life cycles considered for Wood Wool boards related to 1m²**

<table>
<thead>
<tr>
<th>Basic materials</th>
<th>Production</th>
<th>Packaging</th>
<th>Transport</th>
<th>Eol 100% incineration</th>
<th>Credit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water [m³]</td>
<td>1.41E-02</td>
<td>1.70E-02</td>
<td>1.07E-03</td>
<td>1.98E-05</td>
<td>8.98E-03</td>
<td>-1.04E-04</td>
</tr>
<tr>
<td>Water [m³]</td>
<td>1.73E-02</td>
<td>2.08E-02</td>
<td>1.50E-03</td>
<td>2.43E-05</td>
<td>1.10E-02</td>
<td>-1.27E-04</td>
</tr>
<tr>
<td>Water [m³]</td>
<td>1.41E-02</td>
<td>1.70E-02</td>
<td>1.07E-03</td>
<td>1.98E-05</td>
<td>1.15E-02</td>
<td>0.00</td>
</tr>
<tr>
<td>Water [m³]</td>
<td>1.73E-02</td>
<td>2.08E-02</td>
<td>1.50E-03</td>
<td>2.43E-05</td>
<td>1.85E-02</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Waste**

The production of waste is listed in the following table.

**Table 8-5: Occurrence of waste over the life cycles considered for Wood Wool boards related to 1m²**

<table>
<thead>
<tr>
<th>Basic materials</th>
<th>Production</th>
<th>Packaging</th>
<th>Transport</th>
<th>Eol 100% incineration</th>
<th>Credit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockpile products [kg]</td>
<td>6.34</td>
<td>4.84</td>
<td>-0.20</td>
<td>6.76E-03</td>
<td>2.01</td>
<td>-6.46E-02</td>
</tr>
<tr>
<td>Domestic waste[kg]</td>
<td>1.91E-04</td>
<td>1.16</td>
<td>1.68E-02</td>
<td>0.00</td>
<td>1.63E-05</td>
<td>0.00</td>
</tr>
<tr>
<td>Hazardous waste [kg]</td>
<td>2.30E-03</td>
<td>2.57E-02</td>
<td>4.73E-04</td>
<td>0.00</td>
<td>0.61</td>
<td>0.00</td>
</tr>
<tr>
<td>Radioactive waste [kg]</td>
<td>1.51E-03</td>
<td>2.20E-03</td>
<td>-2.20E-04</td>
<td>4.82E-06</td>
<td>1.22E-02</td>
<td>-1.56E-05</td>
</tr>
<tr>
<td>Stockpile products [kg]</td>
<td>6.34</td>
<td>4.84</td>
<td>-0.20</td>
<td>6.76E-03</td>
<td>12.23</td>
<td>0.00</td>
</tr>
<tr>
<td>Domestic waste[kg]</td>
<td>1.91E-04</td>
<td>1.16</td>
<td>1.68E-02</td>
<td>0.00</td>
<td>1.91E-06</td>
<td>0.00</td>
</tr>
<tr>
<td>Hazardous waste [kg]</td>
<td>2.30E-03</td>
<td>2.57E-02</td>
<td>4.73E-04</td>
<td>0.00</td>
<td>1.01E-02</td>
<td>0.00</td>
</tr>
<tr>
<td>Radioactive waste [kg]</td>
<td>1.51E-03</td>
<td>2.20E-03</td>
<td>-2.20E-04</td>
<td>4.82E-06</td>
<td>3.88E-04</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Impact assessment**

In order to determine the possible environmental impacts of the manufacture of the declared Wood Wool boards, the CML method with the characterisation factors for the year 2009 is used. The following tables and diagrams show the results of the life cycles of the declared Wood Wool boards under consideration according to the effect categories ADP elements, ADP fossil, GWP, ODP, AP, EP and POCP.
Table 8-6: Impacts categories of the life cycles of the products under consideration

