COMFORTECH

BUILDING PERFORMANCE SOLUTIONS

Environmental Product Declaration
FEI and Other Insulation Products

This EPD covers multiple products, based on a representative product. In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for Comfortech®'s glass wool insulation products. A full list of products covered by this EPD is presented within this document on page 9.

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EPD INTERNATIONAL EPD SYSTEM

AUSTRALASIA EPD® INTERNATIONAL EPD SYSTEM

ECO PLATFORM EPD VERIFIED

What is an EPD?

An Environmental Product Declaration (EPD) tells the environmental story of a product over its life cycle in a format that is clear and transparent. It is science-based, independently verified and publicly available. EPDs are often compared to the nutrition labels on food products.

EPDs help manufacturers translate complex sustainability information about their product's environmental footprint into simpler information that governments, companies, industry associations and end consumers can trust to make decisions.

An EPD communicates the environmental impacts at different stages in a product's life cycle. This may include the carbon emitted when it's made, and any emissions that pollute the air, land or waterways during its use.

This EPD covers the environmental impacts of glass wool insulation products manufactured by Comfortech® for the building and construction industry. The products are manufactured at Comfortech®'s facility in Auckland, New Zealand.

This EPD is based on a 'cradle-to-gate' Life Cycle Assessment (LCA) with end-of-life options (modules A1-A3, C1-C4 and D) included. 'Cradle' refers to the raw material extraction and 'the gate' is the gate of the insulation manufacturing facilities as the product is ready to go out to customers.

Comfortech®, as the EPD owner has the sole ownership, liability, and responsibility for the EPD.

Content

About Comfortech®

Comfortech Building Performance Solutions® is a business that engineers' solutions for comfort, climate, and protection. Comfortech® is the result of two locally owned and operated companies (Tasman Insulation and Forman Building Systems) uniting 170 years of experience, history, and expertise under one roof.

Our goals are focused around sustainability and energy efficiency, in order to be future focused and ensure we strive towards our purpose of creating New Zealand's most comfortable living and working spaces.

As leaders and experts in building performance solutions, to be at the forefront of helping our industry successfully meet today's challenges, including those presented to address the building for climate change agenda and building code changes. As Comfortech®, and along with our strong product brands like Armstrong® and Promat we are perfectly positioned to do that.

Every product produced at our Auckland site is tested and designed specifically for New Zealand conditions.

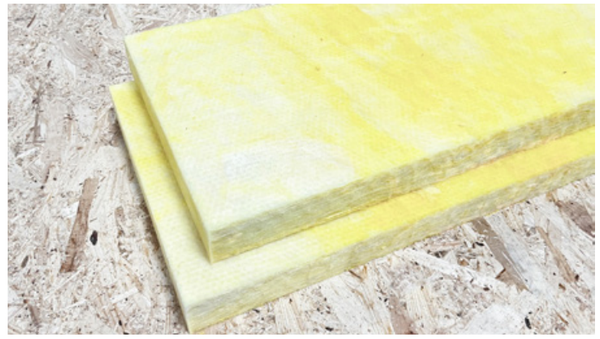
Product information

Comfortech® collects and processes recycled crushed glass into insulation products in Auckland, New Zealand. Comfortech® insulation is a lightweight, flexible glass wool insulation, designed to thermally and acoustically insulate building equipment.

This EPD covers Comfortech® insulation products.

This EPD covers multiple products, based on this representative product:
FEI .69x.6x.038m 30/BG (90415).

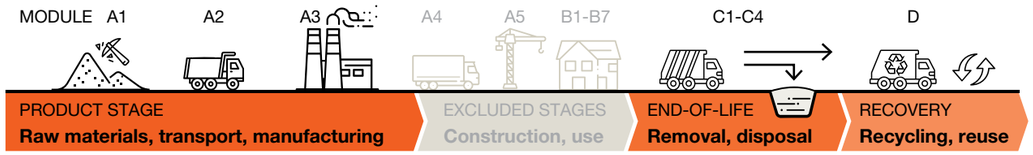
A full list of products covered by this EPD is presented within this document on page 9.



Product life cycle

This is a 'cradle-to-gate' type A EPD with modules C1-C4 and module D added. This means that the production (modules A1-A3), end-of-life (C1-C4) and recovery (D) stages are modelled in this EPD. The construction process (modules A4-A5) and use stages (B1-B7) are not modelled. These life cycle stages are dependent on particular scenarios and best modelled at the building or construction level.

The processes below are included in the product system to be studied. For modules beyond A3, the scenarios included are currently in use and are representative for one of the most probable alternatives.



The production stage (Modules A1-A3) includes all aspects of Comfortech® insulation production from cradle to gate, utilising elementary and product flows. End-of-life stage (C1-C4) and benefits beyond the system boundary (module D) are included according to the mandatory requirements of EPD.

Technical information

Declared Unit

This EPD is based on a declared unit. ISO 14040 defines a functional unit as ‘quantified performance of a product system for use as a reference unit’. Since a functional unit cannot be defined because of the scope of product system considered, the term ‘declared unit’ is used.

The declared unit and reference flow is
1 m² of glass wool insulation product with a density of 36 kg/m³
as placed on the market intended to be used for industry.

Table 1. Industry classification

Product	Classification	Code	Category
Comfortech® glass wool insulation	UN CPC Ver.2.1	88539	Other non-metallic mineral product manufacturing services n.e.c.
	ANZSIC 2006	2090	Other Non-Metallic Mineral Product Manufacturing

Dangerous substances from the candidate list of SVHC for Authorisation

Hazardous properties for Hazardous Substances and New Organisms (HSNO classifications) and Globally Harmonized System (GHS) classifications are reproduced from vendor SDS or OECD’s global portal to information on chemical substances available at: https://www.echemportal.org/echemportal/substance-search. No products declared within this EPD contain substances exceeding the limits for registration according to the European Chemicals Agency’s ‘Candidate List of Substances of Very High Concern for authorisation’ (European Union, 2024).

