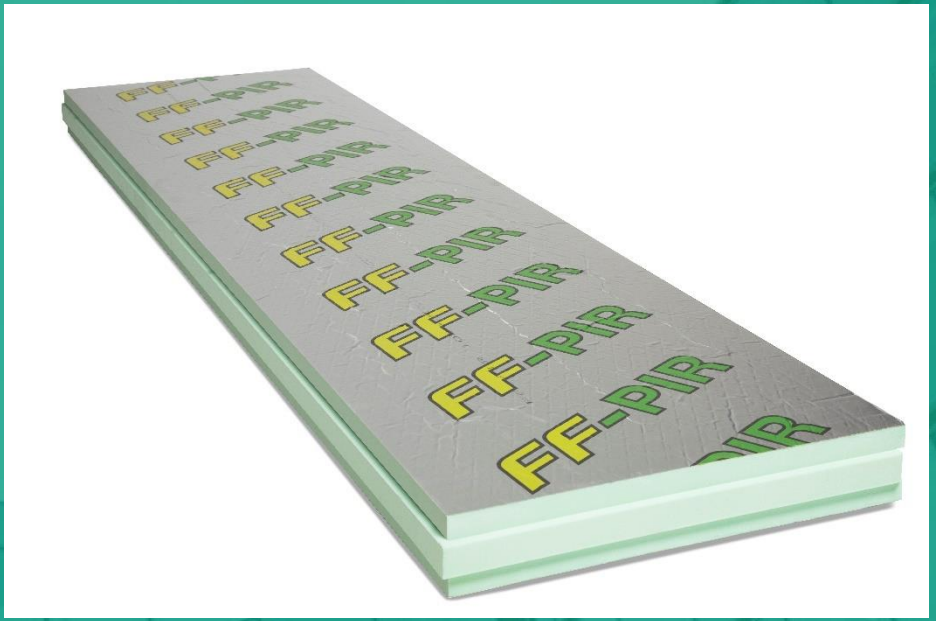
# ENVIRONMENTAL PRODUCT DECLARATION

**IN ACCORDANCE WITH EN 15804+A2 & ISO 14025 / ISO 21930**

## FF-PIR POLYURETHANE INSULATION

**FINNFOAM OY**



# GENERAL INFORMATION

## MANUFACTURER INFORMATION

| | |
|---|---|
| **Manufacturer** | Finnfoam Oy |
| **Address** | Finnfoam Oy, Satamakatu 5, 24100<br>Salo, Finland |
| **Contact details** | Sari Judin,<br>sari.judin@finnfoam.fi |
| **Website** | www.finnfoam.fi |

## PRODUCT IDENTIFICATION

| | |
|---|---|
| **Product name** | FF-PIR Polyurethane Insulation |
| **Place of production** | Salo, Finland |

Jessica Karhu
RTS EPD Committee secretary

Laura Apilo
Managing Director

## EPD INFORMATION

EPDs of construction products may not be comparable if they do not comply with EN 15804 and if they are not compared in a building context.

| | |
|---|---|
| **EPD program operator** | The Building Information Foundation RTS sr<br>Malminkatu 16 A, 00100 Helsinki, Finland<br>http://cer.rts.fi |
| **EPD standards** | This EPD is in accordance with EN 15804 +A2, ISO 14025 and ISO 21930 standards. |
| **Product category rules (PCR)** | The CEN standard EN 15804+A2 serves as the core PCR. In addition, the RTS PCR (English version, 26.8.2020) is used. |
| **EPD author** | Ipek Goktas, at One Click LCA Ltd<br>Suvilahdenkatu 10 B 00500 Helsinki, Finland<br>www.oneclicklca.com |
| **EPD verification** | Independent verification of this EPD and data, according to ISO 14025:<br>☐ Internal certification ☑ External verification |
| **EPD verifier** | Silvia Vilčeková, Silcert, s.r.o. |
| **Verification date** | 22.7.2021 |
| **EPD number** | RTS_140_21 |
| **ECO Platform nr.** | - |
| **Publishing date** | 23.7.2021 |
| **EPD valid until** | 23.7.2026 |

# PRODUCT INFORMATION

## PRODUCT DESCRIPTION

Finnfoam Oy only uses PIR insulation materials whose fire endurance is significantly better than that of PUR insulation materials. The fire rating of the insulating foam component of FF-PIR insulation is D-s2, d0. The CE marked FF-PIR is also a mold-proof and safe material in terms of moisture performance. FF-PIR is one of the most effective insulation materials and thermal conductivity of FF-PIR insulation products is 0.022 W/mK.

## PRODUCT RAW MATERIAL COMPOSITION

| Material | FF-PIR AL Weight, kg | FF-PIR PL Weight, kg | FF-PIR FR Weight, kg |
|---|---|---|---|
| Aluminium laminate (AL) | 0.09 | - | - |
| Plastic laminate (PL) | - | 0.05 | - |
| Fire-Resistant laminate (FR) | - | - | 0.23 |
| MDI isocyanate | 0.58 | 0.60 | 0.49 |
| Polyester polyol | 0.28 | 0.30 | 0.24 |
| Pentane | 0.05 | 0.05 | 0.04 |

## PRODUCT RAW MATERIAL MAIN COMPOSITION

| Raw material category | Amount, mass- % | Material origin |
|---|---|---|
| Fossil materials | ≥ 77 | Europe |
| Minerals | ≤ 23 | Europe |
| Metals | ≤ 9 | Europe |
| Bio-based materials | - | - |

## SUBSTANCES, REACH - VERY HIGH CONCERN

The product does not contain any REACH SVHC substances in amounts greater than 0,1% (1000 ppm).

## PRODUCT APPLICATION

FF-PIR thermal insulation products ensure energy-efficiency in walls, roof/ceilings, and the sauna with significantly thinner layers of insulation.

## TECHNICAL SPECIFICATIONS

FF-PIR is available in thicknesses 20 - 240 mm. The study has been conducted on an average FF-PIR insulation panel, with a total thickness of 100 mm. Nominal density of the panel is 33 kg/m3 without coating/laminate, and for example 36.2 kg/m3 with the aluminium-paper coating. Thermal conductivity is 0.022 W(mK). FF-PIR panels are mainly used in insulating roofs and walls.

## PRODUCT STANDARDS

EN 13165:2012 Thermal insulation products for buildings. Factory made rigid polyurethane foam (PUR) products. Specification.

## PHYSICAL PROPERTIES OF THE PRODUCT

Detailed physical information can be found from the manufacturer's webpage (www.finnfoam.fi/tuotteet/ff-pir/).

## ADDITIONAL TECHNICAL INFORMATION

Further information can be found at www.finnfoam.fi.

# PRODUCT LIFE CYCLE

## MANUFACTURING AND PACKAGING (A1-A3)

The main raw materials of the polyurethane production include MDI-isocyanate and polyester polyol. The product also contains small amounts of fire retardants as well as colouring. The raw materials are first mixed, after which the mass is evenly spread and expanded with pentane. Most of the pentane remains in the product. The panel is then coated with aluminium, plastic or fire-resistant laminate and cut. The finished product is trimmed, packed into plastic and moved to storage from where it can be shipped to the customers. PIR-waste produced during the manufacturing process is directed to Warmotech factory as a raw material. The production loss is considered in the mass balance.

Manufacturing flow chart


## TRANSPORT AND INSTALLATION (A4-A5)

Annual delivery rates are taken into consideration for transportation scenario. There is no significant weight loss due to the emission of the rest of the pentane in the product during transportation. Transportation impacts occurred from delivering of the product cover direct exhaust emissions of fuel, environmental impacts of fuel production, as well as related infrastructure emissions. (A4)

This EPD does not cover installation. Air, soil and water impacts during installation have not been studied. (A5)

## PRODUCT USE AND MAINTENANCE (B1-B7)

This EPD does not cover use phase. Air, soil and water impacts during the use phase have not been studied. During the service life of the product, rest of the pentane is emitted. However, it does not have any harmful impact; therefore, it is not taken into consideration.

