Environmental Product Declaration

of multiple products based on a representative product of the product group.

In accordance with ISO 14025:2006 and EN 15804:2012+A2: 2019/AC:2021

Kingspan KoolDuct System

from

Kingspan Insulation Pty Ltd (Australia)

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
Regional Programme:	EPD Australasia, www.epd-australasia.com
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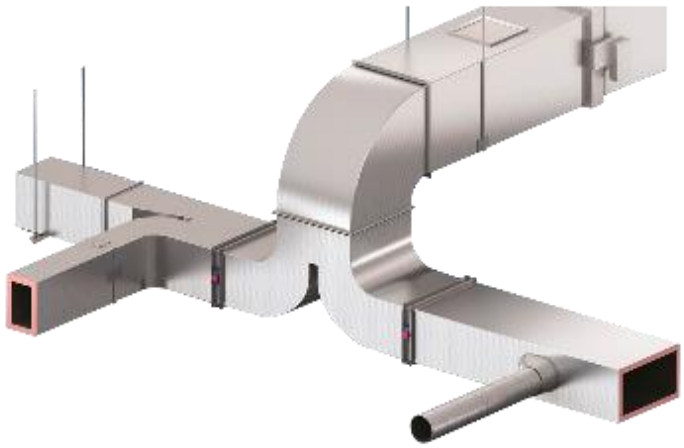
An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com



Version History

Version

Version	2
Revision Date	21 March 2025 (valid until 12 December 2029)

Version differences

Version	Amendment summary
1	Original Version
2	Typo errors are corrected. Descriptions of products have been updated. There are no changes to the environmental results.

General Information

Programme information

Declaration Owner	Kingspan Insulation Pty Ltd (Australia) Somerton, Victoria, Australia W: https://www.kingspan.com/au	
Geographical Scope	Australia	
Reference Year for Data	1 January 2022 - 31 December 2022	
EPD programme operator:	**EPD Australasia Limited** epd-australasia.com info@epd-australasia.com EPD Australasia Limited 315a Hardy Street Nelson 7010, New Zealand	**EPD International AB** info@environdec.com EPD International AB Box 210 60, SE-100 31 Stockholm, Sweden
PRODUCT CATEGORY RULES (PCR)		
CEN standard EN 15804 served as the core Product Category Rules (PCR)		
Product Category Rules (PCR):	PCR 2019.14 Construction Products, version 1.3.4	
PCR review was conducted by:	The Technical Committee of the International EPD® System. See www.environdec.com for a list of members	
Review Chair:	Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact	
LIFE CYCLE ASSESSMENT (LCA)		
EPD Prepared by:	Sazal Kundu, Weiqi Xing, Lilia Caballero Edge Environment Pty Limited Greenhouse, Level 3, 180 George Street, Sydney NSW 2000 W: www.edgeimpact.global E: info@edgeimpact.global	
THIRD-PARTY VERIFICATION		
Independent verification of the declaration and data, according to ISO 14025:2006	☒ EPD verification by accredited certification body	
Third Party Verifier	Epsten Group, Inc. 101 Marietta St. NW, Suite 2600, Atlanta, Georgia 30303, USA www.epstengroup.com Accredited by: A2LA, Certificate #3142.03	
Procedure for follow-up of data during EPD validity involved third-party verifier	☐ Yes ☒ No	

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

Company Information

Owner of the EPD: Kingspan Insulation Pty Ltd (Australia)
Contact: Danny Leahy – Sustainability, Innovation, & Commercialization Officer
Danny.leahy@kingspan.com
Description of the organisation: Kingspan is a global manufacturer of insulation and building envelope solutions. Kingspan focus on innovation that makes a difference, offering rigid insulation, flexible insulation and building wraps.
Name and location of production site(s): Somerton, Victoria, Australia

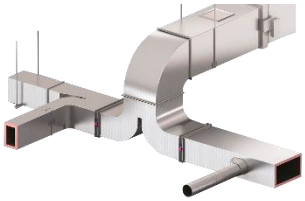
Product Information

Kingspan KoolDuct System

Product description:
Kingspan KoolDuct System is a rectangular HVAC ductwork system that is installed in a single fix. Designed for HVAC systems, KoolDuct is suitable for residential, commercial, public, light industrial and leisure projects. The system can reduce air leakage by up to 80%*, translating into significant energy savings, reduced heating and cooling loads, smaller plant sizes, and capital cost savings.

*Figure based on research conducted in the US by independent consultants MDA Engineering Inc. 2010.

Product highlights:



- Available up to R2.0
- Lightweight yet durable
- Saves on installation time
- NCC and AS/NZS 4859.1:2018 compliant
- Air flows over sealed aluminium surfaces, minimising any risk of loose fibres entering the air handling system
- Fibre-free insulation core, non-deleterious, odourless and non-tainting

Application:
The Kingspan KoolDuct System is designed for use in building services / HVAC applications. It is suitable for both new build and residential, commercial, public, light industrial and leisure sectors.

Dimensions:
Board Size: 3930mm x 1200mm
Board Thickness: 22*, 30, 46mm
*Minimum order quantities apply

Product sustainability:

Aspect	Characteristic
Re-usability	Re-usable if removed with care (long term service provided)
Water Use	No water used in Kingspan Insulation's manufacturing process

Product covered by this EPD:

This is an EPD for multiple products, based on a representative product (RP), valid for 1 m² of KoolDuct system in 20mm, 22mm, 30mm, 42mm and 46mm sizes produced at Kingspan's site in Somerton, Victoria, Australia. The rationale for choosing the RP is that it is the most sold product from its range. Table 1 lists the products included in this EPD and identifies the representative product. The environmental impacts of this RP are shown in the Environmental Performance section, while the conversion factors for the other products are provided in the Additional Environmental Information section of this EPD.

Table 1: Products Included

Product Type	Description	Declared Unit	Products Included
Ductwork system	Rectangular HVAC ductwork system – single fix	1 m^2 installed product	KoolDuct System 20mm
			KoolDuct System 22mm
			KoolDuct System 30mm (RP)
			KoolDuct System 42mm
			KoolDuct System 46mm

LCA Information

Declared unit: 1 m^2 of installed KoolDuct System 30mm, manufactured in Somerton, Victoria, Australia.
Technical service life: 50 years
Time representativeness: The LCA study was conducted on the calendar year 2022 (01 Jan 2022 to 31 Dec 2022) production data
Database(s) and LCA software used:
The inventory data for the process are entered into the SimaPro (v9.6) LCA software program and linked to the pre-existing data for the upstream feedstocks and services selected in order of preference from:

- For Australia, the Australian Life Cycle Inventory (AusLCI) v1.42 compiled by the Australian Life Cycle Assessment Society ((ALCAS), 2023). The AusLCI database at the time of this report was less than 1 year old.
- Other authoritative sources (e.g., ecoinvent v3.10, (Wernet, et al., 2023)), where necessary adapted for relevance to Australian conditions (energy sources, transport distances and modes and so on, and documented to show how the data is adapted for national relevance). At the time of reporting, the ecoinvent v3.10, database was less than 1 year old.
- Other sources with sensitivity analysis reported to show the significance of this data for the results and conclusions drawn.

Description of system boundaries:
The scope of the LCA was cradle to gate with options, modules A4-A5, modules C1–C4 and module D. The geographical scope of this EPD is Australia, New Zealand and Asia.

This EPD has been produced in conformance with the requirements of PCR2019:14, General Program Instructions (GPI) and EN 15804.

It is discouraged to use the results of modules A1-A3 without considering the results of module C.

Table 2: Life Cycle of building products: stages and modules included in this EPD

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	x	x	x	x	x	ND	ND	ND	ND	ND	ND	ND	x	x	x	x	x
Geography	AU	AU	AU	AU, NZ, Asia	AU, NZ, Asia	-	-	-	-	-	-	-	AU, NZ, Asia	AU, NZ, Asia	AU, NZ, Asia	AU, NZ, Asia	AU, NZ, Asia
Specific data used	<10%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – products	+44%/-26%			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Variation – sites	0%			-	-	-	-	-	-	-	-	-	-	-	-	-	-

ND = not declared (such a declaration shall not be regarded as an indicator of zero result).