<table>
<thead>
<tr>
<th>Heraklith Standard-</th>
<th>Binding agent</th>
<th>Wood</th>
<th>Other Basic materials incl. transport</th>
<th>Production</th>
<th>Packaging</th>
<th>Transport</th>
<th>EoL 100% incineration</th>
<th>Credit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel</td>
<td>AOP elem. [kg Sb-eq./m²]</td>
<td>6.0E-06</td>
<td>1.76E-09</td>
<td>1.13E-08</td>
<td>1.01E-06</td>
<td>0.06E-08</td>
<td>4.07E-09</td>
<td>1.13E-06</td>
<td>0.36E-08</td>
</tr>
<tr>
<td></td>
<td>AOP fossil [MJ/m²]</td>
<td>2.831</td>
<td>0.32</td>
<td>10.85</td>
<td>21.31</td>
<td>0.49</td>
<td>2.84</td>
<td>12.15</td>
<td>-11.73</td>
</tr>
<tr>
<td></td>
<td>GWP [kg CO2-eq./m²]</td>
<td>5.63</td>
<td>-5.04</td>
<td>1.13</td>
<td>2.73</td>
<td>4.02E-03</td>
<td>0.19</td>
<td>5.97</td>
<td>-0.90</td>
</tr>
<tr>
<td></td>
<td>DOP [kg R11-eq./m²]</td>
<td>8.56E-08</td>
<td>1.25E-06</td>
<td>3.51E-08</td>
<td>1.74E-06</td>
<td>0.76E-05</td>
<td>9.72E-08</td>
<td>1.78E-06</td>
<td>1.33E-09</td>
</tr>
<tr>
<td></td>
<td>AP [kg SO2-eq./m²]</td>
<td>7.59E-03</td>
<td>2.91E-04</td>
<td>2.75E-03</td>
<td>4.75E-03</td>
<td>4.87E-04</td>
<td>9.18E-04</td>
<td>1.76E-02</td>
<td>8.98E-04</td>
</tr>
<tr>
<td></td>
<td>EP [kg P2O5-eq./m²]</td>
<td>9.93E-04</td>
<td>6.01E-05</td>
<td>2.93E-04</td>
<td>1.03E-03</td>
<td>8.49E-06</td>
<td>2.08E-04</td>
<td>1.48E-03</td>
<td>1.44E-04</td>
</tr>
<tr>
<td></td>
<td>POCP [kg PO43-eq./m²]</td>
<td>7.73E-04</td>
<td>3.66E-04</td>
<td>2.40E-04</td>
<td>4.34E-04</td>
<td>3.79E-06</td>
<td>9.95E-05</td>
<td>6.99E-04</td>
<td>-1.12E-04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heraklith Standard-</th>
<th>Binding agent</th>
<th>Wood</th>
<th>Other Basic materials incl. transport</th>
<th>Production</th>
<th>Packaging</th>
<th>Transport</th>
<th>EoL 100% incineration</th>
<th>Credit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel</td>
<td>AOP elem. [kg Sb-eq./m²]</td>
<td>6.0E-06</td>
<td>1.76E-09</td>
<td>1.13E-08</td>
<td>1.01E-06</td>
<td>0.06E-08</td>
<td>4.07E-09</td>
<td>1.13E-06</td>
<td>0.36E-08</td>
</tr>
<tr>
<td></td>
<td>AOP fossil [MJ/m²]</td>
<td>2.831</td>
<td>0.32</td>
<td>10.85</td>
<td>21.31</td>
<td>0.49</td>
<td>2.84</td>
<td>12.15</td>
<td>-11.73</td>
</tr>
<tr>
<td></td>
<td>GWP [kg CO2-eq./m²]</td>
<td>5.63</td>
<td>-5.04</td>
<td>1.13</td>
<td>2.73</td>
<td>4.02E-03</td>
<td>0.19</td>
<td>5.97</td>
<td>-0.90</td>
</tr>
<tr>
<td></td>
<td>DOP [kg R11-eq./m²]</td>
<td>8.56E-08</td>
<td>1.25E-06</td>
<td>3.51E-08</td>
<td>1.74E-06</td>
<td>0.76E-05</td>
<td>9.72E-08</td>
<td>1.78E-06</td>
<td>1.33E-09</td>
</tr>
<tr>
<td></td>
<td>AP [kg SO2-eq./m²]</td>
<td>7.59E-03</td>
<td>2.91E-04</td>
<td>2.75E-03</td>
<td>4.75E-03</td>
<td>4.87E-04</td>
<td>9.18E-04</td>
<td>1.76E-02</td>
<td>8.98E-04</td>
</tr>
<tr>
<td></td>
<td>EP [kg P2O5-eq./m²]</td>
<td>9.93E-04</td>
<td>6.01E-05</td>
<td>2.93E-04</td>
<td>1.03E-03</td>
<td>8.49E-06</td>
<td>2.08E-04</td>
<td>1.48E-03</td>
<td>1.44E-04</td>
</tr>
<tr>
<td></td>
<td>POCP [kg PO43-eq./m²]</td>
<td>7.73E-04</td>
<td>3.66E-04</td>
<td>2.40E-04</td>
<td>4.34E-04</td>
<td>3.79E-06</td>
<td>9.95E-05</td>
<td>6.99E-04</td>
<td>-1.12E-04</td>
</tr>
</tbody>
</table>

In the impact category ADP elements, the binding agent has the greatest effect. For AOP fossil the largest portion results from production and the Basic materials, primarily from the binding agent. In the incineration scenarios a negative portion is apparent, which represents the thermal credit.