## PRODUCT END OF LIFE (C1-C4, D)

The rest of the pentane is assumed to be emitted during the service life of the product; therefore, the mass loss due to this blowing agent is taken into consideration in end-of-life stage. Consumption of energy and natural resources in demolition process is assumed to be negligible. (C1) The distance for transportation to disposal is assumed as 50 km and the transportation method is assumed to be lorry. (C2) Considering the manufacturer's information, 100% of end-of-life product is assumed to be recycled as it is easy to collect and qualified for recycling. (C3) The environmental impacts of disposal are zero since 100% of the end-of-life product is considered to be recycled. (C4) Thanks to the recycling process, end-of-life product replaces virgin material in further productions. (D)

# LIFE CYCLE ASSESSMENT

## LIFE CYCLE ASSESSMENT INFORMATION

| | |
|---|---|
| **Period for data** | 2019 year |

## DECLARED AND FUNCTIONAL UNIT

| | |
|---|---|
| **Declared unit** | 1 kg |
| **Mass per declared unit** | 1 kg |

## BIOGENIC CARBON CONTENT

Product's biogenic carbon content at the factory gate

| | |
|---|---|
| **Biogenic carbon content in product. kg C** | - |
| **Biogenic carbon content in packaging. kg C** | - |

## SYSTEM BOUNDARY

The scope of the EPD is "cradle to gate with modules A4, C1-C4 and D". The modules A1 (Raw material supply), A2 (Transport) and A3 (Manufacturing), A4 (Transport), as well as C1 (Deconstruction/ demolition), C2 (Transport at end-of-life), C3 (Waste processing), C4 (Disposal) and D (benefits and loads beyond the system boundary) are included in the study.

| Product stage | | | Assembly stage | | Use stage | | | | | | | End of life stage | | | | Beyond the system boundaries | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D | D | D |
| X | X | X | X | MND | MND | MND | MND | MND | MND | MND | MND | x | x | x | x | x | x | x |
| Raw materials | Transport | Manufacturing | Transport | Assembly | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstr./demol. | Transport | Waste processing | Disposal | Reuse | Recovery | Recycling |

*Modules not declared = MND*

## CUT-OFF CRITERIA

The study does not exclude any modules or processes which are stated mandatory in the *EN 15804A1:2012+A2:2019* and *RTS PCR*. The study does not exclude any hazardous materials or substances.

The study includes all major raw material and energy consumption. All inputs and outputs of the unit processes which data are available for are included in the calculation. There is no neglected unit process more than 1% of total mass and energy flows. The total neglected input and output flows do also not exceed 5% of energy usage or mass. The life cycle analysis includes all industrial processes from raw material acquisition to production, distribution, and end-of-life stages.

The modules A5, B1-B7 have not been calculated. Accordingly, at a minimum, used sources and generated waste during installation, and emitted pentane during service life are excluded.

The production of capital equipment, construction activities, and infrastructure, maintenance and operation of capital equipment, personnel-related activities, energy, and water use related to company management and sales activities are excluded.

## ALLOCATION, ESTIMATES AND ASSUMPTIONS

Allocation is based on annual production rate and made with high accuracy and precision. The values for 1 kg of the produced product which is used within this study are calculated by considering the total product weight per annual production. The product output is fixed to 1 kg and the corresponding amount of product is used in the calculations.

In the production plant, several kinds of products are produced; since the production processes of these products are similar, the annual production percentages are taken into consideration for allocation. According to the ratio of the annual production of the declared product to the total annual production at the factory, the annual total energy consumption, packaging materials and the generated waste per the declared product are allocated. Subsequently, the produced product output fixed to 1kg and the corresponding amount of product is used in the calculations.

This LCA study is conducted in accordance with all methodological considerations, such as performance, system boundaries, data quality, allocation procedures, and decision rules to evaluate inputs and outputs. All estimations and assumptions are given below.

- Module A2, A4 & C2: Vehicle capacity utilization volume factor is assumed to be 1 which means full load. In reality it may vary but as the role of transportation emission in total results is small and so the variety in load assumed to be negligible. Empty returns are not taken into account as it is assumed that return trip is used by transportation companies to serve the needs of other clients.
- Module A4: Transportation doesn't cause losses as products are packaged properly. Also, volume capacity utilisation factor is assumed to be 1 for the nested packaged products. Additionally, transportation distances and vehicle types are assumed according to the delivery in the last year.
- Module C1: The impacts of the disassembly stage are assumed zero, since the consumption of energy and natural resources for disassembling the end-of-life product is negligible.
- Module C2: Transportation distance to the closest disposal area is estimated as 50 km and the transportation method is assumed as lorry which is the most common.
- Module C3, C4, D: According to the manufacturer's information, 100% of the end-of-life product is assumed to be recycled due to the recycling potential of the end-of-life product and its value in the market. In order the PIR-material at the end of its lifetime to be recycled and used as raw material in Warmotech products, boards have to be used according to the guidelines stated by Finnfoam; for example, product should not have been exposed to UV-radiation during the use. Module C4 impacts are zero as the products are considered to be 100 % collected for recycling. Module D considers the benefits of production of recycled material which replaces virgin material.

## AVERAGES AND VARIABILITY

Any average and variation are not concerned since this EPD refers one specific product produced in one production plant. There are different laminate options for the product; however, the products with different laminates have been assessed independently. The results are given separately for each product with different laminates.

# ENVIRONMENTAL IMPACT DATA

The LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Note: "ENVIRONMENTAL IMPACTS - EN 15804+A1, CML / ISO 21930" and "ENVIRONMENTAL IMPACTS - TRACI 2.1" are presented in ANNEX-1 and ANNEX-2 respectively.

## FF-PIR WITH ALUMINIUM LAMINATE

## CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Climate change – total | kg $CO_2e$ | 2.27E+00 | 2.08E-01 | 1.79E-01 | 2.66E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.08E-03 | 6.19E-01 | 0.00E+00 | -1.65E+00 |
| Climate change – fossil | kg $CO_2e$ | 2.26E+00 | 2.08E-01 | 1.77E-01 | 2.65E+00 | 1.85E-02 | MND | MND | 0.00E+00 | 6.07E-03 | 6.19E-01 | 0.00E+00 | -1.65E+00 |
| Climate change – biogenic | kg $CO_2e$ | 6.65E-03 | 1.27E-04 | 5.58E-04 | 7.34E-03 | 1.34E-05 | MND | MND | 0.00E+00 | 3.72E-06 | 4.06E-05 | 0.00E+00 | -4.69E-03 |
| Climate change – LULUC | kg $CO_2e$ | 2.05E-03 | 6.93E-05 | 1.48E-03 | 3.60E-03 | 5.56E-06 | MND | MND | 0.00E+00 | 2.14E-06 | 2.00E-05 | 0.00E+00 | -1.75E-03 |
| Ozone depletion | kg CFC11e | 4.95E-06 | 4.79E-08 | 1.95E-08 | 5.02E-06 | 4.34E-09 | MND | MND | 0.00E+00 | 1.39E-09 | 7.95E-09 | 0.00E+00 | -4.56E-06 |
| Acidification | mol $H^+e$ | 7.75E-03 | 8.59E-04 | 7.26E-04 | 9.34E-03 | 7.76E-05 | MND | MND | 0.00E+00 | 2.50E-05 | 5.17E-03 | 0.00E+00 | -5.58E-03 |
| Eutrophication, aquatic freshwater [1] | kg Pe | 3.29E-05 | 1.72E-06 | 7.94E-06 | 4.26E-05 | 1.50E-07 | MND | MND | 0.00E+00 | 5.25E-08 | 4.72E-07 | 0.00E+00 | -1.58E-05 |
| Eutrophication, aquatic marine | kg Ne | 1.49E-03 | 2.57E-04 | 1.29E-04 | 1.88E-03 | 2.34E-05 | MND | MND | 0.00E+00 | 7.41E-06 | 3.02E-03 | 0.00E+00 | -1.18E-03 |
| Eutrophication, terrestrial | mol Ne | 1.69E-02 | 2.83E-03 | 1.53E-03 | 2.13E-02 | 2.58E-04 | MND | MND | 0.00E+00 | 8.18E-05 | 2.93E-02 | 0.00E+00 | -1.34E-02 |
| Photochemical ozone formation | kg NMVOCe | 5.42E-03 | 8.86E-04 | 3.07E-03 | 9.38E-03 | 8.30E-05 | MND | MND | 0.00E+00 | 2.57E-05 | 7.25E-03 | 0.00E+00 | -6.85E-03 |
| Abiotic depletion, minerals & metals [2] | kg Sbe | 3.09E-04 | 4.79E-06 | 7.16E-07 | 3.15E-04 | 3.15E-07 | MND | MND | 0.00E+00 | 1.52E-07 | 7.52E-07 | 0.00E+00 | -1.37E-04 |
| Abiotic depletion of fossil resources [2] | MJ | 6.92E+01 | 3.17E+00 | 5.32E+00 | 7.77E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.26E-02 | 5.92E-01 | 0.00E+00 | -6.25E+01 |
| Water use [2] | $m^3e$ deprived | 4.61E-01 | 1.09E-02 | 7.07E-02 | 5.43E-01 | 1.07E-03 | MND | MND | 0.00E+00 | 3.29E-04 | 1.75E-02 | 0.00E+00 | -4.06E-01 |