The following life cycle stages have not been declared, as they are deemed not applicable for Kingspan Insulation product ranges: Material emissions from usage (B1); Maintenance (B2); Repair (B3); Replacement (B4); Refurbishment (B5), Operational energy use (B6) and Operational water use (B7).

System Diagram:

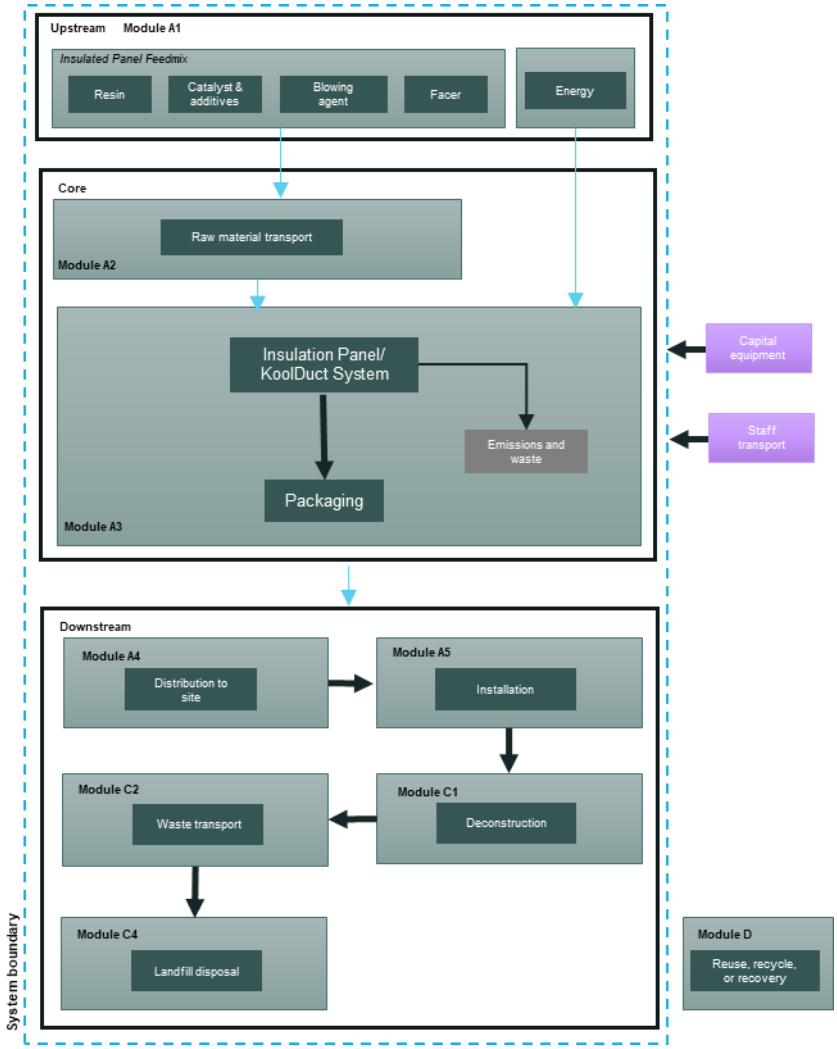


Figure 1: Kingspan Insulation EPD system boundary

Upstream Processes

The upstream processes include those involved in Module A1 – Raw material supply. This module includes:

- Extraction, transport and manufacturing of raw materials.
- Generation of electricity from primary and secondary energy resources, also including their extraction, refining and transport for Modules A1.
- Processing up to the end-of-waste state or disposal of final residues including any packaging not leaving the factory gate with the product

Core Processes

The core processes include those involved in Module A2 and Module A3, including:

- External transportation of materials to the core processes and internal transport.
- Manufacturing of the Kingspan Insulation products.
- Packaging materials.
- Processing of waste to landfill and recycling.

Downstream Processes

The downstream processes include those involved in Module A4 to C4, including:

- Transportation from the production gate to the construction site.
- Transport of waste generated from the construction site.
- Installation of the product on the site.
- Wastage of construction products (additional production processes to compensate for the loss of construction products included in module A1-A3).
- Waste processing of the waste from product wastage during the construction processes up to the end-of-waste state or disposal of final residues.
- Transport of equipment and use of materials for deconstruction at the end of life.
- Transport of waste generated at the end of life.
- Treatment of waste generated at the end of life.

Cut-off rules and Exclusion of Small Amounts

It is common practice in LCA/LCI protocols to propose exclusion limits for inputs and outputs that fall below a threshold % of the total, but with the exception that where the input/output has a "significant" impact it should be included. According to the PCR 2019:14 v1.3.4, Life cycle inventory data shall according to EN 15804 A2 include a minimum of 95% of total inflows (mass and energy) per module. Inflows not included in the LCA shall be documented in the EPD. Data gaps in included stages in the downstream modules shall be reported in the EPD, including an evaluation of their significance. In accordance with the PCR 2019:14 v1.3.4, the following system boundaries are applied to manufacturing equipment and employees:

- Environmental impact from infrastructure, construction, production equipment, and tools that are not directly consumed in the production process are not accounted for in the LCI. Capital equipment and buildings typically account for less than a few percent of nearly all LCIs and this is usually smaller than the error in the inventory data itself. For this project, it is assumed that capital equipment makes a negligible contribution to the impacts as per Frischknecht et al. (Frischknecht, 2007) with no further investigation.
- Personnel-related impacts, such as transportation to and from work, are also not accounted for in the LCI. The impacts of employees are also excluded from inventory impacts on the basis that if they were not employed for this production or service function, they would be employed for another. It is very hard to decide what proportion of the impacts from their whole lives should count towards their employment. For this project, the impacts of employees are excluded.

Allocation

In a process step where more than one type of product is generated, it is necessary to allocate the environmental stressors (inputs and outputs) from the process to the different products (functional outputs) in order to get product-based inventory data instead of process-based data. An allocation problem also occurs for multi-input processes. In an allocation procedure, the sum of the allocated inputs and outputs to the products shall be equal to the unallocated inputs and outputs of the unit process.

The following stepwise allocation principles shall be applied for multi-input/output allocations:

- The initial allocation step includes dividing up the system sub-processes and collecting the input and output data related to these sub-processes.
- The first (preferably) allocation procedure step for each sub-process is to partition the inputs and outputs of the system into their different products in a way that reflects the underlying physical relationships between them.
- The second (worst case) allocation procedure step is needed when physical relationship alone cannot be established or used as the basis for allocation. In this case, the remaining environmental inputs and outputs from a sub-process must be allocated between the products in a way that reflects other relationships between them, such as the economic value of the products.

Data Quality and Validation

The primary data used for the study (core module) is based on direct utility bills or feedstock quantities from the Kingspan Insulation's procurement records. Primary data was carefully reviewed in order to ensure completeness, accuracy and representativeness of the data supplied. Contribution analysis was used to focus on the key pieces of data contributing to the environmental impact categories. The data was benchmarked against relevant benchmark data in ecoinvent. Overall, the data was deemed to be of high quality for the core module. The data quality ranking is as follows: geographical representativeness – good; technical representativeness – good and time representativeness – very good.