Content Declaration

According to the General Programme Instructions, the EPD shall include a content declaration with a list of materials and chemical substances including information on their hazardous properties.

The content declaration for this EPD of multiple products is based on the representative product. All Comfortech® glass wool insulation products have the similar material composition, as presented in Table 2. The range of the content of the included products are included in the content declaration, in addition to the representative content.

Table 2. Content declaration for Comfortech® glass wool FEI and other insulation products (by mass)

Product components	Weight-%	Post-consumer recycled material, weight-%	Biogenic material, weight-% of product	Biogenic material, kg C/product or declared unit
Borosilicate Glass				
Recycled window glass	81.3	81.3	0	0
Feldspar sand	5.42	0	0	0
Soda ash	0.800	0	0	0
Limestone	1.26	0	0	0
Borax	8.74	0	0	0
Binder[1]	2.50	0	0	0
Sum	100	81.3	0	0

1 Binder is heat cured phenol-formaldehyde resin made from phenol formaldehyde/urea formaldehyde resin, ammonium sulphate, oil emulsion, dicyandiamide, silane and dye.

Packaging

1 kg of insulation product is packaged with high-density polyethylene (HDPE), low-density polyethylene (LDPE) packaging, paper label and cardboard, differing in weight per weight of specific product, as shown in Table 3.

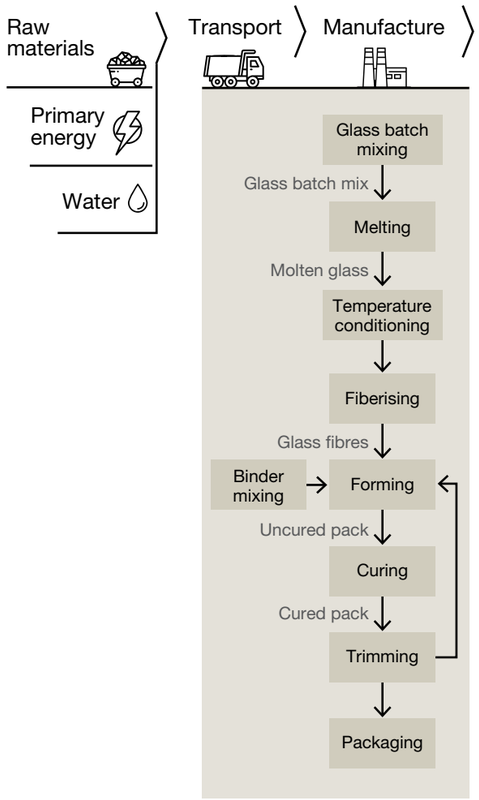
Table 3. Composition of packaging for 1 kg of Comfortech® glass wool FEI and other insulation products

Product components	Weight, kg	Weight-% (versus the product)	Biogenic material, kg C/ product or declared unit
LDPE film	0.022 (0-0.059)	2.2 (0-5.9)	0
HDPE sleeve	0 (0-0.015)	0 (0-1.5)	0
Label	0.0003 (0.0001-0.0005)	0.03 (0.01-0.05)	1.4E-04 (4.6E-05-0.00023)
Cardboard	0 (0.0093-0.0155)	0 (0.93-1.55)	0 (0.0043–0.0071)
Total	0.022 (0.0085-0.059)	2.2 (0.85-5.9)	1.4E-04 (0.0001-0.0061)

Manufacturing Process

The manufacturing process for Comfortech® insulation products includes the following steps:

- **Glass batch mixing.** Glass batch mixing involves mixing the ingredients that are melted into glass for insulation product.
- **Melting, temperature conditioning and fiberising.** The melting process involves melting the glass batch mix into molten glass. Temperature conditioning is a process between melting and fiberising to keep molten glass at the constant temperature. During fiberising, the molten glass is spun and extruded to form fine fibres.
- **Binder mixing.** The fibres in insulation products are held together via a binder. The main ingredients in the binder are a phenol formaldehyde/urea formaldehyde resin mix, ammonium sulphate, silane, water, oil emulsion and dicyandiamide.
- **Forming, curing, trimming and cutting.** During the forming process, the binder is combined with the glass fibres. The glass fibres are sprayed first with cooling water, then with the binder, and are laid down on a perforated conveyor under negative pressure to form a continuous mat
- Then wet uncured pack (containing glass fibres, binder and water moisture) passes through a gas-fired oven where it is dried and the binder is set. Water evaporates in the oven, and emissions of binder are released to the air. The air from the oven is passed through a packed tower water scrubber.
- During the trimming process, edges of the cured pack are trimmed and the product is cut to length. The trimmings are fed back into the virgin product between the fiberisers in the forming hood and therefore the process does not result in waste.
- **Packaging.** The final insulation product is packaged with polyethylene low density (LDPE) films and unitiser sleeves made of polyethylene high density (HDPE). Labels and cardboard are also used in packaging. Compressed air is used in the packaging process.



Products covered in this EPD

This EPD covers multiple products, based on a representative product, highlighted below. The flexible equipment insulation (FEI) and other insulation products covered by this EPD are listed below with their designation, mass per square meter and density for building equipment application. It is worth noting that there are differences in the mass per square meter of different insulation products. FEI and other insulation products are produced either to customer specifications or Comfortech® standard board list. Therefore, these products are not tested for R-value and are not marketed based on R-value. In addition, the area of application and designations are determined according to EN 16783:2024 (CEN, 2024). The products have been manufactured at Comfortech®'s facility in Auckland, New Zealand (9-15 Holloway Pl, Penrose, Auckland 1061).

