ENVIRONMENTAL PRODUCT DECLARATION

ASTM

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GENERAL INFORMATION

This cradle-to-gate with options Environmental Product Declaration covers an ISO Board Panel product produced at Youngwood Plant. The Life Cycle Assessment (LCA) was prepared in conformity with ISO 21930, ISO 14025, ISO 14040, and ISO 14044 and PCR Part A: Life Cycle Assessment Calculation Rules and Report Requirements (UL 10010, Version 4.0) and Part B: Building Envelope Thermal Insulation EPD Requirements (UL10010-1, Version 3.0). This EPD is intended for business-to-business (B-to-B) audiences.

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Product Category Rules for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements (UL 10010, Version 4.0) serves as the core PCR; Part B: Building Envelope Thermal Insulation EPD Requirements (UL10010-1, Version 3.0) serves as the sub-category PCR.

- Core PCR review was conducted by **Lindita Bushi**, PhD, (Chair) Athena Sustainable Materials Institute (lindita.bushi@athenasmi.org), **Hugues Imbeault-Tétreault**, Eng., M.A.Sc., Groupe AGÉCO (hugues.i-tetreault@groupeageco.ca) & **Jack Geibig**, Ecoform, LLC (jgeibig@ecoform.com).
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Limitations:

- Environmental declarations from different programs (ISO 14025) may not be comparable.
- Comparison of the environmental performance of products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR.
- Full conformance with this PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

PRODUCER

Holcim Solutions and Products US LLC delivers high-performance solutions that make the entire building envelope more sustainable for customers around the world. We are committed to raising the standards of building solutions by delivering superior quality and innovation while addressing industry needs.

Our offerings cover a comprehensive range of residential and commercial roofing, wall and lining systems, insulation, and waterproofing solutions for a variety of industries from construction to marine and aerospace. Our powerful portfolio brands include Elevate, Duro-Last, Malarkey Roofing Products, GenFlex, Gaco, and Enverge. Holcim Solutions and Products US LLC is a division of the Holcim Group. Visit HolcimBE.com to learn more.

Holcim's Youngwood, PA facility is ISO 9000 certified and manufactures Elevate polyiso insulation boards for use in commercial roofing systems. The 344,000 square foot plant opened in 1997.

PRODUCT

Two different roof polyiso insulation products are covered by this EPD. These are Elevate ISOGARD (Figure 1) and Elevate RESISTA™ (Figure 2). Insulation boards are one layer of the several layers present in roofing systems. The two specific types under study differ in how they are covered by different facer's materials: coated glass facer (CGF) and Glass Reinforced Facer (GRF).

Elevate ISOGARD roof insulation board consists of a closed cell polyiso foam core laminated to a black glass reinforced mat facer on both major surfaces. ISOGARD insulation provides outstanding thermal performance on commercial roofing applications, while providing positive rooftop drainage to help eliminate ponding water when tapered insulation is used.

Elevate RESISTA™ roof insulation board consists of a closed cell polyiso foam core laminated to a specially coated, inorganic, fiberglass facer. Elevate RESISTA™ roof insulation provides fire, wind and thermal performance for single-ply and modified bitumen commercial roofing applications.

Elevate polyiso insulation board is a formaldehyde free material, uses EPA accepted blowing agents and can contribute to overall LEED® certification for energy optimization and material resource credits.

With thicknesses varying from 1-4.5 inches, polyiso insulation boards use proprietary foam technology to create a strong insulating barrier with a UL Class A rating for fire resistance. Additionally, the double coating of non-organic facing material on both sides of the insulation board meets ASTM D 3273 standards for mold resistance.