[1] The required characterisation method and data are in kg P-eq; to get $PO_4e$, multiply the result by 3.07.

[2] EN 15804+A2 Disclaimer 2: "The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator."

# FF-PIR WITH ALUMINIUM LAMINATE

## ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Particulate matter | Incidence | 1.33E-07 | 1.62E-08 | 3.92E-09 | 1.53E-07 | 1.67E-09 | MND | MND | 0.00E+00 | 4.69E-10 | 2.65E-07 | 0.00E+00 | -7.43E-08 |
| Ionizing radiation, human health [3] | kBq U235e | 7.80E-01 | 1.39E-02 | 9.93E-02 | 8.93E-01 | 1.26E-03 | MND | MND | 0.00E+00 | 4.05E-04 | 2.12E-03 | 0.00E+00 | -8.07E-01 |
| Eco-toxicity (freshwater) [2] | CTUe | 2.57E+01 | 2.44E+00 | 2.76E+00 | 3.09E+01 | 2.20E-01 | MND | MND | 0.00E+00 | 7.23E-02 | 1.26E+01 | 0.00E+00 | -1.43E+01 |
| Human toxicity, cancer effects [2] | CTUh | 1.57E-09 | 6.74E-11 | 5.53E-11 | 1.69E-09 | 5.62E-12 | MND | MND | 0.00E+00 | 2.05E-12 | 4.15E-09 | 0.00E+00 | -7.87E-10 |
| Human toxicity, non-cancer effects [2] | CTUh | 3.11E-08 | 2.81E-09 | 1.41E-09 | 3.53E-08 | 2.60E-10 | MND | MND | 0.00E+00 | 8.30E-11 | 1.55E-08 | 0.00E+00 | -2.90E-08 |
| Land use related impacts/soil quality [2] | - | 1.09E+00 | 3.52E+00 | 1.54E-01 | 4.76E+00 | 4.34E-01 | MND | MND | 0.00E+00 | 1.03E-01 | 7.69E-01 | 0.00E+00 | -3.15E+00 |

[2] EN 15804+A2 Disclaimer 2: "The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator."

[3] EN 15804+A2 Disclaimer 1: "This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator."

## USE OF NATURAL RESOURCES

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Renewable PER used as energy | MJ | 2.29E+00 | 4.28E-02 | 1.29E+00 | 3.62E+00 | 3.62E-03 | MND | MND | 0.00E+00 | 1.32E-03 | 1.02E-02 | 0.00E+00 | -2.68E+00 |
| Renewable PER used as materials | MJ | 4.98E-01 | 0.00E+00 | 0.00E+00 | 4.98E-01 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -4.58E-01 |
| Total use of renewable PER | MJ | 2.79E+00 | 4.28E-02 | 1.29E+00 | 4.12E+00 | 3.62E-03 | MND | MND | 0.00E+00 | 1.32E-03 | 1.02E-02 | 0.00E+00 | -3.14E+00 |
| Non-renewable PER used as energy | MJ | 5.63E+01 | 3.17E+00 | 4.55E+00 | 6.40E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.26E-02 | 5.92E-01 | 0.00E+00 | -4.91E+01 |
| Non-renewable PER used as materials | MJ | 1.52E+01 | 0.00E+00 | 7.65E-01 | 1.60E+01 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -1.55E+01 |
| Total use of non-renewable PER | MJ | 7.14E+01 | 3.17E+00 | 5.32E+00 | 7.99E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.26E-02 | 5.92E-01 | 0.00E+00 | -6.46E+01 |
| Use of secondary materials | kg | 7.97E-02 | 0.00E+00 | 2.50E-04 | 8.00E-02 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -2.45E-02 |
| Use of renewable secondary fuels | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Use of non-renewable secondary fuels | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Use of net fresh water | $m^3$ | 1.36E+01 | 5.91E-04 | 1.45E-03 | 1.36E+01 | 5.98E-05 | MND | MND | 0.00E+00 | 1.76E-05 | 5.66E-04 | 0.00E+00 | -1.25E+01 |

*PER abbreviation stands for primary energy resources.*

# FF-PIR WITH ALUMINIUM LAMINATE

## END OF LIFE – WASTE

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hazardous waste | kg | 1.32E-01 | 3.17E-03 | 1.12E-02 | 1.46E-01 | 2.79E-04 | MND | MND | 0.00E+00 | 9.64E-05 | 0.00E+00 | 0.00E+00 | -4.44E-02 |
| Non-hazardous waste | kg | 1.40E+00 | 2.70E-01 | 2.91E-01 | 1.96E+00 | 3.09E-02 | MND | MND | 0.00E+00 | 8.01E-03 | 0.00E+00 | 0.00E+00 | -7.28E-01 |
| Radioactive waste | kg | 3.23E-04 | 2.18E-05 | 4.28E-05 | 3.88E-04 | 1.97E-06 | MND | MND | 0.00E+00 | 6.34E-07 | 0.00E+00 | 0.00E+00 | -3.42E-04 |

## END OF LIFE – OUTPUT FLOWS

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Components for reuse | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for recycling | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 9.53E-01 | 0.00E+00 | 0.00E+00 |
| Materials for energy recovery | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported energy | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

## KEY INFORMATION TABLE (RTS) – KEY INFORMATION PER KG OF PRODUCT

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Climate change – total | kg $CO_2e$ | 2.27E+00 | 2.08E-01 | 1.79E-01 | 2.66E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.08E-03 | 6.19E-01 | 0.00E+00 | -1.65E+00 |
| Abiotic depletion. minerals & metals [2] | kg Sbe | 3.09E-04 | 4.79E-06 | 7.16E-07 | 3.15E-04 | 3.15E-07 | MND | MND | 0.00E+00 | 1.52E-07 | 7.52E-07 | 0.00E+00 | -1.37E-04 |
| Abiotic depletion of fossil resources [2] | MJ | 6.92E+01 | 3.17E+00 | 5.32E+00 | 7.77E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.26E-02 | 5.92E-01 | 0.00E+00 | -6.25E+01 |
| Water use [2] | $m^3e$ deprived | 4.61E-01 | 1.09E-02 | 7.07E-02 | 5.43E-01 | 1.07E-03 | MND | MND | 0.00E+00 | 3.29E-04 | 1.75E-02 | 0.00E+00 | -4.06E-01 |
| Use of secondary materials | kg | 7.97E-02 | 0.00E+00 | 2.50E-04 | 8.00E-02 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -2.45E-02 |
| Biogenic carbon content in product | kg C | N/A | N/A | 0.00E+00 | 0.00E+00 | N/A | MND | MND | N/A | N/A | N/A | N/A | N/A |
| Biogenic carbon content in packaging | kg C | N/A | N/A | 0.00E+00 | 0.00E+00 | N/A | MND | MND | N/A | N/A | N/A | N/A | N/A |

[2] EN 15804+A2 Disclaimer 2: "The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator."