Table 4. FEI and other insulation product information

Product	Designation	Product code	R-value	Mass / sq m (kg /m²)	Density (kg/m³)
FEI 1.2x.9x.05m 12/BL[1]	IF[2]	7520003	N/A	1.80	36.0
FEI .73x.88x.038m 20/BL (90417)	IF	7520087	N/A	1.37	36.0
FEI .63x.69x.025m 40/BL (90402)	IF	7520089	N/A	0.900	36.0
FEI 1.2x.7x.07m 32kg 8/BL	IF	7520097	N/A	2.24	32.0
FEI .57x.52x.038m 34/BL (90419)	IF	7520098	N/A	1.37	36.0
FEI .46x.67x.038m 35/BG[3] (228637)	IF	7573006	N/A	1.37	36.0
FEI .69x.6x.038m 30/BG (90415)	IF	7573010	N/A	1.37	36.0

1 Bale
2 Flat application
3 Bag

System Boundaries

In Life Cycle Assessments (LCA), the system boundary is a line that divides the processes which are included from those which are excluded. As shown here, this EPD is of the type (a) – cradle-to-gate with modules C1-C4 and module D (A1-A3 + C + D). Distribution and construction process stage (A4-A5) is excluded in this EPD. This is because Comfortech® is not responsible for the delivery and installation of their products. Depending on the different customers, the uncertainty in the delivery mode, distance and installation methods is high. In addition, the use stage environmental performance of insulation products is highly related to building design and location. Therefore, the use stage (B1-B7) is also excluded in this EPD.

Table 5. Modules included in the scope of the EPD

X = declared module
ND = module not declared

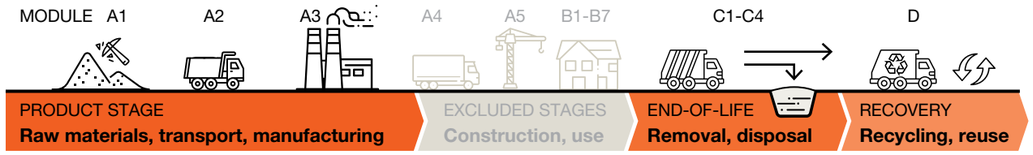
	Product stage			Construction process		Use stage							End-of-life				Recovery
	Raw material supply	Transport	Manufacturing	Transport	Construction Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction / demolition	Transport	Waste processing	Disposal	Future reuse, recycling or energy recovery potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	GLO	GLO	NZ	-	-	-	-	-	-	-	-	-	NZ	NZ	NZ	NZ	NZ
Share of specific data[1]	+48%-52%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	+72%/-29%					-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	0%					-	-	-	-	-	-	-	-	-	-	-	-

1 Specific data material transport (batch and binder materials) and energy use for all processes including manufacturing.

Production (Modules A1-A3)

Raw material supply (Module A1)

- Extraction and processing of raw materials.
- Generation of electricity from primary energy resources, also including their extraction, refining and transport. This includes energy needed for raw material supply and energy for manufacturing in core process.
- Processing up to the end-of-waste state.



Transportation (Module A2)

- Transport of raw materials to the Comfortech® facility.

Manufacturing (Module A3)

- Glass batch mixing, which involves mixing the ingredients that are melted into glass.
- Melting, which involves melting the glass batch mix into molten glass.
- Temperature conditioning, which keeps the molten glass at a constant temperature between melting and fiberising processes.
- Fiberising, involving the molten glass being spun and extruded to form fine fibres.
- Binder mixing, which mixes the binder ingredients to prepare the binder.
- Forming, where the binder is combined with the glass fibres.
- Curing, which involves the wet uncured pack (containing glass fibres, binder and water moisture) passing through a gas-fired oven where it is dried, and the binder is set.
- Trimming, cutting of the product to achieve the desired shape.
- Packaging, in polyethylene bags and unitiser sleeves.

End of life (Modules C1-C4)

When a building reaches its end-of-life it will be demolished (C1) and the demolition waste transported to a processing facility (C2). The waste processing (C3) includes the separation of insulation waste from other building materials. Material that cannot be recycled will be disposed (C4). The end-of-life stage (Modules C1-C4) and resource recovery stage (Module D) are modelled using a scenario reflecting end-of-life recycling/ landfilling rates for insulation products in the construction sector. See Table 6 for assumptions for end-of-life and resource recovery stages.

According to the material fact sheet, glass wool insulation is not currently recycled in New Zealand (BRANZ, 2020). Considering that there is no statistical evidence that glass wool insulation is effectively reused in New Zealand, a conservative assumption has been made that all glass wool insulation materials will go to landfill at the end-of-life stage regardless of its applications. This scenario is currently in use and is representative for one of the most likely scenario alternatives. In addition, this scenario is applied to all insulation products with different applications listed in this study.

Table 6. End of life scenario

Process	Unit
Excavator	1 kg of Comfortech® products
Recovery system specified by type	0% for recycling[1]
Disposal specified by type	100% modelled as inert metals in landfill
Assumptions for scenario development	▪ C1 – Demolishing with an excavator[2] ▪ C2 – 21 km of transport by truck ▪ C4 – Landfill process model with ‘treatment of inert waste, inert material landfill’ dataset from ecoinvent database

1 The European Union Guidance on PEF identifies an R2 value of 0% for glass wool (European Commission, 2020). It is consistent with the New Zealand value (BRANZ, 2020).

2 Hydraulic diggers are used (NZDAA, 2011). The process is modelled based on ‘excavation, hydraulic digger’ dataset from ecoinvent database.

Recovery and recycling potential (Module D)

Since no recycling of glass wool waste is considered, no credit or burden are calculated for Comfortech® products in Module D.

Life cycle inventory

Primary data were collected for insulation products manufactured by Comfortech® for the 12-month period between calendar year (CY) 2023 (1 January 2023 to 31 December 2023). No changes to production technology have occurred since the data collection period and hence the data continues to be representative of current practice.

Upstream data

Background data was used for input materials sourced from different suppliers. Supporting background data specific to the country of origin of the raw materials was used whenever possible. When such background data was not available, global or regional datasets were used as proxy. All electricity and water data were regionalised for New Zealand.