Assumptions, Choices, and Limitations

Table 3: Key assumptions, choices and limitation for this EPD

Assumption or limitation	Impact on LCA results	Discussion
Insulation material ingredient composition.	Minor	Information obtained from Kingspan Production Team. The Kingspan team gave the entire composition of the insulation material. No proxy data was used for insulation material.
Distribution	Minor	Information obtained from Kingspan Production Team. The Kingspan team gave the weighted average distance for each type of transport. The transport includes road transport (via small and large truck), sea transport (local and overseas). Relevant background database was used for each type of weighted average distance. There were four weighted average data: road small truck, road large truck, sea local, sea international.
Construction energy	Minor	The KoolDuct System is manufactured in one plant in Somerton, VIC, Australia. Mass and energy data have been sourced from the manufacturing plant by Kingspan Insulation. Mass data was collected for individual products in CY2022. Energy and utility used as well as waste generated during the production in CY2022 are allocated to KoolDuct System products using mass allocation method.
Exclusion of employees, capital good and infrastructure	Minor	Personnel-related impacts, such as transportation to and from work, are also not accounted for in the LCI. The impacts of employees are also excluded from inventory impacts on the basis that if they were not employed for this production or service function, they would be employed for another. It is very hard to decide what proportion of the impacts from their whole lives should count towards their employment. For this project, the impacts of employees are excluded.

Compliance with Standards

The methodology and report format has been modified to comply with:

- ISO 14040:2006+A1:2020 and ISO14044:2006+A2:2020 which describe the principles, framework, requirements and provides guidelines for life cycle assessment (LCA).
- ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations -- Principles and procedures, which establishes the principles and specifies the procedures for developing Type III environmental declaration programmes and Type III environmental declarations.
- EN 15804:2012+A1:2013; Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
- EN 15804:2012+A2:2019; Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
- Product Category Rules (PCR) 2019:14, v1.3.4 – Construction products – Hereafter referred to as PCR 2019:14.
- General Programme Instructions (GPI) for the International EPD System v5.0 – containing instructions regarding methodology and the content that must be included in EPDs registered under the International EPD System.
- Instructions of EPD Australasia V4.2 – a regional annex to the general programme instructions of the International EPD System.

Environmental Performance Related Information

The potential environmental impacts, use of resources and waste categories included in this EPD were calculated using the SimaPro v9.6 tool and are listed in Table 4. The characterisation factors applied to the calculation of potential environmental impacts (Table 4) are based on version 3.1 of the reference package for CFs used in the Product Environmental Footprint (PEF) framework (EF 3.1). The impact results of the biogenic carbon and energy resource use are coherent with the guidance and requirement in Annex 2 and Annex 3 - Option A of PCR 2019:14

All tables from this point will contain the abbreviation only. 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.

Table 4: Life Cycle Impact, Resource and Waste Assessment Categories, Measurements and Methods in accordance with EN15804+A2

Impact Category	Abbreviation	Measurement Unit	Assessment Method and Implementation
Potential Environmental Impacts			
Total global warming potential	GWP - Total	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2021
Global warming potential (fossil)	GWP - Fossil	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2021
Global warming potential (biogenic)	GWP - Biogenic	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2021
Land use/ land transformation	GWP - Luluc	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2021
Ozone depletion potential	ODP	kg CFC 11 equivalents	Steady-state ODPs, WMO 2014

Acidification potential	AP	mol H^+ eq.	Accumulated Exceedance, Seppälä et al. 2006, Posch et al., 2008
Eutrophication – aquatic freshwater	EP - freshwater	kg P equivalent	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
Eutrophication – aquatic marine	EP - marine	kg N equivalent	EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe
Eutrophication – terrestrial	EP – terrestrial	mol N equivalent	Accumulated Exceedance, Seppälä et al. 2006, Posch et al.
Photochemical ozone creation potential	POCP	kg NMVOC equivalents	LOTOS-EUROS, Van Zelm et al., 2008, as applied in ReCiPe
Abiotic depletion potential (elements)*	ADPE	kg Sb equivalents	CML (v4.8)
Abiotic depletion potential (fossil fuels)*	ADPF	MJ net calorific value	CML (v4.8)
Water Depletion Potential*	WDP	m^3 equivalent deprived	Available Water Remaining (AWARE) Boulay et al., 2016 (includes Australia flows calculated using 36 Australian catchments)
Resource use			
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ, net calorific value	Manual for direct inputs [1]
Use of renewable primary energy resources used as raw materials	PERM	MJ, net calorific value	Manual for direct inputs[2]
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PERT	MJ, net calorific value	ecoinvent version 3.8 and expanded by PRé Consultants[3]
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ, net calorific value	Manual for direct inputs[4]
Use of non- renewable primary energy resources used as raw materials	PENRM	MJ, net calorific value	Manual for direct inputs[5]
Total use of non- renewable primary energy resources (primary energy and primary energy resources used as raw materials)	PENRT	MJ, net calorific value	ecoinvent version 3.8 and expanded by PRé Consultants[6]
Use of secondary material	SM	kg	Manual for direct inputs
Use of renewable secondary fuels	RSF	MJ, net calorific value	Manual for direct inputs
Use of non-renewable secondary fuels	NRSF	MJ, net calorific value	Manual for direct inputs
Use of net fresh water	FW	m^3	ReCiPe 2016
Waste categories			

1 PERE = PERT - PERM
2 Calculated based on the lower heating value of renewable raw materials. LHV is taken from https://phyllis.nl/, as recommended by SimaPro in compliance with EN15804+A2: https://support.simapro.com/s/article/How-to-calculate-EN-15804-A2-indicators-in-desktop-SimaPro
3 Calculated as sum of renewables, biomass; renewable, wind, solar and geothermal, and renewable, water.
4 PENRE = PENRT - PENRM
5 Calculated based on the lower heating value (LHV) of non-renewable raw materials. LHV is taken from https://phyllis.nl/, as recommended by SimaPro in compliance with EN15804+A2: https://support.simapro.com/s/article/How-to-calculate-EN-15804-A2-indicators-in-desktop-SimaPro
6 Calculated as sum of non-renewables, fossil and non-renewable, nuclear.

Hazardous waste disposed	HWD	kg	EDIP 2003 (v1.05)
Non-hazardous waste disposed	NHWD	kg	EDIP 2003 (v1.05) [7]
Radioactive waste disposed/stored	RWD	kg	EDIP 2003 (v1.05)
Output flow categories			
Components for re-use	CRU	kg	Manual for direct inputs
Material for recycling	MFR	kg	Manual for direct inputs
Materials for energy recovery	MERE	kg	Manual for direct inputs
Exported energy - electricity	EE - e	MJ per energy carrier	Manual for direct inputs
Exported energy – thermal	EE – t	MJ per energy carrier	Manual for direct inputs
Additional environmental impact indicators			
Global warming potential, excluding biogenic uptake, emissions and storage	GWP-GHG	kg CO_2 equivalents (GWP100)	Baseline model of 100 years of the IPCC based on IPCC 2021[8]
Particulate matter	Potential incidence of disease due to PM emissions (PM)	Disease incidence	SETAC-UNEP, Fantke et al. 2016
Ionising radiation - human health**	Potential Human exposure efficiency relative to U235 (IRP)	kBq U-235 eq	Human Health Effect model
Eco-toxicity (freshwater)*	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	CTUe	USEtox
Human toxicity potential - cancer effects*	Potential Comparative Toxic Unit for humans (HTP-c)	CTUh	USEtox
Human toxicity potential - non cancer effects*	Potential Comparative Toxic Unit for humans (HTP-nc)	CTUh	USEtox
Soil quality*	Potential soil quality index (SQP)	dimensionless	Soil quality index (LANCA®)
Potential Environmental Impacts – Indicators According to EN 15804+A1			
Global warming potential	GWP	kg CO_2 equivalents	CML (v4.02) based on IPCC AR4
Ozone layer depletion	ODP	kg CFC-11 equivalents	CML (v4.02) based on WMO 1999
Acidification	AP	kg SO_2 equivalents	CML (v4.02)
Eutrophication	EP	kg PO_4^{3-} equivalents	CML (v4.02)
Photochemical oxidation	POCP	kg C_2H_4 equivalents	CML (v4.02)
Abiotic depletion	ADPE	kg Sb equivalents	CML (v4.02)
Abiotic depletion (fossil fuels)	ADPF	MJ, net calorific value	CML (v4.02)

**Disclaimer – The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.*

***Disclaimer – 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.*

7 Calculated as sum of Bulk waste and Slags/ash.

8 This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic CO2 is set to zero.

Content Information

KoolDuct System are available in 5 different thicknesses described in Table 5. Koolduct System 30mm was selected as the representative product, and the mass factors of the other products are also included in this table.