FIGURE 1

Elevate ISOGARD board with GRF Facer

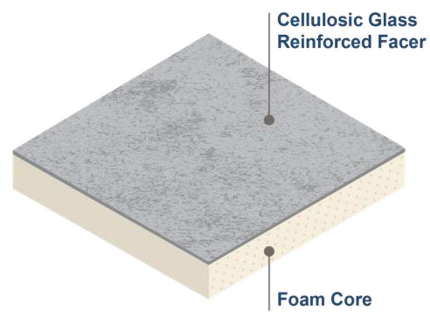
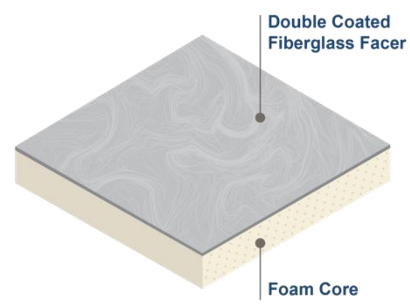


FIGURE 2

Elevate RESISTA™ board with CGF Facer



The products covered in this EPD have the following Physical and Performance Properties

(as illustrated in tables 1 & 2 below)

TABLE 1

Physical Properties (Sizes, thickness & Mass of different product presentation)

PRODUCT TYPE	BOARD SIZE	PRODUCT THICKNESS	SQFT	WEIGHT (LBS)	LBS / SQ FT	LBS / SQM
ISO BOARD	4' x 4'	1"	16	4	0.250	2.69
	4' x 4'	2"	16	5	0.313	3.36
	4' x 8'	1"	32	8	0.250	2.69
	4' x 8'	2"	32	11	0.344	3.70
	4' x 8'	2.5"	32	13.5	0.422	4.54
	4' x 8'	2.6"	32	15	0.469	5.05

TABLE 2

Performance Properties & Related Standards

TYPICAL PROPERTIES (MEETS ASTM C 1289, TYPE II, CLASS 1)		
PROPERTY	**ASTM TEST METHOD**	**ELEVATE TYPICAL PERFORMANCE**
Compressive Strength	D1621	Grade 2: 20 psi (138 kPa) Grade 3: 25 psi (172 kPa)*
Density	D1622	2 pcf (32 kg/m^3)
Dimensional Stability	D2126	<2%
Moisture Vapor Transmission	E96	<1 perm (<57.5 5 ng/(Pa.s.m2))
Water Absorption	C209	<1% by volume
Service Temperature	---	-100 to 250 °F (-73 to 121 °C)
Flame Spread	E84	Index 50
Smoke Development	E84	Index 160-180

** 25 psi (172kPa) available upon request*

TABLE 3

Product Components

MATERIAL	% WEIGHTED AVERAGE COMPOSITION
MDI	38.9 – 43.9
Polyol	19.0 – 21.5
Isopentane / N-Pentane	5.0 – 5.9
Facer	27.1 – 30.0
Other Components	~3.69

FUNCTIONAL UNIT

The functional unit as required by the PCR Section 3.1 in Part B of the PCR) is:

One square meter (1 m²) of installed insulation material with a thickness that gives an average thermal resistance RSI = 1 m²·K/W and with a building service life of 75 years (packaging included).

As requested by the PCR, the Functional Unit of this LCA is expressed in Table 4.

TABLE 4

Functional Unit Properties

FUNCTIONAL UNIT (FU)	VALUE	SI UNIT	VALUE	IMPERIAL UNIT
1 m^2 of insulation material with a thickness that gives an average thermal resistance RSI=1 m^2K/V				
Mass	0.871	kg	1.92	lb
Thickness to achieve FU	0.0254	m	1	inch

** 1.92 lbs in the mass of insulating foam that fulfills the required RSI value*

LIFE CYCLE ASSESSMENT

SYSTEM BOUNDARY

This EPD is a cradle-to-gate with options EPD, covering the life cycle stages indicated in Table 5.

TABLE 5

Life Cycle Product Stages

PRODUCTION STAGE (MANDATORY)			CONSTRUCTION STAGE		USE STAGE					END-OF-LIFE STAGE			
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	De-construction / Demolition	Transport to waste processing or disposal	Waste processing	Disposal of waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4
X	X	X	X	X	MND	MND	MND	X	MND	X	X	X	X

***NOTE**: MND = module not declared; X = module included.*

CUT-OFF

Items excluded from system boundary include:

- production, manufacture and construction of manufacturing capital goods and infrastructure;
- production and manufacture of production equipment, delivery vehicles, and laboratory equipment;
- personnel-related activities (travel, furniture, and office supplies); and
- energy and water use related to company management and sales activities that may be located either within the factory site or at another location.