LCA software and database

Background data for raw materials, energy, and transportation are all from the ecoinvent v3.10 database (Wernet, 2016) with reference year 2023. All data fall within the EN 15804 and PCR requirements of 10 years for generic data and 5 years for producer specific data.

The LCA was conducted in Microsoft Excel. The LCA utilises life cycle inventory data from ecoinvent, Allocation, cut-off, EN15804, ecoinvent database version 3.10 (Wernet, 2016) for several of the raw and process materials obtained from the background system.

The ecoinvent datasets have not been adapted as they are provided in Excel and have not been used in conjunction with an LCA software. This includes capital goods and infrastructure as they are included in the background datasets provided by ecoinvent database for Excel and it is not possible to subtract them in Excel.

Electricity

The composition of the residual electricity grid mix of New Zealand is modelled based on published data for the year 1 April 2021 – 31 March 2022 (BraveTrace, 2023). The New Zealand residual electricity mix is made up of hydro (56.6%), geothermal (19.7%) natural gas (12.5%), wind (6.55%), coal (4.25%), biomass (0.266%) and biogas (0.160%).

Onsite consumption (3.00%), and the medium voltage (1kV-60kV) grid's transmission and distribution losses (3.17%) are calculated based on data from the Ministry of Business, Innovation & Employment (MBIE, 2023).

The emission factor for the New Zealand residual grid mix for the GWP-GHG indicator is 0.157 kg CO_2e/kWh (based on EF3.1).

Recycling and recycled inputs

Comfortech® use crushed glass as a main input material for glass wool insulation production. Polluter-pays principle and cut-off allocation are applied. Therefore, all unit processes before the point of end-of-waste (i.e. production, use and demolition of window glass until the end-of-waste state) are assigned to the product system generating the waste (i.e. the previous life cycle of glass waste).

All unit processes after the point of end-of-waste are assigned to the subsequent product system (i.e. the system boundary used in this study). This assumption is also aligned with the statement "…flows leaving the product system as outputs from the building, shall at first be considered to be waste, and leave the product system when reaching the end-of-waste state." in section 4.5.2 of PCR 2019:14 v1.3.4 (EPD International, 2024).

Comfortech® pays for the crushed glass inputs, which are made of glass waste and supplied by recycler companies. Therefore, Comfortech® becomes responsible for environmental impacts of the delivering and further processing of crushed glass while the processing of glass waste until end-of-waste state is excluded in the system boundary.

Transport

Primary transport data was used for transport of production inputs (A2) and any wastes from the production process (A3) to treatment or disposal sites.

Transport modes:

- **Truck** – transport, freight, lorry, all sizes, EURO3 to generic market for transport, freight, lorry, unspecified
- **Container ship** – transport, freight, sea, container ship
- **Aircraft** – transport, freight, aircraft, all distances to generic market for transport, freight, aircraft, unspecified.

Explanation of Representative Products & Variation

The declared GWP-GHG results of representative product for modules A1-A3 may differ by more than 10% compared to the GWP-GHG results of other included products in this EPD. This is due to the differences in mass per square meter of different insulation products. FEI .69X.6X.038 30/BG (90415) has been selected as the representative product in this EPD. This representative product has been chosen as it represents the product with the highest production rate and therefore is the most popular purchased product in this EPD according to production data.

Variation of GWP-GHG results within this EPD has been presented in previous sections. Detailed variation of core environmental indicator results for module A-C will be presented in environmental performance.

Cut off criteria

Personnel-related processes are excluded as per section 4.3.2 in the PCR (EPD International, 2023).

In this study capital goods and infrastructure have been included in the background datasets as provided by ecoinvent (Wernet, 2016). It is not possible, within reasonable effort, to subtract the data on infrastructure/capital goods from these datasets[1].

All other reported data were incorporated and modelled using the best available life cycle inventory data.

Allocation

Post-consumer scrap, i.e. crushed glass, is a main input to the Comfortech® product system. Comfortech® pays for the crushed glass inputs, which are made of glass waste and supplied by recycler companies. Therefore, in line with the polluter pays principle, Comfortech® becomes responsible for environmental impacts of the processing and delivering of crushed glass while the production and collection of glass waste is excluded in the system boundary. Therefore, the glass waste is considered burden free when it enters the system boundary. This is in line with the provisions of Allocation of Waste in PCR 2019:14 v1.3.4 (section 4.5.2) (EPD International, 2024b).

Multi-output allocation generally follows the requirements PCR 2019:14 v1.3.4 (EPD International, 2024b) section 4.5.1.

At Comfortech®, different insulation products of varying dimensions, thicknesses, densities and binder contents per cubic metre are produced. Electricity and water consumption data was unavailable separately for these products, therefore, electricity and water consumption are allocated according to the production volume by weight of each product.

End-of-Life allocation generally follows the requirements of ISO 14044, section 4.3.4.3 (ISO, 2006b) and the requirements of section 4.5.2 in PCR 2019:14 v1.3.4 (EPD International, 2024b). It also generally follows the polluter pays principle.

Material recycling (cut-off approach): Any open scrap inputs into manufacturing remain unconnected. The system boundary at end-of-life is drawn after scrap collection to account for the collection rate, which generates an open scrap output for the product system. The processing and recycling of the scrap is associated with the subsequent product system and is not considered in this study.

Energy recovery & landfilling (cut-off approach): Any open scrap inputs into manufacturing remain unconnected. The system boundary includes the waste incineration and landfilling processes following the polluter-pays-principle. In cases where materials are sent to landfills, they are linked to an inventory that accounts for waste composition, regional leachate rates, landfill gas capture as well as utilisation rates (flaring vs. power production). No credits for power or heat production are assigned.