Table 5: Products included in EPD.

Product Type	Description	Declared Unit	Products Included	Weight (Kg)	Mass factor (%)
Ductwork system	Designed for HVAC systems, KoolDuct is suitable for residential, commercial, public, light industrial and leisure projects. The system can reduce air leakage by up to 80%*, translating into significant energy savings, reduced heating and cooling loads, smaller plant sizes, and capital cost savings.	1 m^2 installed product	KoolDuct System 30mm	1.524	-
			KoolDuct System 20mm	1.001	66
			KoolDuct System 22mm	1.069	70
			KoolDuct System 42mm	2.304	151
			KoolDuct System 46mm	2.599	171

Product Stage (Modules A1 – A3)

Modules A1 – A3 covers the extraction and transport of raw materials, and the production stage of KoolDuct System.

The primary raw materials for KoolDuct System are resin, acid and facing materials and chemicals.

KoolDuct System is manufactured in Somerton, VIC, Australia. In the modelling of electricity related impacts, self-production through photovoltaic (PV) modules and purchased GreenPower from a local electricity supplier are identified. Large-scale generation certificate sources of GreenPower from local electricity supplier, Origin, are documented as 69% wind, 29% solar PV, 1% hydro, and 1% biomass[9]. The carbon emissions of PV modules and green power are 0.14 and 3.94E-04 kg CO_2 eq./kWh (GWP-GHG), respectively.

KoolDuct System is manufactured at Somerton in Victoria. The raw materials are transported by truck and ship from United Kingdom, India, China, Malaysia, Netherlands, USA, and only by road within Australia.

The manufacturing process of KoolDuct System products involves several steps. First, the Laydown/Dispensing stage mixes a blend of liquid chemicals, laying it onto a moving bottom facer. The foam expands as it meets the top facer, bonding auto-adhesively without additional adhesive. Conveyor adjustments determine board thickness. During the Curing phase, boards are stacked and transferred to ovens for uniform curing, eliminating distortion and moisture, with curing times ranging from 1 to 12 hours based on thickness. In the Cutting phase, boards are cut to size. Finally, in Packaging, boards are re-stacked, wrapped, sealed, and moved to the warehouse.

Packaging materials such as shrink wrap and EPS skids are used to protect KoolDuct System during distribution. These EPS skids and shrink wraps are designed for single-use purposes. During the manufacturing process, various wastes are generated, including packaging waste, resin waste, and

[9] National GreenPower Accreditation Program - Table 5. (2023). https://www.greenpower.gov.au/documents/2022-greenpower-annual-audit-report

chemicals and solvents. Depending on the type of waste, they are directed to municipal landfills, or municipal recycling facilities.

All waste materials collected at the Kingspan manufacturing site are handled by relevant third parties. Materials sent to landfill do not have any specific end-of-life uses. In contrast, materials destined for recycling are repurposed for specific purposes, have a market, and comply with all national and local laws and regulations.

Table 6 and Table 7 show the materials used in manufacturing and packaging related data.

Table 6: Content declaration for 1m^2 of installed Kingspan KoolDuct System

	Weight				
Product components	RP: KoolDuct System 30 mm (kg)	Other KoolDuct System products (factors)	Post-consumer recycled material, weight-% of product	Biogenic material, weight-% of product	Biogenic material, kg C/product or declared unit
Resin	1.41	0.70– 1.51	0	0	0
Acid	0.27	0.76 – 1.54	0	0	0
Facing materials and chemicals	0.42	0.80 – 1.34	0	0	0
Sum	2.11	0.72 – 1.48	0	0	0

Table 7: Content declaration of packaging for 1 m^2 of *installed* Kingspan KoolDuct System

	Weight			
Product components	RP: KoolDuct System 30 mm (kg)	Other KoolDuct System products (factors)	Weight-% (versus the product)	Biogenic material, kg C/product or declared unit
Shrink-wrap	0.008	0.79 – 2.52	0	0
EPS skids	0.001	0.79 – 2.25	0	0
Sum	0.009	0.79 – 2.52	0	0

Additional information on the release of dangerous substances to indoor air, soil and water

The products are highly inert and are used predominantly in outdoor applications. They do not release any dangerous substances to indoor air, soil, or water.

None of the products contain one or more substances that are listed in the “Candidate List of Substances of Very High Concern for authorisation”. Based on available information and safety data sheet, KoolDuct System products are Not classified as Hazardous according to Safe Work Australia criteria and No signal of hazard or precautionary statements have been allocated according to the GHS classification.

Transport (Module A4)

KoolDuct System products are distributed across Australia, New Zealand and Asia with a market share of 70.5%, 11.1% and 18.4% respectively. Transport distances were calculated based on primary data from Kingspan’s percentage of total products shipped to each location. According to Kingspan's historic data there is no reported losses during the transport to construction site. The transport is volume constrained that volume utilization is <1. It’s assumed that all products are transported in a medium size truck (16-32t) from manufacturing plants to sites. It’s assumed that the return trip is empty. The utilization rate for the truck is 50%. Based on the information, the estimated A4 transport distances were calculated and summarized in Table 8.

Table 8: Distribution distance for KoolDuct System

	% Mix of Sales per State/Country	Road Distance from Somerton	Shipping Distance from Somerton
State/ Country	KoolDuct System	(km)	(km)
NT	2.67%	3863	0
VIC	17.83%	100	0
TAS	0.83%	850	0
SA	14.39%	835	0
WA	23.05%	40	3529
QLD	5.33%	1840	0
NSW	12.03%	943	0
ACT	8.82%	685	0
SINGAPORE	6.26%	40	6000
NZ	8.80%	40	2640

Installation Stage (Module A5)

Energy required for machinery used during the construction has been included in the assessment. There are no cut-offs produced during installation since all products are cut to size and all waste is used. The installation procedures are the same across all KoolDuct System products.

- Diesel fuel consumption for installation has been calculated based on the gravitational potential energy required to lift a typical KoolDuct System product 10m above ground, assuming 15% diesel energy conversion into effective work.
- The product packaging disposed of in the commingled waste to landfill because no market exists for it.

Table 9 Installation inputs and outputs per 1 m² produced

Input	Unit	KoolDuct System 20mm	KoolDuct System 22mm	KoolDuct System 30mm	KoolDuct System 42mm	KoolDuct System 46mm
Energy from Diesel	MJ	1.00E-03	6.89E-04	1.01E-03	1.41E-03	1.67E-03
Outputs	**Unit**	**KoolDuct System 20mm**	**KoolDuct System 22mm**	**KoolDuct System 30mm**	**KoolDuct System 42mm**	**KoolDuct System 46mm**
Offcuts	kg	0	0	0	0	0
Packaging - Shrinkwrap	kg	2.02E-02	2.02E-02	8.34E-03	6.62E-03	2.10E-02
Packaging - EPS skids	kg	3.16E-03	3.16E-03	1.30E-03	1.03E-03	3.28E-03

Deconstruction and End of Life (Modules C1 – C4)

Following the use of the KoolDuct System products, Kingspan has limited evidence of what the end-of-life fate for their products. The recommended cradle to grave environmental profile will be based on the most common scenario as KoolDuct System products are deconstructed and transported to disposal.

The aluminium foil from the facer cannot be manually separated from the product during the dismantling activities for recycling. Therefore, the whole product is disposed of in landfill.

The following assumptions have been used in this study to model KoolDuct System products deconstruction and end of life scenarios:

- Diesel fuel consumption for deconstruction has been calculated based on the gravitational potential energy required to lift a typical product 10m above ground, assuming 15% diesel energy conversion into effective work.
- 6% of KoolDuct System products are assumed to be deconstruction loss during the waste collection.
- 50km delivery distance to landfill is assumed for waste collection process.

Benefits and loads beyond the system boundary (Module D)

As the whole product is sent to landfill, there is no environmental benefits or burden claimed from Module D.