## FF-PIR WITH PLASTIC LAMINATE

## CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Climate change – total | kg $CO_2e$ | 1.82E+00 | 2.05E-01 | 1.79E-01 | 2.20E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.06E-03 | 6.18E-01 | 0.00E+00 | -1.65E+00 |
| Climate change – fossil | kg $CO_2e$ | 1.82E+00 | 2.05E-01 | 1.77E-01 | 2.20E+00 | 1.85E-02 | MND | MND | 0.00E+00 | 6.06E-03 | 6.18E-01 | 0.00E+00 | -1.65E+00 |
| Climate change – biogenic | kg $CO_2e$ | 1.21E-03 | 1.26E-04 | 5.58E-04 | 1.89E-03 | 1.34E-05 | MND | MND | 0.00E+00 | 3.71E-06 | 4.05E-05 | 0.00E+00 | -4.68E-03 |
| Climate change – LULUC | kg $CO_2e$ | 1.49E-04 | 6.79E-05 | 1.48E-03 | 1.70E-03 | 5.56E-06 | MND | MND | 0.00E+00 | 2.14E-06 | 2.00E-05 | 0.00E+00 | -1.74E-03 |
| Ozone depletion | kg CFC11e | 5.14E-06 | 4.72E-08 | 1.95E-08 | 5.21E-06 | 4.34E-09 | MND | MND | 0.00E+00 | 1.39E-09 | 7.93E-09 | 0.00E+00 | -4.55E-06 |
| Acidification | mol $H^+e$ | 4.48E-03 | 8.46E-04 | 7.26E-04 | 6.05E-03 | 7.76E-05 | MND | MND | 0.00E+00 | 2.50E-05 | 5.16E-03 | 0.00E+00 | -5.56E-03 |
| Eutrophication, aquatic freshwater [1] | kg Pe | 8.46E-06 | 1.69E-06 | 7.94E-06 | 1.81E-05 | 1.50E-07 | MND | MND | 0.00E+00 | 5.23E-08 | 4.71E-07 | 0.00E+00 | -1.58E-05 |
| Eutrophication, aquatic marine | kg Ne | 1.01E-03 | 2.53E-04 | 1.29E-04 | 1.39E-03 | 2.34E-05 | MND | MND | 0.00E+00 | 7.39E-06 | 3.01E-03 | 0.00E+00 | -1.18E-03 |
| Eutrophication, terrestrial | mol Ne | 1.14E-02 | 2.79E-03 | 1.53E-03 | 1.57E-02 | 2.58E-04 | MND | MND | 0.00E+00 | 8.16E-05 | 2.92E-02 | 0.00E+00 | -1.33E-02 |
| Photochemical ozone formation | kg NMVOCe | 3.94E-03 | 8.74E-04 | 3.27E-03 | 8.08E-03 | 8.30E-05 | MND | MND | 0.00E+00 | 2.56E-05 | 7.24E-03 | 0.00E+00 | -6.84E-03 |
| Abiotic depletion, minerals & metals [2] | kg Sbe | 5.87E-06 | 4.67E-06 | 7.16E-07 | 1.13E-05 | 3.15E-07 | MND | MND | 0.00E+00 | 1.51E-07 | 7.50E-07 | 0.00E+00 | -1.36E-04 |
| Abiotic depletion of fossil resources [2] | MJ | 6.91E+01 | 3.13E+00 | 5.32E+00 | 7.76E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.24E-02 | 5.91E-01 | 0.00E+00 | -6.24E+01 |
| Water use [2] | $m^3e$ deprived | 4.30E-01 | 1.07E-02 | 7.07E-02 | 5.11E-01 | 1.07E-03 | MND | MND | 0.00E+00 | 3.28E-04 | 1.75E-02 | 0.00E+00 | -4.05E-01 |

[1] The required characterisation method and data are in kg P-eq; to get $PO_4e$, multiply the result by 3.07.

[2] EN 15804+A2 Disclaimer 2: "The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator."

# FF-PIR WITH PLASTIC LAMINATE

## ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Particulate matter | Incidence | 3.70E-08 | 1.61E-08 | 3.92E-09 | 5.70E-08 | 1.67E-09 | MND | MND | 0.00E+00 | 4.68E-10 | 2.64E-07 | 0.00E+00 | -7.42E-08 |
| Ionizing radiation, human health [3] | kBq U235e | 7.96E-01 | 1.37E-02 | 9.93E-02 | 9.09E-01 | 1.26E-03 | MND | MND | 0.00E+00 | 4.04E-04 | 2.11E-03 | 0.00E+00 | -8.05E-01 |
| Eco-toxicity (freshwater) [2] | CTUe | 1.04E+01 | 2.40E+00 | 2.76E+00 | 1.56E+01 | 2.20E-01 | MND | MND | 0.00E+00 | 7.22E-02 | 1.26E+01 | 0.00E+00 | -1.43E+01 |
| Human toxicity, cancer effects [2] | CTUh | 2.73E-10 | 6.62E-11 | 5.53E-11 | 3.95E-10 | 5.62E-12 | MND | MND | 0.00E+00 | 2.04E-12 | 4.14E-09 | 0.00E+00 | -7.85E-10 |
| Human toxicity, non-cancer effects [2] | CTUh | 1.65E-08 | 2.77E-09 | 1.41E-09 | 2.07E-08 | 2.60E-10 | MND | MND | 0.00E+00 | 8.28E-11 | 1.55E-08 | 0.00E+00 | -2.90E-08 |
| Land use related impacts/soil quality [2] | - | 1.90E-01 | 3.52E+00 | 1.54E-01 | 3.86E+00 | 4.34E-01 | MND | MND | 0.00E+00 | 1.03E-01 | 7.67E-01 | 0.00E+00 | -3.15E+00 |

[2] EN 15804+A2 Disclaimer 2: "The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator."

[3] EN 15804+A2 Disclaimer 1: "This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator."