1 The results of the impact categories abiotic depletion of minerals and metals, land use, human toxicity (cancer), human toxicity, non-cancer and ecotoxicity (freshwater) may be highly uncertain in LCAs that include capital goods/infrastructure in generic datasets, in case infrastructure/capital goods contribute greatly to the total results. This is because the LCI data of infrastructure/capital goods used to quantify these indicators in currently available generic datasets sometimes lack temporal, technological and geographical representativeness. Caution should be exercised when using the results of these indicators for decision-making purposes. (CEN, 2019).

Assumptions

- Where specific life cycle inventory data were unavailable, proxy data were used, giving preference to regional data.
- Energy and water usage was allocated based on the mass of product produced for the reference year 2023.
- Use of any required secondary data from outside New Zealand is sufficiently representative of the impacts of the material. Where the geography is expected to have an impact on the results, this is indicated as a geographical proxy.
- It was assumed that no insulation productions are recycled at the end-of-life stage.
- It was assumed that no significant changes in manufacturing processes between 2022 to 2024.

Data Quality Assessment

The quality of inventory data is assessed based on four key factors:

- Precision – how accurately the data is measured, calculated, or estimated.
- Completeness – whether all relevant data is included (e.g., no missing or unreported emissions).
- Consistency – how reliably the same methods are applied across the data.
- Representativeness – how well the data reflects real-world conditions across different locations, time periods and technologies.

In this report:

- The data has high precision and completeness.
- The methodology is applied consistently throughout.
- The data for modules A1-A3 is very representative in terms of time and technology. Its geographical representativeness is also good.
- The data for modules C1, C2 and C4 is very representative in terms of time. However, its geographical and technical representativeness is only fair.
- Data quality of modules C3 and D was not assessed as no recycling of used insulation products was considered in end-of-life stage.

How to use this EPD

Comfortech® has developed this product specific EPD to help to showcase the environmental credentials of their glass wool insulation products. The EPD also provides life cycle data for calculating the impacts of glass wool insulation products at a building level. These data sets may be used by specifiers and developers to calculate and present the environmental impacts of particular construction projects.

The following section of this EPD comprises of the Technical Information for the method, assumptions, description of environmental indicators. Followed by the results from modelling the life cycle assessment of the different products.

EPDs are not always comparable

An EPD is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as a PCR (Product Category Rules).

It's important to note that EPDs within the same product category but from different programs may not be directly comparable. Construction products can only be compared if the EPDs comply with the EN 15804 standard. EPDs of construction products from a group of manufacturers may not be comparable to an EPD of a similar construction product that a single manufacturer has generated.

Understanding the detail is important in comparisons. Expert analysis is required to ensure data is truly comparable to avoid unintended misrepresentations.

Furthermore, this EPD conforms to EN 15804+A2. EPDs conforming to EN 15804+A1 are not directly comparable with those conforming to EN 15804+A2 due to differences in methodologies.

Green Star

Green Star is Australasia's largest voluntary sustainability rating system for non-residential buildings, fitouts and communities

This EPD can allow the represented products to qualify for points under the Green Building Council Australia (GBCA) Green Star rating system.

The Green Star rating system has also been adopted and adapted for New Zealand conditions by the New Zealand Green Building Council.

Assessment indicators

An introduction the core environmental impact indicators is provided here.

The best-known effect of each indicator is listed in the descriptions and the abbreviations, in brackets, correspond to the labels in the following results tables. The results tables describe the different environmental indicators for each product per declared unit, for each declared module. The EN 15804 reference package based on EF 3.1 is used.

The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks.

- Energy indicators (MJ) are always given as net calorific value.
- Long-term emissions (> 100 years) are not taken into consideration in the impact estimate.

Table 7. Environmental impact indicators described

Climate change (global warming potential) (GWP-total, GWP-fossil, GWP-biogenic, GWP-luluc)

A measure of greenhouse gas emissions, such as CO_2 and methane. These emissions are causing an increase in the absorption of radiation emitted by the earth, increasing the natural greenhouse effect. This may in turn have adverse impacts on ecosystem health, human health and material welfare. The global warming potential (GWP) is split into three sub indicators: fossil, biogenic, and land-use and land-use change.

Ozone depletion potential (ODP)

Depletion of the ozone leads to higher levels of UVB ultraviolet rays reaching the earth's surface with detrimental effects on humans and plants. ODP is a measure of air emissions that contribute to the depletion of the stratospheric ozone layer.

Acidification potential (AP)

Acidification potential is a measure of emissions that cause acidifying effects to the environment. A molecule's acidification potential indicates its capacity to increase the hydrogen ion (H+) concentration in the presence of water, thus decreasing the pH value. Potential effects include fish mortality, forest decline, and the deterioration of building materials.

Eutrophication potential (EP-freshwater, EP-marine, EP-terrestrial)

Eutrophication covers all potential impacts of excessively high levels of macronutrients, the most important of which are nitrogen (N) and phosphorus (P). In aquatic ecosystems where this term is mostly applied, this typically describes a degradation in water quality. Eutrophication can result in an undesirable change in the type of species that flourish and an increase in the production of biomass. As the decomposition of biomass consumes oxygen, eutrophication may decrease the available oxygen level in the water column and threaten fish in their ability to respire.

Photochemical ozone creation potential (POCP)

Photochemical ozone formation potential gives an indication of the emissions from precursors that contribute to ground level smog formation, mainly ozone (O3). Ground level ozone may be harmful to human health and ecosystems and may also damage crops. These emissions are produced by the reaction of volatile organic compounds (VOCs) and carbon monoxide in the presence of nitrogen oxides and UV light.

Abiotic resource depletion (ADP-mm, ADP-fossil)

The consumption of non-renewable resources decreases the availability of these resources and their associated functions in the future. Depletion of mineral resources and non-renewable energy resources are reported separately. Depletion of mineral resources is assessed based on total reserves.

Water use (WDP)

Water scarcity is a measure of the stress on a region due to water consumption.

The results

The results tables describe the different environmental indicators for the representative products for FEI and other insulation products for each declared module. The EN 15804 reference package based on EF 3.1 is used.