Environmental Performance

Table 10: Primary environmental impacts per m² of installed KoolDuct System 30mm

Environmental Impacts										
Indicator	Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential - fossil	GWP - Fossil	kg CO_2 eq.	8.79E+00	8.83E-02	9.80E-04	8.49E-03	1.55E-02	0.00E+00	5.46E-03	0.00E+00
Global warming potential - biogenic	GWP - Biogenic	kg CO_2 eq.	4.06E-03	4.72E-06	6.48E-07	6.11E-06	8.58E-07	0.00E+00	2.68E-06	0.00E+00
Global warming potential - land use/ land transformation	GWP - Luluc	kg CO_2 eq.	5.01E-03	2.95E-07	5.16E-08	4.62E-07	7.31E-09	0.00E+00	2.26E-09	0.00E+00
Global warming potential - total	**GWP - Total**	**kg CO_2 eq.**	**8.80E+00**	**8.83E-02**	**9.80E-04**	**8.50E-03**	**1.55E-02**	**0.00E+00**	**5.46E-03**	**0.00E+00**
Ozone depletion potential	ODP	kg CFC 11 eq.	1.90E-07	1.26E-08	4.10E-12	2.64E-11	2.44E-09	0.00E+00	7.48E-10	0.00E+00
Acidification potential	AP	mol H^+ eq.	4.52E-02	9.49E-04	1.62E-06	7.96E-06	1.36E-04	0.00E+00	1.43E-05	0.00E+00
Eutrophication – freshwater	EP - F	kg P eq.	1.60E-03	6.73E-08	8.48E-09	7.39E-08	1.59E-09	0.00E+00	6.28E-09	0.00E+00
Eutrophication – marine	EP - M	kg N eq.	7.57E-03	2.77E-04	2.07E-05	1.93E-04	4.28E-05	0.00E+00	2.57E-06	0.00E+00
Eutrophication – terrestrial	EP - T	mol N eq.	8.07E-02	3.04E-03	7.60E-06	3.38E-05	4.69E-04	0.00E+00	2.80E-05	0.00E+00
Photochemical ozone creation potential	POCP	kg NMVOC eq.	3.98E-02	7.60E-04	2.58E-06	1.31E-05	1.14E-04	0.00E+00	7.45E-06	0.00E+00
Abiotic depletion potential - minerals and metals*	ADP	kg Sb eq.	1.33E-05	1.15E-10	4.06E-11	3.52E-10	3.21E-12	0.00E+00	1.01E-12	0.00E+00
Abiotic depletion potential - fossil fuels*	ADPF	MJ	1.78E+02	1.20E+00	3.49E-03	2.26E-02	2.12E-01	0.00E+00	7.52E-02	0.00E+00
Water Depletion Potential*	WDP	m^3 eq. deprived	2.27E+00	7.03E-03	-1.54E-03	-1.46E-02	1.36E-03	0.00E+00	5.18E-04	0.00E+00

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Table 11: Resource use per m² of installed KoolDuct System 30mm

Resource Use										
Indicator	Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	MJ	4.19E+00	1.78E-03	2.79E-05	2.41E-04	3.05E-04	0.00E+00	9.94E-04	0.00E+00
Use of renewable primary energy resources used as raw materials	PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Primary renewable energy - total	PERT	MJ	**4.19E+00**	**1.78E-03**	**2.79E-05**	**2.41E-04**	**3.05E-04**	**0.00E+00**	**9.94E-04**	**0.00E+00**
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	MJ	1.78E+02	1.20E+00	3.89E-01	2.26E-02	2.12E-01	0.00E+00	7.52E-02	0.00E+00
Use of non- renewable primary energy resources used as raw materials	PENRM	MJ	3.86E-01	0.00E+00	-3.86E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Primary nonrenewable energy - total	PENRT	MJ	**1.78E+02**	**1.20E+00**	**3.49E-03**	**2.26E-02**	**2.12E-01**	**0.00E+00**	**7.52E-02**	**0.00E+00**
Use of secondary material	SM	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	FW	m^3	5.56E-02	1.63E-04	-3.58E-05	-3.39E-04	3.15E-05	0.00E+00	1.14E-05	0.00E+00

Table 12: Waste production per m² of installed KoolDuct System 30mm

Waste Production										
Indicator	Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste disposed	HWD	kg	2.08E-03	7.96E-07	2.30E-08	1.46E-07	5.03E-08	0.00E+00	1.56E-08	0.00E+00
Non-hazardous waste disposed	NHWD	kg	7.87E-02	5.11E-05	9.65E-03	9.15E-02	9.61E-06	0.00E+00	1.43E+00	0.00E+00
Radioactive waste disposed/stored	RWD	kg	7.44E-05	5.04E-09	5.43E-10	4.62E-09	1.31E-11	0.00E+00	4.15E-12	0.00E+00

Table 13: Output flow per m² of installed KoolDuct System 30mm

Output Flows										
Indicator	Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Components for reuse	CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	MFR	kg	4.14E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.80E-02	0.00E+00	0.00E+00
Materials for energy recovery	MFRE	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy - electricity	EE - e	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy - thermal	EE - t	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 14: Additional environmental impacts per m² of installed KoolDuct System 30mm

Additional Environmental Impact Indicators										
Indicator	Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential, excluding biogenic uptake, emissions and storage	GWP-GHG	kg CO2 eq	8.80E+00	8.83E-02	9.80E-04	8.50E-03	1.55E-02	0.00E+00	5.46E-03	0.00E+00
Particulate matter	PM	disease incidence	5.08E-07	4.12E-09	4.14E-11	1.80E-10	7.65E-10	0.00E+00	8.70E-11	0.00E+00
Ionising radiation - human health**	IRP	kBq U-235 eq	3.01E-01	2.30E-05	2.24E-06	1.90E-05	3.71E-07	0.00E+00	1.15E-07	0.00E+00
Ecotoxicity – freshwater*	ETP - fw	CTUe	1.43E+02	2.45E-01	3.34E-02	3.17E-01	4.70E-02	0.00E+00	1.45E-02	0.00E+00
Human toxicity potential - cancer effects*	HTP - c	CTUh	1.31E-07	1.72E-12	1.88E-13	1.73E-12	6.64E-14	0.00E+00	8.02E-14	0.00E+00
Human toxicity potential - non cancer effects*	HTP - nc	CTUh	3.42E-08	2.47E-11	2.15E-11	2.03E-10	1.27E-12	0.00E+00	6.59E-13	0.00E+00
Soil quality*	SQP	Pt	6.20E+00	5.07E-03	5.27E-03	4.99E-02	9.54E-04	0.00E+00	2.73E-03	0.00E+00

*Disclaimer – The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

**Disclaimer – 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.

Table 15: Potential environmental impacts (EN15804+A1:2013) per m² of installed KoolDuct System 30mm

Potential Environmental Impact - Indicators According to EN15804+A1:2013										
Indicator	Abbreviation	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential	GWP	kg CO_2 eq	8.80E+00	8.83E-02	9.84E-04	8.54E-03	1.55E-02	0.00E+00	5.46E-03	0.00E+00
Ozone layer depletion	ODP	kg CFC-11 eq	1.55E-07	9.98E-09	3.25E-12	2.09E-11	1.93E-09	0.00E+00	5.91E-10	0.00E+00
Acidification	AP	kg SO_2 eq	3.79E-02	5.90E-04	1.16E-06	5.82E-06	7.53E-05	0.00E+00	9.62E-06	0.00E+00
Eutrophication	EP	kg PO_4^{3-} eq	7.56E-03	1.01E-04	8.73E-06	8.16E-05	1.59E-05	0.00E+00	1.36E-06	0.00E+00
Photochemical oxidation	POCP	kg C_2H_4 eq	3.95E-03	3.08E-05	1.64E-07	1.42E-06	4.88E-06	0.00E+00	4.98E-07	0.00E+00
Abiotic depletion	ADPE	kg Sb eq	1.34E-05	1.92E-10	4.08E-11	3.53E-10	1.82E-11	0.00E+00	6.23E-12	0.00E+00
Abiotic depletion (fossil fuels)	ADPF	MJ	5.42E+01	1.06E+00	2.09E-04	1.86E-03	2.07E-01	0.00E+00	7.61E-02	0.00E+00

Additional Environmental Information

This EPD is declared as 1m^2 of installed KoolDuct System with a thickness of 30mm. As per section 5.4.6.1 of PCR, to allow for obtaining the results for different thicknesses (e.g. 20, 22, 42, and 46mm) of KoolDuct System products, the conversion factors are applied to this EPD for the results of declared modules.