## USE OF NATURAL RESOURCES

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Renewable PER used as energy | MJ | 1.57E+00 | 4.21E-02 | 1.29E+00 | 2.90E+00 | 3.62E-03 | MND | MND | 0.00E+00 | 1.31E-03 | 1.02E-02 | 0.00E+00 | -2.68E+00 |
| Renewable PER used as materials | MJ | 5.20E-01 | 0.00E+00 | 0.00E+00 | 5.20E-01 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -4.57E-01 |
| Total use of renewable PER | MJ | 2.09E+00 | 4.21E-02 | 1.29E+00 | 3.42E+00 | 3.62E-03 | MND | MND | 0.00E+00 | 1.31E-03 | 1.02E-02 | 0.00E+00 | -3.13E+00 |
| Non-renewable PER used as energy | MJ | 5.29E+01 | 3.13E+00 | 4.55E+00 | 6.06E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.24E-02 | 5.91E-01 | 0.00E+00 | -4.90E+01 |
| Non-renewable PER used as materials | MJ | 1.85E+01 | 0.00E+00 | 7.65E-01 | 1.93E+01 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -1.55E+01 |
| Total use of non-renewable PER | MJ | 7.14E+01 | 3.13E+00 | 5.32E+00 | 7.99E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.24E-02 | 5.91E-01 | 0.00E+00 | -6.45E+01 |
| Use of secondary materials | kg | 8.48E-04 | 0.00E+00 | 2.50E-04 | 1.10E-03 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -2.45E-02 |
| Use of renewable secondary fuels | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Use of non-renewable secondary fuels | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Use of net fresh water | $m^3$ | 1.42E+01 | 5.85E-04 | 1.45E-03 | 1.42E+01 | 5.98E-05 | MND | MND | 0.00E+00 | 1.75E-05 | 5.65E-04 | 0.00E+00 | -1.25E+01 |

*PER abbreviation stands for primary energy resources.*

# FF-PIR WITH PLASTIC LAMINATE

## END OF LIFE – WASTE

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hazardous waste | kg | 1.02E-02 | 3.11E-03 | 1.12E-02 | 2.45E-02 | 2.79E-04 | MND | MND | 0.00E+00 | 9.62E-05 | 0.00E+00 | 0.00E+00 | -4.43E-02 |
| Non-hazardous waste | kg | 2.43E-01 | 2.69E-01 | 2.91E-01 | 8.03E-01 | 3.09E-02 | MND | MND | 0.00E+00 | 7.99E-03 | 0.00E+00 | 0.00E+00 | -7.26E-01 |
| Radioactive waste | kg | 3.20E-04 | 2.14E-05 | 4.28E-05 | 3.84E-04 | 1.97E-06 | MND | MND | 0.00E+00 | 6.32E-07 | 0.00E+00 | 0.00E+00 | -3.41E-04 |

## END OF LIFE – OUTPUT FLOWS

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Components for reuse | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for recycling | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 9.51E-01 | 0.00E+00 | 0.00E+00 |
| Materials for energy recovery | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported energy | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

## KEY INFORMATION TABLE (RTS) – KEY INFORMATION PER KG OF PRODUCT

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Climate change – total | kg $CO_2e$ | 1.82E+00 | 2.05E-01 | 1.79E-01 | 2.20E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.06E-03 | 6.18E-01 | 0.00E+00 | -1.65E+00 |
| Abiotic depletion. minerals & metals [2] | kg Sbe | 5.87E-06 | 4.67E-06 | 7.16E-07 | 1.13E-05 | 3.15E-07 | MND | MND | 0.00E+00 | 1.51E-07 | 7.50E-07 | 0.00E+00 | -1.36E-04 |
| Abiotic depletion of fossil resources [2] | MJ | 6.91E+01 | 3.13E+00 | 5.32E+00 | 7.76E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.24E-02 | 5.91E-01 | 0.00E+00 | -6.24E+01 |
| Water use [2] | $m^3e$ deprived | 4.30E-01 | 1.07E-02 | 7.07E-02 | 5.11E-01 | 1.07E-03 | MND | MND | 0.00E+00 | 3.28E-04 | 1.75E-02 | 0.00E+00 | -4.05E-01 |
| Use of secondary materials | kg | 8.48E-04 | 0.00E+00 | 2.50E-04 | 1.10E-03 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -2.45E-02 |
| Biogenic carbon content in product | kg C | N/A | N/A | 0.00E+00 | 0.00E+00 | N/A | MND | MND | N/A | N/A | N/A | N/A | N/A |
| Biogenic carbon content in packaging | kg C | N/A | N/A | 0.00E+00 | 0.00E+00 | N/A | MND | MND | N/A | N/A | N/A | N/A | N/A |

[2] EN 15804+A2 Disclaimer 2: "The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator."

## FF-PIR WITH FIRE RESISTANT

## CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Climate change – total | kg $CO_2e$ | 1.87E+00 | 2.80E-01 | 1.79E-01 | 2.33E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.12E-03 | 6.24E-01 | 0.00E+00 | -1.66E+00 |
| Climate change – fossil | kg $CO_2e$ | 1.86E+00 | 2.80E-01 | 1.77E-01 | 2.32E+00 | 1.85E-02 | MND | MND | 0.00E+00 | 6.12E-03 | 6.24E-01 | 0.00E+00 | -1.66E+00 |
| Climate change – biogenic | kg $CO_2e$ | 9.45E-03 | 1.63E-04 | 5.58E-04 | 1.02E-02 | 1.34E-05 | MND | MND | 0.00E+00 | 3.75E-06 | 4.09E-05 | 0.00E+00 | -4.72E-03 |
| Climate change – LULUC | kg $CO_2e$ | 4.67E-04 | 9.55E-05 | 1.48E-03 | 2.04E-03 | 5.56E-06 | MND | MND | 0.00E+00 | 2.16E-06 | 2.02E-05 | 0.00E+00 | -1.76E-03 |
| Ozone depletion | kg CFC11e | 4.23E-06 | 6.41E-08 | 1.95E-08 | 4.31E-06 | 4.34E-09 | MND | MND | 0.00E+00 | 1.40E-09 | 8.01E-09 | 0.00E+00 | -4.59E-06 |
| Acidification | mol $H^+e$ | 7.05E-03 | 1.15E-03 | 7.26E-04 | 8.93E-03 | 7.76E-05 | MND | MND | 0.00E+00 | 2.52E-05 | 5.21E-03 | 0.00E+00 | -5.62E-03 |
| Eutrophication, aquatic freshwater [1] | kg Pe | 2.37E-05 | 2.33E-06 | 7.94E-06 | 3.40E-05 | 1.50E-07 | MND | MND | 0.00E+00 | 5.28E-08 | 4.75E-07 | 0.00E+00 | -1.59E-05 |
| Eutrophication, aquatic marine | kg Ne | 1.49E-03 | 3.43E-04 | 1.29E-04 | 1.96E-03 | 2.34E-05 | MND | MND | 0.00E+00 | 7.46E-06 | 3.04E-03 | 0.00E+00 | -1.19E-03 |
| Eutrophication, terrestrial | mol Ne | 1.66E-02 | 3.79E-03 | 1.53E-03 | 2.19E-02 | 2.58E-04 | MND | MND | 0.00E+00 | 8.24E-05 | 2.95E-02 | 0.00E+00 | -1.35E-02 |
| Photochemical ozone formation | kg NMVOCe | 5.00E-03 | 1.18E-03 | 2.77E-03 | 8.95E-03 | 8.30E-05 | MND | MND | 0.00E+00 | 2.59E-05 | 7.31E-03 | 0.00E+00 | -6.90E-03 |
| Abiotic depletion, minerals & metals [2] | kg Sbe | 1.06E-04 | 6.86E-06 | 7.16E-07 | 1.14E-04 | 3.15E-07 | MND | MND | 0.00E+00 | 1.53E-07 | 7.57E-07 | 0.00E+00 | -1.38E-04 |
| Abiotic depletion of fossil resources [2] | MJ | 6.05E+01 | 4.25E+00 | 5.32E+00 | 7.01E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.33E-02 | 5.96E-01 | 0.00E+00 | -6.30E+01 |
| Water use [2] | $m^3e$ deprived | 3.41E-01 | 1.42E-02 | 7.07E-02 | 4.26E-01 | 1.07E-03 | MND | MND | 0.00E+00 | 3.31E-04 | 1.77E-02 | 0.00E+00 | -4.09E-01 |

[1] The required characterisation method and data are in kg P-eq; to get $PO_4e$, multiply the result by 3.07.

[2] EN 15804+A2 Disclaimer 2: "The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator."

## ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Particulate matter | Incidence | 5.04E-08 | 2.10E-08 | 3.92E-09 | 7.53E-08 | 1.67E-09 | MND | MND | 0.00E+00 | 4.72E-10 | 2.67E-07 | 0.00E+00 | -7.49E-08 |
| Ionizing radiation, human health [3] | kBq U235e | 6.78E-01 | 1.86E-02 | 9.93E-02 | 7.96E-01 | 1.26E-03 | MND | MND | 0.00E+00 | 4.08E-04 | 2.13E-03 | 0.00E+00 | -8.13E-01 |
| Eco-toxicity (freshwater) [2] | CTUe | 1.20E+01 | 3.28E+00 | 2.76E+00 | 1.80E+01 | 2.20E-01 | MND | MND | 0.00E+00 | 7.29E-02 | 1.27E+01 | 0.00E+00 | -1.44E+01 |
| Human toxicity, cancer effects [2] | CTUh | 6.96E-10 | 9.22E-11 | 5.53E-11 | 8.44E-10 | 5.62E-12 | MND | MND | 0.00E+00 | 2.06E-12 | 4.18E-09 | 0.00E+00 | -7.93E-10 |
| Human toxicity, non-cancer effects [2] | CTUh | 4.33E-08 | 3.75E-09 | 1.41E-09 | 4.85E-08 | 2.60E-10 | MND | MND | 0.00E+00 | 8.36E-11 | 1.56E-08 | 0.00E+00 | -2.92E-08 |
| Land use related impacts/soil quality [2] | - | 6.72E-01 | 4.29E+00 | 1.54E-01 | 5.12E+00 | 4.34E-01 | MND | MND | 0.00E+00 | 1.04E-01 | 7.75E-01 | 0.00E+00 | -3.18E+00 |

[2] EN 15804+A2 Disclaimer 2: "The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator."

[3] EN 15804+A2 Disclaimer 1: "This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator."

## USE OF NATURAL RESOURCES

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Renewable PER used as energy | MJ | 1.78E+00 | 5.84E-02 | 1.29E+00 | 3.13E+00 | 3.62E-03 | MND | MND | 0.00E+00 | 1.33E-03 | 1.03E-02 | 0.00E+00 | -2.70E+00 |
| Renewable PER used as materials | MJ | 4.24E-01 | 0.00E+00 | 0.00E+00 | 4.24E-01 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -4.62E-01 |
| Total use of renewable PER | MJ | 2.21E+00 | 5.84E-02 | 1.29E+00 | 3.56E+00 | 3.62E-03 | MND | MND | 0.00E+00 | 1.33E-03 | 1.03E-02 | 0.00E+00 | -3.16E+00 |
| Non-renewable PER used as energy | MJ | 4.95E+01 | 4.25E+00 | 4.55E+00 | 5.83E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.33E-02 | 5.96E-01 | 0.00E+00 | -4.94E+01 |
| Non-renewable PER used as materials | MJ | 1.29E+01 | 0.00E+00 | 7.65E-01 | 1.37E+01 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -1.56E+01 |
| Total use of non-renewable PER | MJ | 6.24E+01 | 4.25E+00 | 5.32E+00 | 7.20E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.33E-02 | 5.96E-01 | 0.00E+00 | -6.51E+01 |
| Use of secondary materials | kg | 2.15E-03 | 0.00E+00 | 2.50E-04 | 2.40E-03 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -2.47E-02 |
| Use of renewable secondary fuels | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Use of non-renewable secondary fuels | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Use of net fresh water | $m^3$ | 1.16E+01 | 7.68E-04 | 1.45E-03 | 1.16E+01 | 5.98E-05 | MND | MND | 0.00E+00 | 1.77E-05 | 5.70E-04 | 0.00E+00 | -1.26E+01 |

*PER abbreviation stands for primary energy resources.*

# FF-PIR WITH FIRE RESISTANT

## END OF LIFE – WASTE

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hazardous waste | kg | 2.24E-02 | 4.27E-03 | 1.12E-02 | 3.79E-02 | 2.79E-04 | MND | MND | 0.00E+00 | 9.71E-05 | 0.00E+00 | 0.00E+00 | -4.47E-02 |
| Non-hazardous waste | kg | 9.87E-01 | 3.38E-01 | 2.91E-01 | 1.62E+00 | 3.09E-02 | MND | MND | 0.00E+00 | 8.07E-03 | 0.00E+00 | 0.00E+00 | -7.33E-01 |
| Radioactive waste | kg | 2.85E-04 | 2.92E-05 | 4.28E-05 | 3.57E-04 | 1.97E-06 | MND | MND | 0.00E+00 | 6.38E-07 | 0.00E+00 | 0.00E+00 | -3.44E-04 |

## END OF LIFE – OUTPUT FLOWS

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Components for reuse | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for recycling | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 9.60E-01 | 0.00E+00 | 0.00E+00 |
| Materials for energy recovery | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported energy | MJ | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

## KEY INFORMATION TABLE (RTS) – KEY INFORMATION PER KG OF PRODUCT

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Climate change – total | kg $CO_2e$ | 1.87E+00 | 2.80E-01 | 1.79E-01 | 2.33E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.12E-03 | 6.24E-01 | 0.00E+00 | -1.66E+00 |
| Abiotic depletion. minerals & metals [2] | kg Sbe | 1.06E-04 | 6.86E-06 | 7.16E-07 | 1.14E-04 | 3.15E-07 | MND | MND | 0.00E+00 | 1.53E-07 | 7.57E-07 | 0.00E+00 | -1.38E-04 |
| Abiotic depletion of fossil resources [2] | MJ | 6.05E+01 | 4.25E+00 | 5.32E+00 | 7.01E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.33E-02 | 5.96E-01 | 0.00E+00 | -6.30E+01 |
| Water use [2] | $m^3e$ deprived | 3.41E-01 | 1.42E-02 | 7.07E-02 | 4.26E-01 | 1.07E-03 | MND | MND | 0.00E+00 | 3.31E-04 | 1.77E-02 | 0.00E+00 | -4.09E-01 |
| Use of secondary materials | kg | 2.15E-03 | 0.00E+00 | 2.50E-04 | 2.40E-03 | 0.00E+00 | MND | MND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | -2.47E-02 |
| Biogenic carbon content in product | kg C | N/A | N/A | 0.00E+00 | 0.00E+00 | N/A | MND | MND | N/A | N/A | N/A | N/A | N/A |
| Biogenic carbon content in packaging | kg C | N/A | N/A | 0.00E+00 | 0.00E+00 | N/A | MND | MND | N/A | N/A | N/A | N/A | N/A |

[2] EN 15804+A2 Disclaimer 2: "The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator."

## SCENARIO DOCUMENTATION

### Manufacturing energy scenario documentation

| Scenario parameter | Value |
|---|---|
| Electricity data source and quality | Electricity, high voltage, production mix Ecoinvent v3.6, Finland, 2019 |
| Electricity CO2e / kWh | 0.0579 kg CO2e / kWh |
| District heating data source and quality | Heat and power co-generation, oil Ecoinvent v3.6, Finland, 2019 |
| District heating CO2e / kWh | 0.0470 kg CO2e / kWh |

### Transport scenario documentation

| Scenario parameter | Value |
|---|---|
| A4 specific transport CO2e emissions, kg $CO_2$e / tkm | 0.0901 |
| A4 average transport distance, km | 200 |

### End of life scenario documentation*

| Scenario parameter | Value |
|---|---|
| Collection process – kg collected separately | 0.95 – 0.96 |
| Collection process – kg collected with mixed waste | 0 |
| Recovery process – kg for re-use | 0 |
| Recovery process – kg for recycling | 0.95 – 0.96 |
| Recovery process – kg for energy recovery | 0 |
| Disposal (total) – kg for final deposition | 0 |
| Scenario assumptions for transportation | End-of-life product is transported 50 km with an average lorry |

* The values are based on the manufacturer's information regarding the end-of-life treatment of the product.