MANUFACTURING

The manufacturing process applied at Youngwood is depicted in the flow diagram presented in Figure 3. Within this stage, all manufacturing activities of polyiso insulation boards, including packaging, manufacturing waste, and associated releases to the air, soil, ground, and surface water are included.

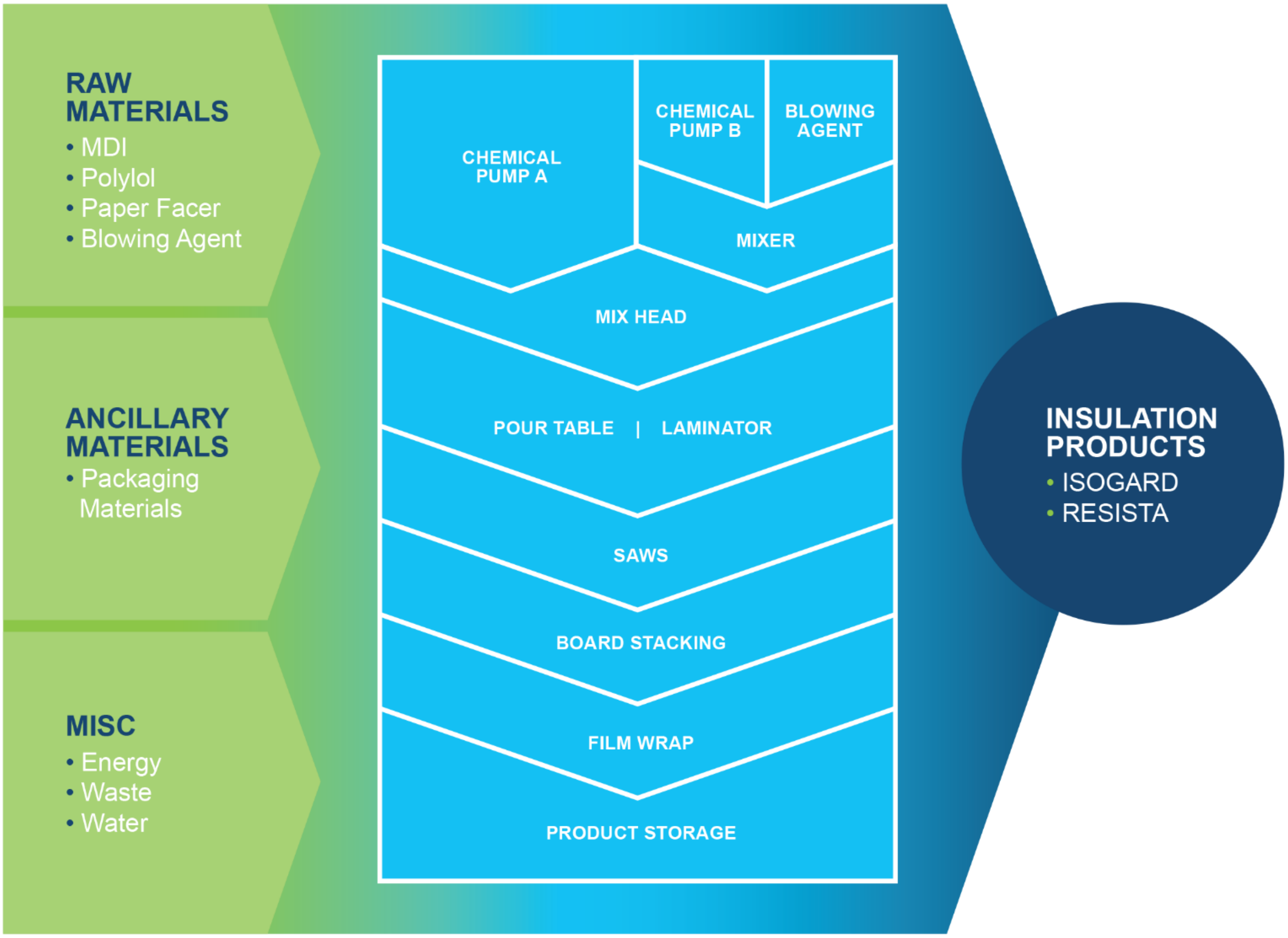
The raw materials inputs to the polyiso manufacturing process are different chemical products stored in onsite tanks. The chemicals from the Pump “A” side (MDI), the chemical pump “B” side (polyester polyol plus catalyst, surfactant, and flame retardant) and the blowing agent are pumped from raw materials storage into process tanks. The “B” side and blowing agent are then derived to a mixer and later to a mix head where they are combined with the “A” side and injected between the top and bottom facers on the pour table. The mixed chemicals react rapidly to form a closed-cell foam board with a foam core sandwiched between the top and bottom facers. The rigid foam board moves through a heated laminator, which controls thickness and aids in cell formation, curing, and facer adhesion. The board exits the laminator and is fed through saws that trim the board to the desired width and then through a crosscut saw that cuts the board to the desired lengths. After the processing, they are stacked and wrapped in film, to be stored.