Table 16: Conversion factors of Primary environmental impact indicators for KoolDuct System 20mm

Conversion factors for KoolDuct System 20mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential - fossil	GWP - Fossil	0.74	0.67	2.26	0.66	0.66	1.00	0.66	1.00
Global warming potential - biogenic	GWP - Biogenic	0.88	0.67	2.42	0.66	0.66	1.00	0.66	1.00
Global warming potential - land use/ land transformation	GWP - Luluc	0.84	0.67	2.32	0.66	0.66	1.00	0.66	1.00
Global warming potential - total	**GWP - Total**	**0.74**	**0.67**	**2.26**	**0.66**	**0.66**	**1.00**	**0.66**	**1.00**
Ozone depletion potential	ODP	0.73	0.67	1.79	0.66	0.66	1.00	0.66	1.00
Acidification potential	AP	0.74	0.67	1.47	0.66	0.66	1.00	0.66	1.00
Eutrophication – freshwater	EP - F	0.77	0.67	2.27	0.66	0.66	1.00	0.66	1.00
Eutrophication – marine	EP - M	0.75	0.67	2.39	0.66	0.66	1.00	0.66	1.00
Eutrophication – terrestrial	EP - T	0.76	0.67	1.38	0.66	0.66	1.00	0.66	1.00
Photochemical ozone creation potential	POCP	0.73	0.67	1.51	0.66	0.66	1.00	0.66	1.00
Abiotic depletion potential - minerals and metals*	ADP	0.95	0.67	2.26	0.66	0.66	1.00	0.66	1.00
Abiotic depletion potential - fossil fuels*	ADPF	0.72	0.67	1.80	0.66	0.66	1.00	0.66	1.00
Water Depletion Potential*	WDP	1.43	0.67	2.43	0.66	0.66	1.00	0.66	1.00

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Table 17: Conversion factors of resource use indicators for KoolDuct System 20mm

Conversion factors for KoolDuct System 20mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	0.88	0.67	2.25	0.66	0.66	1.00	0.66	1.00
Use of renewable primary energy resources used as raw materials	PERM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary renewable energy - total	PERT	0.88	0.67	2.25	0.66	0.66	1.00	0.66	1.00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	0.72	0.67	2.42	0.66	0.66	1.00	0.66	1.00
Use of non- renewable primary energy resources used as raw materials	PENRM	2.43	1.00	2.43	1.00	1.00	1.00	1.00	1.00
Primary nonrenewable energy - total	PENRT	0.72	0.67	1.80	0.66	0.66	1.00	0.66	1.00
Use of secondary material	SM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of renewable secondary fuels	RSF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of non-renewable secondary fuels	NRSF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of net fresh water	FW	1.39	0.67	2.43	0.66	0.66	1.00	0.66	1.00

Table 18: Conversion factors of waste production indicators for KoolDuct System 20mm

Conversion factors for KoolDuct System 20mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste disposed	HWD	0.76	0.67	1.78	0.66	0.66	1.00	0.66	1.00
Non-hazardous waste disposed	NHWD	0.95	0.67	2.43	0.66	0.66	1.00	0.66	1.00
Radioactive waste disposed/stored	RWD	0.76	0.67	2.22	0.66	0.66	1.00	0.66	1.00

Table 19: Conversion factors of output flow indicators for KoolDuct System 20mm

Conversion factors for KoolDuct System 20mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Components for reuse	CRU	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Materials for recycling	MFR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Materials for energy recovery	MFRE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Exported energy - electricity	EE - e	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Exported energy - thermal	EE - t	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 20: Conversion factors of additional environmental impacts indicators for KoolDuct System 20mm

Conversion factors for KoolDuct System 20mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential, excluding biogenic uptake, emissions and storage	GWP-GHG	0.74	0.67	2.26	0.66	0.66	1.00	0.66	1.00
Particulate matter	PM	0.79	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ionising radiation - human health**	IRP	0.76	0.67	1.35	0.66	0.66	1.00	0.66	1.00
Ecotoxicity – freshwater*	ETP - fw	0.71	0.67	2.22	0.66	0.66	1.00	0.66	1.00
Human toxicity potential - cancer effects*	HTP - c	0.71	0.67	2.42	0.66	0.66	1.00	0.66	1.00
Human toxicity potential - non cancer effects*	HTP - nc	0.78	0.67	2.37	0.66	0.66	1.00	0.66	1.00
Soil quality*	SQP	0.80	0.67	2.42	0.66	0.66	1.00	0.66	1.00

*Disclaimer – The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

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Table 21: Conversion factors of potential environmental impact indicators (EN15804+A1:2013) for KoolDuct System 20mm

Conversion factors for KoolDuct System 20mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential	GWP	0.74	0.67	2.26	0.66	0.66	1.00	0.66	1.00
Ozone layer depletion	ODP	0.73	0.67	1.79	0.66	0.66	1.00	0.66	1.00
Acidification	AP	0.74	0.67	1.49	0.66	0.66	1.00	0.66	1.00
Eutrophication	EP	0.77	0.67	2.40	0.66	0.66	1.00	0.66	1.00
Photochemical oxidation	POCP	0.72	0.67	2.26	0.66	0.66	1.00	0.66	1.00
Abiotic depletion	ADPE	0.96	0.67	2.26	0.66	0.66	1.00	0.66	1.00
Abiotic depletion (fossil fuels)	ADPF	0.76	0.67	2.31	0.66	0.66	1.00	0.66	1.00

Table 22: Conversion factors of Primary environmental impact indicators for KoolDuct System 22mm

Conversion factors for KoolDuct System 22mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential - fossil	GWP - Fossil	0.80	0.71	2.26	0.70	0.70	1.00	0.70	1.00
Global warming potential - biogenic	GWP - Biogenic	0.92	0.71	2.42	0.70	0.70	1.00	0.70	1.00
Global warming potential - land use/ land transformation	GWP - Luluc	0.87	0.71	2.32	0.70	0.70	1.00	0.70	1.00
Global warming potential - total	**GWP - Total**	**0.80**	**0.71**	**2.26**	**0.70**	**0.70**	**1.00**	**0.70**	**1.00**
Ozone depletion potential	ODP	0.79	0.71	1.81	0.70	0.70	1.00	0.70	1.00
Acidification potential	AP	0.80	0.71	1.50	0.70	0.70	1.00	0.70	1.00
Eutrophication – freshwater	EP - F	0.82	0.71	2.27	0.70	0.70	1.00	0.70	1.00
Eutrophication – marine	EP - M	0.81	0.71	2.39	0.70	0.70	1.00	0.70	1.00
Eutrophication – terrestrial	EP - T	0.82	0.71	1.40	0.70	0.70	1.00	0.70	1.00
Photochemical ozone creation potential	POCP	0.79	0.71	1.53	0.70	0.70	1.00	0.70	1.00
Abiotic depletion potential - minerals and metals*	ADP	1.09	0.71	2.26	0.70	0.70	1.00	0.70	1.00
Abiotic depletion potential - fossil fuels*	ADPF	0.78	0.71	1.82	0.70	0.70	1.00	0.70	1.00
Water Depletion Potential*	WDP	9.45	0.71	2.43	0.70	0.70	1.00	0.70	1.00

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Table 23: Conversion factors of resource use indicators for KoolDuct System 22mm