EN15804+A2 core environmental impact indicators

The reported impact categories represent impact potentials, i.e. they are approximations of environmental impacts that could occur if the emissions would (a) follow the underlying impact pathway and (b) meet certain conditions in the receiving environment while doing so. The environmental impact results are therefore relative expressions only and do not predict actual impacts, the exceeding of thresholds, safety margins, or risks.

Since Module C is included in the EPD, the use of Module A1-A3 (A1-A5 for services) results without considering the results of Module C is discouraged.

Range/variability

According to the assessment results, variations for core environmental indicator results, aggregated over all included modules (from A to C), are significant. This is mainly due to the differences in mass per square meter of different insulation products. The detailed variation of each core environmental impact indicator result has been provided in the environmental performance.

Table 8. Abbreviations environmental impact indicators

Abbr	Indicator
GWP-total	Climate change (total)
GWP-fossil	Climate change (fossil)
GWP-biogenic	Climate change (biogenic)
GWP-luluc	Climate change (land use and land use change)
ODP	Depletion potential of the stratospheric ozone layer
AP	Acidification potential of land and water
EP-freshwater	Eutrophication potential (freshwater)
EP-marine	Eutrophication aquatic (marine)
EP-terrestrial	Eutrophication (terrestrial)
POCP	Photochemical ozone formation
ADP-mm	Depletion abiotic resources – minerals and metals[1]
ADP-fossil	Depletion abiotic resources – fossil fuels[1]
WDP	Water use deprivation[1]

1 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 experience with the indicator.

The variations between A-C results of core environmental indicators are less than 10% for most indicators. The exception is ADP-mm, which has a higher variation.

Table 9. EN15804+A2 Core environmental impact indicator results for 1 m^2 of FEI and other insulation products

Abbr	Unit	A1-A3	C1	C2	C3	C4	D	Max variation – absolute
GWP-total	kg CO_2 eq	1.49E+00	2.21E-02	4.60E-03	0.00E+00	8.56E-03	0.00E+00	71.6%
GWP-fossil	kg CO_2 eq	1.40E+00	2.21E-02	4.60E-03	0.00E+00	8.56E-03	0.00E+00	71.2%
GWP-biogenic	kg CO_2 eq	9.16E-02	2.03E-06	2.32E-07	0.00E+00	1.10E-06	0.00E+00	103%
GWP-luluc	kg CO_2 eq	4.79E-04	2.43E-06	1.87E-06	0.00E+00	4.44E-06	0.00E+00	77.6%
ODP	kg CFC 11 eq	2.42E-08	3.16E-10	6.56E-11	0.00E+00	2.47E-10	0.00E+00	73.3%
AP	Mol H+ eq	6.61E-03	1.96E-04	2.59E-05	0.00E+00	6.06E-05	0.00E+00	70.1%
EP-freshwater	kg P eq	2.61E-04	9.40E-07	3.70E-07	0.00E+00	7.10E-07	0.00E+00	74.3%
EP-marine	kg N eq	1.47E-03	8.99E-05	1.05E-05	0.00E+00	2.31E-05	0.00E+00	71.7%
EP-terrestrial	Mol N eq	1.79E-02	9.84E-04	1.14E-04	0.00E+00	2.52E-04	0.00E+00	69.2%
POCP	kg NMVOC eq	5.25E-03	2.93E-04	3.67E-05	0.00E+00	9.03E-05	0.00E+00	73.4%
ADP-mm	kg Sb eq	1.28E-04	9.90E-09	1.44E-08	0.00E+00	1.33E-08	0.00E+00	64.2%
ADP-fossil	MJ	2.16E+01	2.88E-01	6.56E-02	0.00E+00	2.10E-01	0.00E+00	74.4%
WDP	m^3 world eq	3.13E-01	1.13E-03	3.75E-04	0.00E+00	9.34E-03	0.00E+00	79.1%

Resource use indicators

The resource use indicators describe the use of renewable and non-renewable material resources, renewable and non-renewable primary energy and water.

Table 10. Abbreviations resource use indicators

Abbr	Indicator
PERE	Renewable primary energy as energy carrier
PERM	Renewable primary energy resources as material utilization
PERT	Total use of renewable primary energy resources
PENRE	Non-renewable primary energy as energy carrier
PENRM	Non-renewable primary energy as material utilization
PENRT	Total use of non-renewable primary energy resources
SM	Use of secondary material
RSF	Use of renewable secondary fuels
NRSF	Use of non-renewable secondary fuels
FW	Use of net fresh water

Table 11. EN15804+A2 Resource use indicator results for 1 m^2 of FEI and other insulation products

Abbr	Unit	A1-A3	C1	C2	C3	C4	D
PERE	MJ	1.67E+01	2.40E-03	8.88E-04	0.00E+00	1.94E-03	0.00E+00
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.67E+01	2.40E-03	8.88E-04	0.00E+00	1.94E-03	0.00E+00
PENRE	MJ	1.77E+01	2.88E-01	6.56E-02	0.00E+00	2.10E-01	0.00E+00
PENRM	MJ	9.54E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.86E+01	2.88E-01	6.56E-02	0.00E+00	2.10E-01	0.00E+00
SM	kg	1.21E+00	2.07E-04	2.92E-05	0.00E+00	5.27E-05	0.00E+00
RSF	MJ	1.62E-03	3.43E-07	3.69E-07	0.00E+00	1.09E-06	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	1.49E-02	2.76E-05	9.17E-06	0.00E+00	2.18E-04	0.00E+00

Waste material and output flow indicators

Waste indicators describe waste generated within the life cycle of the product. Waste is categorised by hazard class, end-of-life fate and exported energy content.