The finished polyiso board are placed on a pallet made of scrap polyiso insulation board slats. After being labeled, the pallets are moved via fork truck to a warehouse area for storage and eventual loading onto trucks for shipment.

After manufacturing (A1-A3) processes, the installation phase covers both transport to site (A4) and Installation (A5). For modeling this process, some assumptions are considered. For example, the boards are transported an average of 282 miles to its installation site in typical diesel trucks with high capacity but very low weight due to the product’s low density. After being transported to the site, the packs are unloaded from the truck to the rooftop using a diesel crane. Then, the boards are installed manually through a mechanical attachment procedure involving fasteners and fastening plates and necessary equipment to support the procedure. Finally, the waste scrap from installation is collected and transported to a local landfill for disposal. Disposal of installation waste scrap to a local landfill was modeled as 7% of the board foot.

FIGURE 3

Process Flow Diagram of Polyiso Insulation Foam



B1 – B5 USE STAGE

As part of a system, the polyiso insulation boards are expected to be covered and protected by several layers. The roof membrane, when installed properly and adequately maintained, protects the insulation from the environmental elements and weather during its use. Therefore, it is expected that polyiso insulation boards will not sustain damage that affects its performance and function. As defined in the PCR, the Building Estimated Service Life (ESL) is 75 years. Assuming that the whole system is well installed and maintained, the insulation will serve its functional purpose for the 75-year life span of the building. However, usually at least one reroofing activity will take place during the 75-year building ESL. This practice establishes a 40-year RSL for polyiso roof insulation boards, which brings a 1.9 replacement cycle (see further description to support this value in section "Scenarios and additional technical information" below).

C1 – C4 END-OF-LIFE STAGE

At the end of building service life and during roof replacement, the polyiso insulation boards may be reused, recovered and repurposed, or disposed of. This study does not take reuse and recovery into account, and it is assumed that insulation is removed when the building is decommissioned and disposed of in a landfill, for which an average distance and specific end of life LCI is applied.

LIFE CYCLE ASSESSMENT RESULTS

This declaration is cradle-to-gate with options. As discussed in the Life Cycle Assessment Scope and Boundaries Section, information modules B1, B2, B3, B5, B6, B7, C1 and C3 do not contribute to impacts and are declared as zero. Optional Module D – Benefits and Loads Beyond the System Boundary – is not included in this LCA study. Only relevant stages are presented with results, to make it easier to follow.