Conversion factors for KoolDuct System 22mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	1.93	0.71	2.26	0.70	0.70	1.00	0.70	1.00
Use of renewable primary energy resources used as raw materials	PERM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary renewable energy - total	PERT	1.93	0.71	2.26	0.70	0.70	1.00	0.70	1.00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	0.78	0.71	2.42	0.70	0.70	1.00	0.70	1.00
Use of non- renewable primary energy resources used as raw materials	PENRM	2.43	1.00	2.43	1.00	1.00	1.00	1.00	1.00
Primary nonrenewable energy - total	PENRT	0.78	0.71	1.82	0.70	0.70	1.00	0.70	1.00
Use of secondary material	SM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of renewable secondary fuels	RSF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of non-renewable secondary fuels	NRSF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of net fresh water	FW	9.00	0.71	2.43	0.70	0.70	1.00	0.70	1.00

Table 24: Conversion factors of waste production indicators for KoolDuct System 22mm

Conversion factors for KoolDuct System 22mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste disposed	HWD	0.81	0.71	1.79	0.70	0.70	1.00	0.70	1.00
Non-hazardous waste disposed	NHWD	1.00	0.71	2.43	0.70	0.70	1.00	0.70	1.00
Radioactive waste disposed/stored	RWD	0.82	0.71	2.23	0.70	0.70	1.00	0.70	1.00

Table 25: Conversion factors of output flow indicators for KoolDuct System 22mm

Conversion factors for KoolDuct System 22mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Components for reuse	CRU	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Materials for recycling	MFR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Materials for energy recovery	MFRE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Exported energy - electricity	EE - e	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Exported energy - thermal	EE - t	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 26: Conversion factors of additional environmental impacts indicators for KoolDuct System 22mm

Conversion factors for KoolDuct System 22mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential, excluding biogenic uptake, emissions and storage	GWP-GHG	0.80	0.71	2.26	0.70	0.70	1.00	0.70	1.00
Particulate matter	PM	0.84	0.71	1.00	1.00	1.00	1.00	1.00	1.00
Ionising radiation - human health**	IRP	0.82	0.71	1.38	0.70	0.70	1.00	0.70	1.00
Ecotoxicity – freshwater*	ETP - fw	0.76	0.71	2.22	0.70	0.70	1.00	0.70	1.00
Human toxicity potential - cancer effects*	HTP - c	0.76	0.71	2.42	0.70	0.70	1.00	0.70	1.00
Human toxicity potential - non cancer effects*	HTP - nc	0.82	0.71	2.37	0.70	0.70	1.00	0.70	1.00
Soil quality*	SQP	1.07	0.71	2.42	0.70	0.70	1.00	0.70	1.00

*Disclaimer – The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.
**Disclaimer – 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.

Table 27: Conversion factors of potential environmental impact indicators (EN15804+A1:2013) for KoolDuct System 22mm

Conversion factors for KoolDuct System 22mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential	GWP	0.80	0.71	2.26	0.70	0.70	1.00	0.70	1.00
Ozone layer depletion	ODP	0.80	0.71	1.81	0.70	0.70	1.00	0.70	1.00
Acidification	AP	0.80	0.71	1.52	0.70	0.70	1.00	0.70	1.00
Eutrophication	EP	0.82	0.71	2.40	0.70	0.70	1.00	0.70	1.00
Photochemical oxidation	POCP	0.77	0.71	2.26	0.70	0.70	1.00	0.70	1.00
Abiotic depletion	ADPE	1.18	0.71	2.26	0.70	0.70	1.00	0.70	1.00
Abiotic depletion (fossil fuels) - A1	ADPF (A1)	0.85	0.71	2.31	0.70	0.70	1.00	0.70	1.00

Table 28: Conversion factors of Primary environmental impact indicators for KoolDuct System 42mm

Conversion factors for KoolDuct System 42mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential - fossil	GWP - Fossil	1.27	1.51	0.86	1.51	1.51	1.00	1.51	1.00
Global warming potential - biogenic	GWP - Biogenic	1.14	1.51	0.80	1.51	1.51	1.00	1.51	1.00
Global warming potential - land use/ land transformation	GWP - Luluc	1.17	1.51	0.84	1.51	1.51	1.00	1.51	1.00
Global warming potential - total	**GWP - Total**	**1.27**	**1.51**	**0.86**	**1.51**	**1.51**	**1.00**	**1.51**	**1.00**
Ozone depletion potential	ODP	1.30	1.51	1.05	1.51	1.51	1.00	1.51	1.00
Acidification potential	AP	1.28	1.51	1.18	1.51	1.51	1.00	1.51	1.00
Eutrophication – freshwater	EP - F	1.24	1.51	0.86	1.51	1.51	1.00	1.51	1.00
Eutrophication – marine	EP - M	1.26	1.51	0.81	1.51	1.51	1.00	1.51	1.00
Eutrophication – terrestrial	EP - T	1.26	1.51	1.22	1.51	1.51	1.00	1.51	1.00
Photochemical ozone creation potential	POCP	1.28	1.51	1.17	1.51	1.51	1.00	1.51	1.00
Abiotic depletion potential - minerals and metals*	ADP	1.06	1.51	0.86	1.51	1.51	1.00	1.51	1.00
Abiotic depletion potential - fossil fuels*	ADPF	1.29	1.51	1.05	1.51	1.51	1.00	1.51	1.00
Water Depletion Potential*	WDP	1.15	1.51	0.79	1.51	1.51	1.00	1.51	1.00

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Table 29: Conversion factors of resource use indicators for KoolDuct System 42mm

Conversion factors for KoolDuct System 42mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	1.21	1.51	0.86	1.51	1.51	1.00	1.51	1.00
Use of renewable primary energy resources used as raw materials	PERM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary renewable energy - total	PERT	1.21	1.51	0.86	1.51	1.51	1.00	1.51	1.00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	1.29	1.51	0.80	1.51	1.51	1.00	1.51	1.00
Use of non- renewable primary energy resources used as raw materials	PENRM	0.79	1.00	0.79	1.00	1.00	1.00	1.00	1.00
Primary nonrenewable energy - total	PENRT	1.29	1.51	1.05	1.51	1.51	1.00	1.51	1.00
Use of secondary material	SM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of renewable secondary fuels	RSF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of non-renewable secondary fuels	NRSF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of net fresh water	FW	1.17	1.51	0.79	1.51	1.51	1.00	1.51	1.00

Table 30: Conversion factors of waste production indicators for KoolDuct System 42mm

Conversion factors for KoolDuct System 42mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste disposed	HWD	1.26	1.51	1.06	1.51	1.51	1.00	1.51	1.00
Non-hazardous waste disposed	NHWD	1.06	1.51	0.79	1.51	1.51	1.00	1.51	1.00
Radioactive waste disposed/stored	RWD	1.25	1.51	0.88	1.51	1.51	1.00	1.51	1.00

Table 31: Conversion factors of output flow indicators for KoolDuct System 42mm

Conversion factors for KoolDuct System 42mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Components for reuse	CRU	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Materials for recycling	MFR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Materials for energy recovery	MFRE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Exported energy - electricity	EE - e	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Exported energy - thermal	EE - t	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 32: Conversion factors of additional environmental impacts indicators for KoolDuct System 42mm

Conversion factors for KoolDuct System 42mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential, excluding biogenic uptake, emissions and storage	GWP-GHG	1.27	1.51	0.86	1.51	1.51	1.00	1.51	1.00
Particulate matter	PM	1.22	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ionising radiation - human health**	IRP	1.26	1.51	1.23	1.51	1.51	1.00	1.51	1.00
Ecotoxicity – freshwater*	ETP - fw	1.30	1.51	0.88	1.51	1.51	1.00	1.51	1.00
Human toxicity potential - cancer effects*	HTP - c	1.30	1.51	0.79	1.51	1.51	1.00	1.51	1.00
Human toxicity potential - non cancer effects*	HTP - nc	1.24	1.51	0.82	1.51	1.51	1.00	1.51	1.00
Soil quality*	SQP	1.24	1.51	0.80	1.51	1.51	1.00	1.51	1.00