For the GWP impact category, the largest portion is due to the end of life and the binding agent. This results from the emissions which are produced in incineration and in the landfill or from the basic material chain. Wood has a negative portion of the GWP as CO₂ is stored in the wood.

With the ODP production shows the largest portion. This mainly results from the electricity which is used. The visible negative portion results from the incineration of the packaging material and the associated credits.

The impact category AP is mostly influenced by incineration scenarios for the end of life of the products. In the case of the landfill scenario, the influence is primarily due to the binding agent. The results are mainly due to the emissions from incineration or from the basic materials chain of the binding agent.

In the case of EP, products with a landfill scenario are mainly influenced by the end...
of life, while in the other illustration the binding agent and the production predomi-
nate. In the end of life the EP is influenced by emissions from landfill disposal. For
the binding agent and the production, the energy consumption and the basic materi-
als chains play a large role.

With the POCP the binding agent and the end of life have a similarly large influence.
For the binding agent this mainly results from the basic materials chains; for the end
of life from operation and emissions.

Fig. 8-7: Relative proportions of the life cycle phases in % (ADP and GWP)
9  Certificates

Formaldehyde  A mineral binding agent is used for the manufacture of Wood Wool products. Formaldehyde is not used in any version of the binding agent.

MDI  The binding of Wood Wool products is done by using binding agents. No adhesive system containing MDI is used to bind the Wood Wool.

Examination of pre-treatment of the materials used  This examination only applies for wood materials in which recycled wood is used. This is not the case for the products declared here.

Toxic nature of combustion gases  This examination is only relevant for wood materials which are used in meeting halls. This is not the case for the products declared here.

VOC  Test procedure according to the AgBB scheme

Testing laboratory:

Eurofins Product Testing A/S
Smedeskovvej 38, DK-8464 Galten, Dänemark

The test sample was selected by the company Knauf Insulation Technology GmbH as representative for the entire range.

Assessment of the test results according to AgBB:

- Carcinogens were not detectable after 3 and after 28 days.
- The total VOC (TVOC) after 3 days was below the assessment limit of 10 mg/m³
- The total VOC (TVOC) after 28 days was below the assessment limit of 1 mg/m³
The total SVOC after 28 days was below the assessment limit of 0.1 mg/m³.

For the individual VOC substances with more than 5 µg/m³ determined after 28 days, there was an assessment figure R below the upper limit of 1.

After 28 days the total individual VOC substances without the NIK value was below the assessment limit of 0.1 mg/m³.

The assessment limit for formaldehyde (120 µg/m² after 28 days) was complied with.

"The examined product is suitable for use in interior rooms according to the "Zulassungsgrundsätzen zur gesundheitlichen Bewertung von Bauprodukten in Innenräumen [Approval principles for the health assessment of building products]" (DIBt report 10/2010) in combination with the NIK values of the AgBB, status May 2010." (Excerpt from the certification-)

Oosterhout: December 2011
Simbach: November and December 2011
Zalaegerszeg: November/December 2011

Lindan/PCP

Lindan and PCP were formerly used in wood preservatives (insecticide and fungicidal effect). However only untreated wood is used for the manufacture of Wood Wool products (max. 2 years, no recycled wood). With regard to this, reference is made to the now valid EU regulations, which generally prohibits the use of these substances.

10 PCR document and verification

This declaration was produced on the basis of the PCR document "Wood materials", 2011-11.

Review of the PCR document by the expert committee.
Chairman of the expert committee Prof. Dr.-Ing. Hans-Wolf Reinhardt (Universität Stuttgart, IWB)

Independent verification of the declaration according to ISO 14025:

☐ internal ☒ external

Validation of the declaration: Dr. Frank Werner

11 Literature

/Istitut Bauen und Umwelt/
Guidelines for the formulation of requirements specific to product groups for environmental product declarations (Type III) for building products, www.bau-umwelt.com

/GaBi 4 2010/

AgBB
Committee for the health evaluation of building products: Health assessment of the emissions of volatile organic compounds (VOC and SVOC) from building products.

Standards and statutes

/ISO 14025/ ISO 14025: 2007-10, environmental labelling and declarations - Type III environ-
Environmental Product Declaration
Wood Wool Boards

Product group: Wood materials
Declared by: Knauf Insulation
Declaration number: EPD-KNI-2012511-E

mental declarations - principles and procedures (ISO 14025:2006); text: German and English


/ISO 9001/ DIN EN ISO 9001:2008-12, Requirements for a Quality Management System (QM-System)


/ISO 16001/ DIN EN 16001:2009: Environmental management systems - requirements with instructions for use

/OHSAS 18001/ OHSAS 18001:2007: Industrial health and safety management systems


In the case of a doubt is the original EPD “EPD-KNI-2012511-D” applicable.