TABLE 6

ISOGARD™ Polyisocyanurate Insulation, per 1 m^2 with 1.92 lbs/m^2 polyiso insulation

IMPACT ASSESSMENT (UNIT)	PRODUCTION (A1-A3)	TRANSPORT (A4)	INSTALLATION (A5)	REPLACEMENT (B4)	TRANSPORT TO DISPOSAL OF WASTE (C2)	DISPOSAL OF WASTE (C4)	TOTAL
Global warming potential (GWP)[1] (kg CO_2 eq)							
	3.34	0.05	0.18	3.16	6.04E-03	8.53E-03	**6.74**
Depletion potential of the stratospheric ozone layer (ODP) (kg CFC-11 eq)							
	4.20E-08	2.21E-12	8.82E-09	4.29E-08	2.53E-13	3.20E-09	**9.69E-08**
Eutrophication potential (EP) (kg N eq)							
	0.01	4.08E-05	6.22E-04	9.41E-03	4.28E-06	8.78E-06	**0.02**
Acidification potential of soil and water sources (AP) (kg SO_2 eq)							
	0.01	6.78E-04	9.95E-04	0.01	7.15E-05	6.09E-05	**0.03**
Formation potential of tropospheric ozone (POCP) (kg O_3 eq)							
	0.25	0.02	0.02	0.25	1.81E-03	1.74E-03	**0.54**
Resource Use							
Abiotic depletion potential for non-fossil mineral resources ($ADP_{elements}$)*							
	1.59E-06	0.00	1.92E-06	2.53E-06	0.00	8.83E-09	**6.05E-06**
Abiotic depletion potential for fossil resources (ADP_{fossil}) (MJ, NCV)							
	39.8	0.75	1.91	37.7	0.09	0.21	**80.5**
Renewable primary energy resources as energy (fuel), (RPRE[2])* (MJ, NCV)							
	1.86	0.00	0.14	1.76	0.00	1.40E-03	**3.77**
Renewable primary resources as material, (RPRM[2])* (MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Non-renewable primary resources as energy (fuel), (NRPRE[2])* (MJ, NCV)							
	77.0	0.75	2.00	71.2	0.09	0.21	**151.2**
Non-renewable primary resources as material, (NRPRM[2])* (MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Consumption of fresh water, (FW[2]) (m^3)							
	0.10	0.00	1.19E-03	0.09	0.00	2.28E-04	**0.20**
Secondary Material, Fuel and Recovered Energy							
Secondary Materials, (SM[2])* (kg)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Renewable secondary fuels, (RSF[2])* (MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Non-renewable secondary fuels (NRSF[2])* (MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Recovered energy, (RE[2])*(MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Waste & Output Flows							
Hazardous waste disposed, (HW[2])* (kg)							
	5.63E-04	0.00	0.00	5.07E-04	0.00	0.00	**1.07E-03**
Non-hazardous waste disposed, (NHWD[2])* (kg)							
	0.07	0.00	0.09	0.11	0.00	1.13	**1.40**
High-level radioactive waste, (HLRW[2])* (kg)							
	1.00E-09	0.00	7.07E-11	9.43E-10	0.00	2.37E-12	**2.02E-09**
Intermediate and low-level radioactive waste, (ILLRW[2])* (kg)							
	5.18E-09	0.00	1.14E-09	5.32E-09	0.00	1.14E-11	**1.17E-08**
Components for reuse, (CRU[2])* (kg)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Materials for recycling, (MR[2])* (kg)							
	8.03E-03	0.00	0.00	7.23E-03	0.00	0.00	**0.02**
Materials for energy recovery, (MER[2])* (kg)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Recovered energy exported from the product system, (EE[2])* (MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**

** Emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in these categories. The following optional indicators are not reported and have high levels of uncertainty: Land use related impacts, toxicological aspects, and emissions from land use change*

***Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, quantified by the same functional unit, and taking account of replacement based on the product reference service life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products.*

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[1] GWP 100; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5). CO_2 from biogenic secondary fuels used in kiln are climate-neutral (CO_2 sink = CO_2 emissions), ISO 21930, 7.2.7.

[2] Calculated per ACLCA ISO 21930 Guidance.