Table 12. Abbreviations waste material and output flow indicators

Abbr	Indicator
HWD	Hazardous waste disposed
NHWD	Non-hazardous waste disposed
RWD	Radioactive waste disposed
CRU	Components for re-use
MFR	Materials for recycling
MER	Materials for energy recovery
EEE	Exported electrical energy
EET	Exported thermal energy

Table 13. EN15804+A2 Waste categories and output flow indicator results for 1 m^2 of FEI and other insulation products

Abbr	Unit	A1-A3	C1	C2	C3	C4	D
HWD	kg	4.51E-02	5.16E-04	1.15E-04	0.00E+00	2.33E-04	0.00E+00
NHWD	kg	7.30E+00	6.67E-03	2.17E-03	0.00E+00	1.37E+00	0.00E+00
RWD	kg	1.54E-05	8.11E-08	2.77E-08	0.00E+00	6.52E-08	0.00E+00
CRU	kg	2.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MFR	kg	1.27E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Biogenic carbon content

Biogenic carbon refers to the carbon stored in organic materials. This is sequestered during growth and released at end of life. EN15804+A2 requires the declaration of biogenic carbon content of the product and its packaging.

Table 14. EN15804+A2 Biogenic carbon content indicator results for 1 m^2 of FEI and other insulation products

Indicator	Abbr	Unit	
Biogenic carbon content – product	BCC-prod	kg	0.00E+00
Biogenic carbon content – packaging	BCC-pack	kg	6.24E-04

1 kg biogenic carbon is equivalent to 44/12 kg CO_2.

Additional environmental impact indicators

Optional environmental impact categories provide further information on environmental impacts.

Table 15. Abbreviations for additional environmental impact indicators

Abbr	Indicator
GWP-GHG	Global warming potential[1]
GWP-GHG (IPCC AR5)	IPCC AR5 GWP-GHG[2]
PM	Respiratory inorganics
IRP	Ionising radiation – human health[3]
ETP-fw	Ecotoxicity – freshwater[4]
HTPc	Human toxicity, cancer effects[4,5]
HTPnc	Human toxicity, non-cancer effects[4,5]
SQP	Land use related impacts / soil quality[4,5]

Table 16. Additional environmental indicator results for 1 m^2 of FEI and other insulation products

Abbr	Unit	A1-A3	C1	C2	C3	C4	D	Max variation – absolute
GWP-GHG	kg CO_2-eq.	1.47E+00	2.21E-02	4.60E-03	0.00E+00	8.56E-03	0.00E+00	71.6%
GWP-GHG (IPCC AR5)	kg CO_2-eq.	1.47E+00	2.21E-02	4.61E-03	0.00E+00	8.58E-03	0.00E+00	71.5%
PM	Disease incidences	7.52E-08	5.52E-09	5.01E-10	0.00E+00	1.38E-09	0.00E+00	70.6%
IRP	kBq U235-eq.	3.22E-02	1.65E-04	5.66E-05	0.00E+00	1.34E-04	0.00E+00	79.0%
ETP-fw	CTUe	9.39E+00	6.16E-02	1.72E-02	0.00E+00	2.87E-02	0.00E+00	73.0%
HTPc	CTUh	6.51E-09	1.47E-10	2.42E-11	0.00E+00	3.87E-11	0.00E+00	68.5%
HTPnc	CTUh	8.52E-09	4.87E-11	5.15E-11	0.00E+00	3.77E-11	0.00E+00	73.6%
SQP	Dimensionless	5.30E+00	2.19E-02	4.81E-02	0.00E+00	4.13E-01	0.00E+00	74.7%

1 This indicator should be identical to GWP-total except that the CF for biogenic CO_2 is set to zero. It has been included in the EPD following the PCR (EPD International, 2024b). In this study it is calculated by subtracting the value of Climate change – biogenic (GWP-biogenic) from the value of Climate change – total (GWP-total) since the ecoinvent Excel LCIA results do not include the indicator.

2 GWP-GHG (IPCC AR5) is an additional GWP100 indicator that is aligned with the Intergovernmental Panel on Climate Change (IPCC) 2013 Fifth Assessment Report (AR5) (IPCC 2013), national greenhouse gas reporting frameworks in Australia and New Zealand and previous versions of the Construction Products PCR (PCR2019:14v1.3.2). It excludes biogenic carbon and indirect radiative forcing.

3 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.

4 The results of the impact categories abiotic depletion of minerals and metals, land use, human toxicity (cancer), human toxicity, noncancer and ecotoxicity (freshwater) may be highly uncertain in LCAs that include capital goods/ infrastructure in generic datasets, in case infrastructure/ capital goods contribute greatly to the total results. This is because the LCI data of infrastructure/capital goods used to quantify these indicators in currently available generic datasets sometimes lack temporal, technological and geographical representativeness. Caution should be exercised when using the results of these indicators for decision-making purposes.

5 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 experience with the indicator.

EN15804+A1 environmental impact indicators

EN15804+A1 results are included to aid comparison and backwards compatibility with rating tools.

Table 17. Abbreviations for additional environmental impact indicators EN15804+A1

Abbr	Indicator
GWP-GHG (EN15804+A1)	Global warming potential (total)
ODP (EN15804+A1)	Depletion potential of the stratospheric ozone layer
AP (EN15804+A1)	Acidification potential of land and water
EP (EN15804+A1)	Eutrophication potential
POCP (EN15804+A1)	Photochemical ozone creation potential
ADPE (EN15804+A1)	Abiotic depletion potential – elements
ADPF (EN15804+A1)	Abiotic depletion potential – fossil fuels

Table 18. EN15804+A1 environmental indicator results for 1 m^2 of FEI and other insulation products