## BIBLIOGRAPHY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ISO 21930:2017 Sustainability inbuilding construction - Environmental declaration of building products

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FF-PIR LCA Report 16.06.2021

# ANNEX-1: ENVIRONMENTAL IMPACTS - EN 15804+A1, CML / ISO 21930

## FF-PIR WITH ALUMINIUM LAMINATE

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Global warming potential | kg $CO_2e$ | 2.73E+00 | 2.06E-01 | 1.72E-01 | 3.11E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.02E-03 | 5.67E-01 | 0.00E+00 | -2.10E+00 |
| Depletion of stratospheric ozone | kg CFC11e | 5.65E-08 | 3.81E-08 | 2.58E-08 | 1.20E-07 | 3.45E-09 | MND | MND | 0.00E+00 | 1.11E-09 | 6.47E-09 | 0.00E+00 | -6.11E-08 |
| Acidification | kg $SO_2e$ | 7.94E-03 | 4.19E-04 | 6.03E-04 | 8.96E-03 | 3.76E-05 | MND | MND | 0.00E+00 | 1.24E-05 | 4.88E-03 | 0.00E+00 | -5.86E-03 |
| Eutrophication | kg $(PO_4)^{3-}e$ | 1.86E-03 | 8.56E-05 | 2.41E-04 | 2.19E-03 | 7.59E-06 | MND | MND | 0.00E+00 | 2.57E-06 | 1.96E-02 | 0.00E+00 | -1.09E-03 |
| Photochemical ozone formation | kg $C_2H_4e$ | 1.26E-03 | 2.72E-05 | 4.17E-05 | 1.33E-03 | 2.38E-06 | MND | MND | 0.00E+00 | 8.00E-07 | 2.26E-04 | 0.00E+00 | -1.08E-03 |
| Abiotic depletion of non-fossil resources | kg Sbe | 3.09E-04 | 4.79E-06 | 7.16E-07 | 3.15E-04 | 3.15E-07 | MND | MND | 0.00E+00 | 1.52E-07 | 7.52E-07 | 0.00E+00 | -1.37E-04 |
| Abiotic depletion of fossil resources | MJ | 6.92E+01 | 3.17E+00 | 5.32E+00 | 7.77E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.26E-02 | 5.92E-01 | 0.00E+00 | -6.25E+01 |

## FF-PIR WITH PLASTIC LAMINATE

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Global warming potential | kg $CO_2e$ | 2.33E+00 | 2.03E-01 | 1.72E-01 | 2.71E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.01E-03 | 5.66E-01 | 0.00E+00 | -2.10E+00 |
| Depletion of stratospheric ozone | kg CFC11e | 2.99E-08 | 3.75E-08 | 2.58E-08 | 9.32E-08 | 3.45E-09 | MND | MND | 0.00E+00 | 1.11E-09 | 6.46E-09 | 0.00E+00 | -6.10E-08 |
| Acidification | kg $SO_2e$ | 5.46E-03 | 4.13E-04 | 6.03E-04 | 6.48E-03 | 3.76E-05 | MND | MND | 0.00E+00 | 1.23E-05 | 4.87E-03 | 0.00E+00 | -5.85E-03 |
| Eutrophication | kg $(PO_4)^{3-}e$ | 8.86E-04 | 8.42E-05 | 2.41E-04 | 1.21E-03 | 7.59E-06 | MND | MND | 0.00E+00 | 2.57E-06 | 1.96E-02 | 0.00E+00 | -1.09E-03 |
| Photochemical ozone formation | kg $C_2H_4e$ | 1.18E-03 | 2.67E-05 | 4.17E-05 | 1.25E-03 | 2.38E-06 | MND | MND | 0.00E+00 | 7.98E-07 | 2.25E-04 | 0.00E+00 | -1.07E-03 |
| Abiotic depletion of non-fossil resources | kg Sbe | 5.87E-06 | 4.67E-06 | 7.16E-07 | 1.13E-05 | 3.15E-07 | MND | MND | 0.00E+00 | 1.51E-07 | 7.50E-07 | 0.00E+00 | -1.36E-04 |
| Abiotic depletion of fossil resources | MJ | 6.91E+01 | 3.13E+00 | 5.32E+00 | 7.76E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.24E-02 | 5.91E-01 | 0.00E+00 | -6.24E+01 |

## FF-PIR WITH FIRE RESISTANT

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Global warming potential | kg $CO_2e$ | 2.27E+00 | 2.77E-01 | 1.72E-01 | 2.72E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.06E-03 | 5.71E-01 | 0.00E+00 | -2.12E+00 |
| Depletion of stratospheric ozone | kg CFC11e | 6.42E-08 | 5.10E-08 | 2.58E-08 | 1.41E-07 | 3.45E-09 | MND | MND | 0.00E+00 | 1.12E-09 | 6.52E-09 | 0.00E+00 | -6.15E-08 |
| Acidification | kg $SO_2e$ | 7.23E-03 | 5.63E-04 | 6.03E-04 | 8.40E-03 | 3.76E-05 | MND | MND | 0.00E+00 | 1.25E-05 | 4.92E-03 | 0.00E+00 | -5.90E-03 |
| Eutrophication | kg $(PO_4)^{3-}e$ | 1.43E-03 | 1.15E-04 | 2.41E-04 | 1.79E-03 | 7.59E-06 | MND | MND | 0.00E+00 | 2.59E-06 | 1.98E-02 | 0.00E+00 | -1.10E-03 |
| Photochemical ozone formation | kg $C_2H_4e$ | 1.01E-03 | 3.67E-05 | 4.17E-05 | 1.09E-03 | 2.38E-06 | MND | MND | 0.00E+00 | 8.06E-07 | 2.28E-04 | 0.00E+00 | -1.08E-03 |
| Abiotic depletion of non-fossil resources | kg Sbe | 1.06E-04 | 6.86E-06 | 7.16E-07 | 1.14E-04 | 3.15E-07 | MND | MND | 0.00E+00 | 1.53E-07 | 7.57E-07 | 0.00E+00 | -1.38E-04 |
| Abiotic depletion of fossil resources | MJ | 6.05E+01 | 4.25E+00 | 5.32E+00 | 7.01E+01 | 2.87E-01 | MND | MND | 0.00E+00 | 9.33E-02 | 5.96E-01 | 0.00E+00 | -6.30E+01 |