*Disclaimer – The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

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Table 33: Conversion factors of potential environmental impact indicators (EN15804+A1:2013) for KoolDuct System 42mm

Conversion factors for KoolDuct System 42mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential	GWP	1.27	1.51	0.86	1.51	1.51	1.00	1.51	1.00
Ozone layer depletion	ODP	1.29	1.51	1.05	1.51	1.51	1.00	1.51	1.00
Acidification	AP	1.28	1.51	1.17	1.51	1.51	1.00	1.51	1.00
Eutrophication	EP	1.25	1.51	0.81	1.51	1.51	1.00	1.51	1.00
Photochemical oxidation	POCP	1.29	1.51	0.86	1.51	1.51	1.00	1.51	1.00
Abiotic depletion	ADPE	1.06	1.51	0.86	1.51	1.51	1.00	1.51	1.00
Abiotic depletion (fossil fuels)	ADPF	1.24	1.51	0.84	1.51	1.51	1.00	1.51	1.00

Table 34: Conversion factors of Primary environmental impact indicators for KoolDuct System 46mm

Conversion factors for KoolDuct System 46mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential - fossil	GWP - Fossil	1.44	1.71	2.44	1.71	1.71	1.00	1.71	1.00
Global warming potential - biogenic	GWP - Biogenic	1.23	1.71	2.51	1.71	1.71	1.00	1.71	1.00
Global warming potential - land use/ land transformation	GWP - Luluc	1.28	1.71	2.47	1.71	1.71	1.00	1.71	1.00
Global warming potential - total	**GWP - Total**	**1.44**	**1.71**	**2.44**	**1.71**	**1.71**	**1.00**	**1.71**	**1.00**
Ozone depletion potential	ODP	1.49	1.71	2.22	1.71	1.71	1.00	1.71	1.00
Acidification potential	AP	1.44	1.71	2.08	1.71	1.71	1.00	1.71	1.00
Eutrophication – freshwater	EP - F	1.41	1.71	2.44	1.71	1.71	1.00	1.71	1.00
Eutrophication – marine	EP - M	1.42	1.71	2.50	1.71	1.71	1.00	1.71	1.00
Eutrophication – terrestrial	EP - T	1.42	1.71	2.03	1.71	1.71	1.00	1.71	1.00
Photochemical ozone creation potential	POCP	1.46	1.71	2.09	1.71	1.71	1.00	1.71	1.00
Abiotic depletion potential - minerals and metals*	ADP	1.10	1.71	2.44	1.71	1.71	1.00	1.71	1.00
Abiotic depletion potential - fossil fuels*	ADPF	1.48	1.71	2.23	1.71	1.71	1.00	1.71	1.00
Water Depletion Potential*	WDP	1.59	1.71	2.52	1.71	1.71	1.00	1.71	1.00

* Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Table 35: Conversion factors of resource use indicators for KoolDuct System 46mm

Conversion factors for KoolDuct System 46mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	PERE	1.40	1.71	2.44	1.71	1.71	1.00	1.71	1.00
Use of renewable primary energy resources used as raw materials	PERM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Primary renewable energy - total	PERT	1.40	1.71	2.44	1.71	1.71	1.00	1.71	1.00
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	PENRE	1.48	1.71	2.51	1.71	1.71	1.00	1.71	1.00
Use of non- renewable primary energy resources used as raw materials	PENRM	2.52	1.00	2.52	1.00	1.00	1.00	1.00	1.00
Primary nonrenewable energy - total	PENRT	1.48	1.71	2.23	1.71	1.71	1.00	1.71	1.00
Use of secondary material	SM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of renewable secondary fuels	RSF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of non-renewable secondary fuels	NRSF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Use of net fresh water	FW	1.60	1.71	2.52	1.71	1.71	1.00	1.71	1.00

Table 36: Conversion factors of waste production indicators for KoolDuct System 46mm

Conversion factors for KoolDuct System 46mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste disposed	HWD	1.44	1.71	2.22	1.71	1.71	1.00	1.71	1.00
Non-hazardous waste disposed	NHWD	1.10	1.71	2.52	1.71	1.71	1.00	1.71	1.00
Radioactive waste disposed/stored	RWD	1.43	1.71	2.42	1.71	1.71	1.00	1.71	1.00

Table 37: Conversion factors of output flow indicators for KoolDuct System 46mm

Conversion factors for KoolDuct System 46mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Components for reuse	CRU	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Materials for recycling	MFR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Materials for energy recovery	MFRE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Exported energy - electricity	EE - e	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Exported energy - thermal	EE - t	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 38: Conversion factors of additional environmental impacts indicators for KoolDuct System 46mm

Conversion factors for KoolDuct System 46mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential, excluding biogenic uptake, emissions and storage	GWP-GHG	1.44	1.71	2.44	1.71	1.71	1.00	1.71	1.00
Particulate matter	PM	1.36	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ionising radiation - human health**	IRP	1.43	1.71	2.02	1.71	1.71	1.00	1.71	1.00
Ecotoxicity – freshwater*	ETP - fw	1.49	1.71	2.42	1.71	1.71	1.00	1.71	1.00
Human toxicity potential - cancer effects*	HTP - c	1.48	1.71	2.52	1.71	1.71	1.00	1.71	1.00
Human toxicity potential - non cancer effects*	HTP - nc	1.39	1.71	2.49	1.71	1.71	1.00	1.71	1.00
Soil quality*	SQP	1.43	1.71	2.51	1.71	1.71	1.00	1.71	1.00

*Disclaimer – The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.
**Disclaimer – 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.

Table 39: Conversion factors of potential environmental impact indicators (EN15804+A1:2013) for KoolDuct System 46mm

Conversion factors for KoolDuct System 46mm									
Indicator	Abbreviation	A1-A3	A4	A5	C1	C2	C3	C4	D
Global warming potential	GWP	1.44	1.71	2.44	1.71	1.71	1.00	1.71	1.00
Ozone layer depletion	ODP	1.49	1.71	2.23	1.71	1.71	1.00	1.71	1.00
Acidification	AP	1.45	1.71	2.09	1.71	1.71	1.00	1.71	1.00
Eutrophication	EP	1.41	1.71	2.50	1.71	1.71	1.00	1.71	1.00
Photochemical oxidation	POCP	1.48	1.71	2.44	1.71	1.71	1.00	1.71	1.00
Abiotic depletion	ADPE	1.11	1.71	2.44	1.71	1.71	1.00	1.71	1.00
Abiotic depletion (fossil fuels)	ADPF	1.41	1.71	2.46	1.71	1.71	1.00	1.71	1.00

References

ALCAS (2023). Australian Life Cycle Inventory (AusLCI) – v1.42.

EN 15804:2012+A1:2013; Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. Brussels: European Committee for.

EN 15804:2012+A2:2019; Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products. Brussels: European Committee for.

EPD International. (2024). PCR 2019:14, version 1.3.4 Construction Products. www.environdec.com.

EPD International. (2024). General Programme Instructions of the International EPD System, version 5.0

Frischknecht, R. (2007). The Environmental Relevance of Capital Goods in Life Cycle Assessments of Products and Services. Int. J LCA.

Instructions of the Australasian EPD Programme – a Regional Annex to the General Programme Instructions. (2024) Version 4.2 Published 12-04-2024

ISO. (2006). ISO 14025:2006 - Environmental labels and declarations - Type III environmental declarations - Principles and procedures. Geneva: International Organization for Standardization (ISO).

ISO. (2020). ISO 14040:2006+A1:2020. Environmental management – Life cycle assessment – Principles and framework. Geneva: International Organization for Standardization.

ISO. (2020). ISO 14044:2006+A2:2020. Environmental management – Life cycle assessment – Requirements and guidelines. Geneva: International Organization for Standardization.

Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., & & Weidema, B. (2023). The ecoinvent database version 3.10.

PRe Sustainability. (2024) SimaPro. v9.6

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