Abbr	Unit	A1-A3	C1	C2	C3	C4	D
GWP (EN15804+A1)	kg CO_2-eq.	1.43E+00	2.18E-02	4.54E-03	0.00E+00	8.34E-03	0.00E+00
ODP (EN15804+A1)	kg CFC11-eq.	1.71E-08	2.21E-10	4.51E-11	0.00E+00	1.71E-10	0.00E+00
AP (EN15804+A1)	kg SO_2-eq.	3.96E-03	1.34E-04	1.80E-05	0.00E+00	4.23E-05	0.00E+00
EP (EN15804+A1)	kg PO_4^3-eq.	1.43E-03	3.31E-05	4.67E-06	0.00E+00	1.00E-05	0.00E+00
POCP (EN15804+A1)	kg C_2H_4-eq.	2.14E-03	5.95E-05	9.52E-06	0.00E+00	2.99E-05	0.00E+00
ADPE (EN15804+A1)	kg Sb-eq.	1.28E-04	9.90E-09	1.44E-08	0.00E+00	1.33E-08	0.00E+00
ADPF (EN15804+A1)	MJ	1.87E+01	2.88E-01	6.56E-02	0.00E+00	2.10E-01	0.00E+00

While the indicators and characterisation methods are from EN15804:2012+A1:2013, other LCA rules for the study (system boundaries, allocation, etc.) are according to EN15804:2012+A2:2019; i.e. this study does not claim that the results of the 'A1 indicators' are compliant with EN15804:2012+A1:2013.

Conversion factors

Conversion factors are provided to enable results to be calculated for other products (the representative product has been highlighted).

Table 19. FEI and other insulation product information for industry application

Product	Product code	Conversion factor
FEI 1.2x.9x.05m 12/BL	7520003	1.32
FEI .73x.88x.038m 20/BL (90417)	7520087	1.00
FEI .63x.69x.025m 40/BL (90402)	7520089	0.658
FEI 1.2x.7x.07m 32kg 8/BL	7520097	1.64
FEI .57x.52x.038m 34/BL (90419)	7520098	1.00
FEI .46x.67x.038m 35/BG (228637)	7573006	1.00
FEI .69x.6x.038m 30/BG (90415)	7573010	1.00

Material Circularity

Material Circularity Indicator (MCI) is a method for measuring how well a product performs in the context of a circular economy and aligns with ISO 59020 (ISO, 2024). It measures the degree to which a product system keeps materials in circulation at their highest form of value. It provides a common metric that applies to all of the different circular economy strategies including avoidance, durability, reuse, remanufacturing, recycling, regenerative sourcing, composting and energy recovery. The MCI can be reported as an MCI Score or as a percentage circularity (% MCI).

MCI Score

A value between 0 and 1 in which a score of 0.1 represents a linear system that uses only virgin, non-renewable materials and produces only non-recoverable waste. A score of 1 represents a perfectly circular system that uses only non-virgin or renewable materials and produces only recoverable waste. Values between 0 and 0.1 are reserved for products that consume more material, typically due to a lower utility than an average product.

% MCI

This is calculated using the same methodology and assumptions as the MCI Score but reports circularity on a scale from 0% (Linear) to 100% (Perfectly Circular) that is easier to understand and communicate.

The MCI has been reported as here both an MCI Score and a percentage circularity (% MCI) to support comparability. Although the methodology for MCI Score and % MCI is the same, the score cannot be directly transposed but needs to be converted per the methodology described by the Ellen MacArthur Foundation (Ellen MacArthur Foundation, 2019/2024).

MCI Results

The MCI results below show that the higher binder content, the less circular the product is. This is because the proportion of recycled crushed glass in the product decreases as the binder content increases. Generally, the greater the quantity of recycled crushed glass in the product the higher the MCI. The product is deemed as unrecoverable waste at end-of-life.

Table 20. MCI results for FEI and other insulation products

Product	MCI result	% MCI result
FEI 1.2x.9x.05m 12/BL	0.451	39.1%
FEI .73x.88x.038m 20/BL (90417)	0.451	39.1%
FEI .63x.69x.025m 40/BL (90402)	0.451	39.1%
FEI 1.2x.7x.07m 32kg 8/BL	0.451	39.1%
FEI .57x.52x.038m 34/BL (90419)	0.451	39.1%
FEI .46x.67x.038m 35/BG (228637)	0.451	39.1%
FEI .69x.6x.038m 30/BG (90415)	0.451	39.1%

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An Environmental Product Declaration, or EPD, is a standardised and verified way of quantifying the environmental impacts of a product based on a consistent set of rules known as a PCR (Product Category Rules). The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

The results for EN15804+A2 compliant EPDs are not comparable with EN15804+A1 compliant studies as the methodologies are different. Results that are EN15804+A1 compliant are given in this document to assist comparability across EPDs.

Programme information

Declaration owner	**Tasman Insulation New Zealand Ltd t/a Comfortech Building Performance Solutions®** Post: 9-15 Holloway Place, Penrose, Auckland 1061 New Zealand Web: comfortech.co.nz Email: info@comfortech.co.nz	COMFORTECH BUILDING PERFORMANCE SOLUTIONS
Geographical scope	New Zealand	
Reference year	2023-01-01 to 2023-12-31	
LCA Accountability	**thinkstep Ltd** Barbara Nebel Joel Edwards, Haoran Lei Post: 11 Rawhiti Road, Pukerua Bay, Wellington 5026 New Zealand Web: thinkstep-anz.com Email: anz@thinkstep-anz.com	thinkstep anz
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PCR	c-PCR-005 Thermal Insulation products (EN 16783) (published on 2024-05-03) PCR 2019.14 Construction Products, version 1.3.4 (published on 2024-04-30, valid until 2025-06-20)	
PCR review conducted by	The Technical Committee of the International EPD System. See www.environdec.com for a list of members. Review chair: Claudia Peña, PINDA LCT SpA. The review panel may be contacted via the Secretariat: www.environdec.com/support	
Independent verification of the declaration and data, according to ISO 14025:	☐ EPD process certification (Internal) ☑ EPD verification (External)	
Third party verifier	Claudia A. Peña, PINDA LCT SpA Email: pinda.lct@gmail.com	
Approved by	EPD Australasia Ltd	
Procedure for follow-up of data during EPD validity involved third-party verifier	☐ yes ☑ no	

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