TABLE 7

Elevate RESISTA™, per 1 m^2 with 1.92 lbs/m^2 polyiso insulation

IMPACT ASSESSMENT (UNIT)	PRODUCTION (A1-A3)	TRANSPORT (A4)	INSTALLATION (A5)	REPLACEMENT (B4)	TRANSPORT TO DISPOSAL OF WASTE (C2)	DISPOSAL OF WASTE (C4)	TOTAL
Global warming potential (GWP)[3] (kg CO_2 eq)							
	3.28	0.05	0.18	3.11	6.04E-03	3.20E-09	**6.64**
Depletion potential of the stratospheric ozone layer (ODP) (kg CFC-11 eq)							
	3.68E-08	2.21E-12	8.82E-09	3.82E-08	2.53E-13	3.20E-09	**8.37E-08**
Eutrophication potential (EP) (kg N eq)							
	9.99E-03	4.08E-05	6.22E-04	9.39E-03	4.28E-06	8.78E-06	**0.02**
Acidification potential of soil and water sources (AP) (kg SO_2 eq)							
	0.01	6.78E-04	9.95E-04	0.01	7.15E-05	6.09E-05	**0.03**
Formation potential of tropospheric ozone (POCP) (kg O_3 eq)							
	0.24	0.02	0.02	0.25	1.81E-03	1.74E-03	**0.54**
Resource Use							
Abiotic depletion potential for non-fossil mineral resources ($ADP_{elements}$)*							
	1.88E-06	0.00	1.92E-06	2.79E-06	0.00	8.83E-09	**6.60E-06**
Abiotic depletion potential for fossil resources (ADP_{fossil}) (MJ, NCV)							
	39.1	0.75	1.91	37.0	0.09	0.21	**79.1**
Renewable primary energy resources as energy (fuel), (RPRE[4])* (MJ, NCV)							
	1.84	0.00	0.14	1.74	0.00	1.40E-03	**3.73**
Renewable primary resources as material, (RPRM[2])* (MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Non-renewable primary resources as energy (fuel), (NRPRE[2])* (MJ, NCV)							
	76.1	0.75	2.00	70.4	0.09	0.21	**149.5**
Non-renewable primary resources as material, (NRPRM[2])* (MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Consumption of fresh water, (FW[2]) (m^3)							
	0.10	0.00	1.19E-03	0.09	0.00	2.28E-04	**0.20**
Secondary Material, Fuel and Recovered Energy							
Secondary Materials, (SM[2])* (kg)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Renewable secondary fuels, (RSF[2])* (MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Non-renewable secondary fuels (NRSF[2])* (MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Recovered energy, (RE[2])*(MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Waste & Output Flows							
Hazardous waste disposed, (HW[2])* (kg)							
	5.63E-04	0.00	0.00	5.07E-04	0.00	0.00	**1.07E-03**
Non-hazardous waste disposed, (NHWD[2])* (kg)							
	0.07	0.00	0.09	0.11	0.00	1.13	**1.40**
High-level radioactive waste, (HLRW[2])* (kg)							
	9.42E-10	0.00	7.07E-11	8.89E-10	0.00	2.37E-12	**1.90E-09**
Intermediate and low-level radioactive waste, (ILLRW[2])* (kg)							
	5.09E-09	0.00	1.14E-09	5.24E-09	0.00	1.14E-11	**1.15E-08**
Components for reuse, (CRU[2])* (kg)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Materials for recycling, (MR[2])* (kg)							
	8.03E-03	0.00	0.00	7.23E-03	0.00	0.00	**0.02**
Materials for energy recovery, (MER[2])* (kg)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Recovered energy exported from the product system, (EE[2])* (MJ, NCV)							
	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**

** Emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in these categories. The following optional indicators are not reported and have high levels of uncertainty: Land use related impacts, toxicological aspects, and emissions from land use change*

***Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, quantified by the same functional unit, and taking account of replacement based on the product reference service life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products.*

[3] GWP 100; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5). CO_2 from biogenic secondary fuels used in kiln are climate-neutral (CO_2 sink = CO_2 emissions), ISO 21930, 7.2.7.