# ANNEX-2: ENVIRONMENTAL IMPACTS - TRACI 2.1

## FF-PIR WITH ALUMINIUM LAMINATE

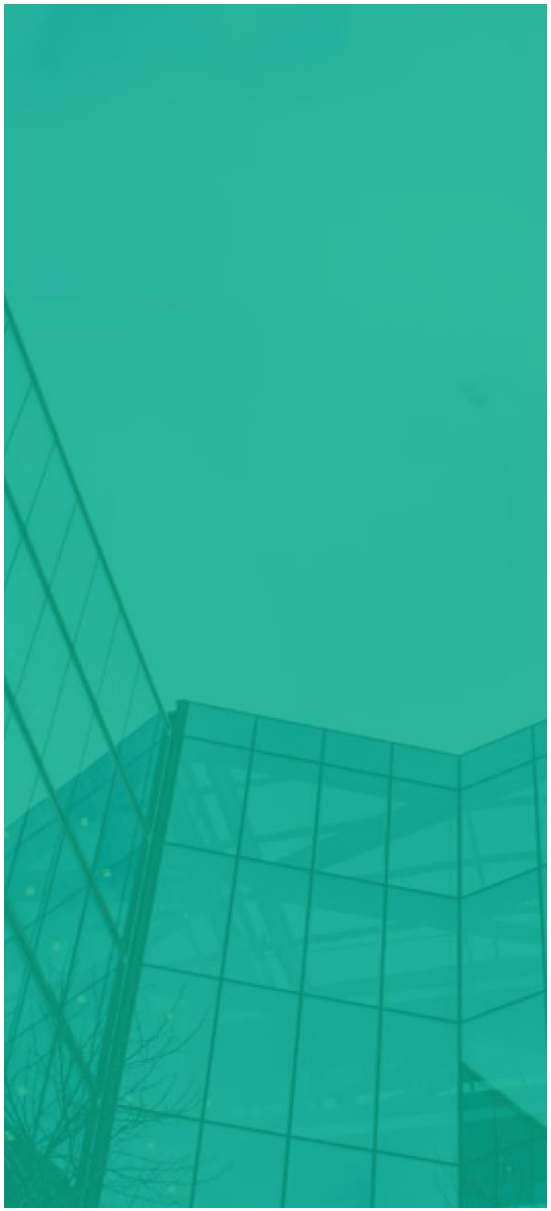
| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Global warming potential | kg $CO_2e$ | 2.19E+00 | 2.06E-01 | 1.73E-01 | 2.57E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.01E-03 | 5.70E-01 | 0.00E+00 | -1.60E+00 |
| Ozone depletion | kg CFC11e | 6.54E-08 | 5.07E-08 | 3.15E-08 | 1.48E-07 | 4.60E-09 | MND | MND | 0.00E+00 | 1.47E-09 | 8.41E-09 | 0.00E+00 | -6.86E-08 |
| Acidification | kg $SO_2e$ | 6.60E-03 | 7.47E-04 | 6.06E-04 | 7.95E-03 | 6.76E-05 | MND | MND | 0.00E+00 | 2.17E-05 | 6.13E-03 | 0.00E+00 | -4.73E-03 |
| Eutrophication | kg Ne | 4.61E-04 | 1.05E-04 | 7.73E-05 | 6.43E-04 | 9.50E-06 | MND | MND | 0.00E+00 | 3.07E-06 | 6.90E-04 | 0.00E+00 | -3.37E-04 |
| Photochemical smog formation | kg $O_3e$ | 9.43E-02 | 1.63E-02 | 7.88E-03 | 1.18E-01 | 1.48E-03 | MND | MND | 0.00E+00 | 4.69E-04 | 1.71E-01 | 0.00E+00 | -7.46E-02 |
| Depletion of non-renewable energy | MJ | 6.65E+00 | 4.54E-01 | 2.77E-01 | 7.38E+00 | 4.11E-02 | MND | MND | 0.00E+00 | 1.32E-02 | 8.32E-02 | 0.00E+00 | -5.92E+00 |

## FF-PIR WITH PLASTIC LAMINATE

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Global warming potential | kg $CO_2e$ | 1.76E+00 | 2.02E-01 | 1.73E-01 | 2.14E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 5.99E-03 | 5.69E-01 | 0.00E+00 | -1.60E+00 |
| Ozone depletion | kg CFC11e | 3.14E-08 | 5.00E-08 | 3.15E-08 | 1.13E-07 | 4.60E-09 | MND | MND | 0.00E+00 | 1.47E-09 | 8.40E-09 | 0.00E+00 | -6.85E-08 |
| Acidification | kg $SO_2e$ | 3.83E-03 | 7.36E-04 | 6.06E-04 | 5.17E-03 | 6.76E-05 | MND | MND | 0.00E+00 | 2.17E-05 | 6.11E-03 | 0.00E+00 | -4.72E-03 |
| Eutrophication | kg Ne | 2.09E-04 | 1.04E-04 | 7.73E-05 | 3.90E-04 | 9.50E-06 | MND | MND | 0.00E+00 | 3.06E-06 | 6.88E-04 | 0.00E+00 | -3.37E-04 |
| Photochemical smog formation | kg $O_3e$ | 6.40E-02 | 1.60E-02 | 7.88E-03 | 8.79E-02 | 1.48E-03 | MND | MND | 0.00E+00 | 4.68E-04 | 1.70E-01 | 0.00E+00 | -7.45E-02 |
| Depletion of non-renewable energy | MJ | 7.11E+00 | 4.47E-01 | 2.77E-01 | 7.83E+00 | 4.11E-02 | MND | MND | 0.00E+00 | 1.32E-02 | 8.30E-02 | 0.00E+00 | -5.91E+00 |

## FF-PIR WITH FIRE RESISTANT

| Impact category | Unit | A1 | A2 | A3 | A1-A3 | A4 | A5 | B1-B7 | C1 | C2 | C3 | C4 | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Global warming potential | kg $CO_2e$ | 1.80E+00 | 2.77E-01 | 1.73E-01 | 2.25E+00 | 1.83E-02 | MND | MND | 0.00E+00 | 6.05E-03 | 5.74E-01 | 0.00E+00 | -1.62E+00 |
| Ozone depletion | kg CFC11e | 7.82E-08 | 6.80E-08 | 3.15E-08 | 1.78E-07 | 4.60E-09 | MND | MND | 0.00E+00 | 1.49E-09 | 8.48E-09 | 0.00E+00 | -6.91E-08 |
| Acidification | kg $SO_2e$ | 5.96E-03 | 1.00E-03 | 6.06E-04 | 7.57E-03 | 6.76E-05 | MND | MND | 0.00E+00 | 2.19E-05 | 6.17E-03 | 0.00E+00 | -4.76E-03 |
| Eutrophication | kg Ne | 4.01E-04 | 1.41E-04 | 7.73E-05 | 6.19E-04 | 9.50E-06 | MND | MND | 0.00E+00 | 3.09E-06 | 6.95E-04 | 0.00E+00 | -3.40E-04 |
| Photochemical smog formation | kg $O_3e$ | 9.28E-02 | 2.18E-02 | 7.88E-03 | 1.22E-01 | 1.48E-03 | MND | MND | 0.00E+00 | 4.73E-04 | 1.72E-01 | 0.00E+00 | -7.52E-02 |
| Depletion of non-renewable energy | MJ | 6.13E+00 | 6.09E-01 | 2.77E-01 | 7.02E+00 | 4.11E-02 | MND | MND | 0.00E+00 | 1.33E-02 | 8.38E-02 | 0.00E+00 | -5.96E+00 |



## ABOUT THE MANUFACTURER

Over nearly forty-year-long history, Finnfoam has become one of the leading manufacturers of plastic-based thermal insulation solutions. The roots of Finnfoam's thermal insulation competence are embedded into the frozen Finnish soil. Today, the group is known for quality, product development, and reliability. Finnfoam's product range includes XPS, EPS and PIR thermal insulation and the Tulppa - wet room boards. The entire Finnfoam (XPS) thermal insulation product range is suitable for use as frost insulation and for insulating floors, ceilings, and walls, as well as for various types of supplementary thermal insulation. As frost and floor insulation, Finnfoam is highly resistant to moisture, freezing, and load. FF-EPS is best suited for use as thermal insulation for walls and ceilings, where it provides a safe and highly cost-effective solution. It can also be used in floors that are not subjected to significant loads. The applications of FF-PIR polyurethane insulation products include the thermal insulation of walls and ceilings as well as saunas. FF-PIR insulation products have a very high thermal insulation capacity, which allows for lower structural thickness.

## EPD AUTHOR AND CONTRIBUTORS

| | |
|---|---|
| **Manufacturer** | Finnfoam Oy |
| **EPD author** | One ClickLCA Ltd, www.oneclicklca.com |
| **EPD verifier** | Silvia Vilčeková, Silcert, s.r.o. |
| **EPD program** | RTS EPD |
| **Background data** | Ecoinvent 3.6 (cut-off), Plastics Europe 2012, PU Europe 2014 |
| **LCA software** | One Click LCA Pre-Verified Generator for Plastic Products |