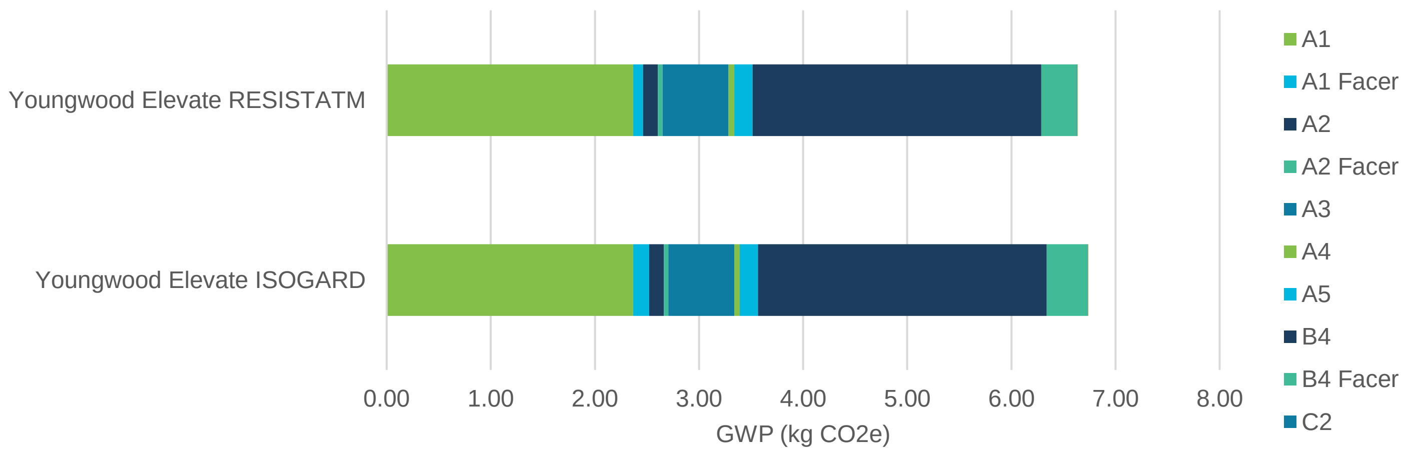
[4] Calculated per ACLCA ISO 21930 Guidance.

INTERPRETATION

The GWP impacts for each information module are shown below in Figure 3.

FIGURE 3

Comparison of Elevate RESISTA™ and Elevate ISOGARD GWP impacts across information modules



As evidenced by Figure 3, most of the GWP impacts for these insulation boards come from the modules A1 and B4. Module B4, the replacement stage, accounts for 46.9% of the total GWP impact of both product types, which is understandable as this module accounts for 90% of the impacts from all other modules. Module A1 accounts for 37.1% and 37.4% of the total GWP impacts of the Elevate RESISTA and Elevate ISOGARD products, respectively. The magnitude of this figure for both products is due to the upstream production of the materials used in the production of these products. However, the Elevate ISOGARD products have slightly higher GWP impacts in the A1 module due to the difference in facer materials used in each product.

While GWP is specifically assessed in Figure 3, several other impact categories are distributed in a similar fashion.

LIMITATIONS

Life cycle impact assessment (LCIA) results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins, or risks.

Emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data from the following categories:

- renewable primary energy resources as energy (fuel), (RPRE)
- renewable primary resources as material, (RPRM)
- nonrenewable primary resources as energy (fuel), (NRPRE)
- nonrenewable primary resources as material (NRPRM)
- secondary materials (SM)
- renewable secondary fuels (RSF)
- nonrenewable secondary fuels (NRSF)
- recovered energy (RE)
- abiotic depletion potential for non-fossil mineral resources ($ADP_{elements}$)
- hazardous waste disposed
- nonhazardous waste disposed
- high-level radioactive waste
- intermediate and low-level radioactive waste
- components for reuse
- materials for recycling
- materials for energy recovery; and
- recovered energy exported from the product system.

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