CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION OPTIMIZATION
UL.COM/EPD

Optimization Summary
Environmental Product Declaration

Company Name Owens Corning

Validity Period 5 Years

EPD Name, Declaration Number, Certification Period
Thermafiber® Formaldehyde-Free Mineral Wool, 4790011847.102.1, October 1, 2021 - October 1, 2026

Reference EPD Name, Declaration Number, Certification Period
Thermafiber® Formaldehyde-Free Mineral Wool, 4788956323.103.1, October 1, 2019 – October 1, 2024

Product Category Rules & Version Number UL Part B: Building Envelope Thermal Insulation EPD Requirements, UL 10010-1

Reference EPD ☑ Product Specific ☐ Industry Average

Link to Optimization Addendum Addendum is Attached, Page 5

Comparability Criteria Totals (from comparability worksheet) 11 1 0 0

Conforms with LEED v4 Building Product Disclosure and Optimization - EPDs, Option 2. Multi-attribute optimization
The comparison of these construction products conforms to the requirements of ISO 14025 §5.6, §6.7.2 and ISO 21930 §5.5, §7.3.



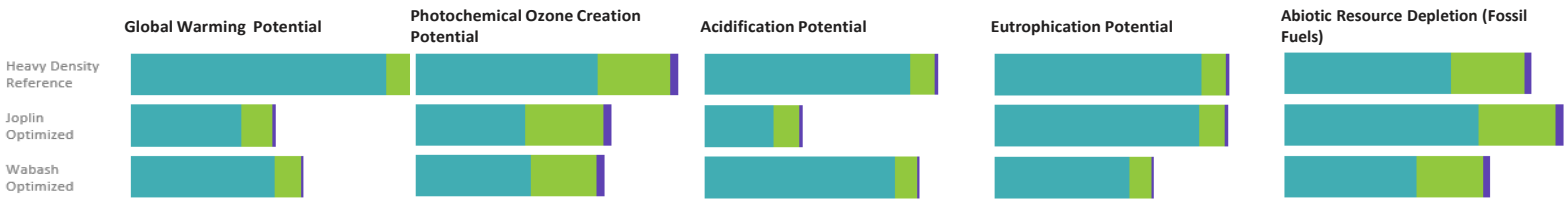
Results

Modules in Which Changes Occur

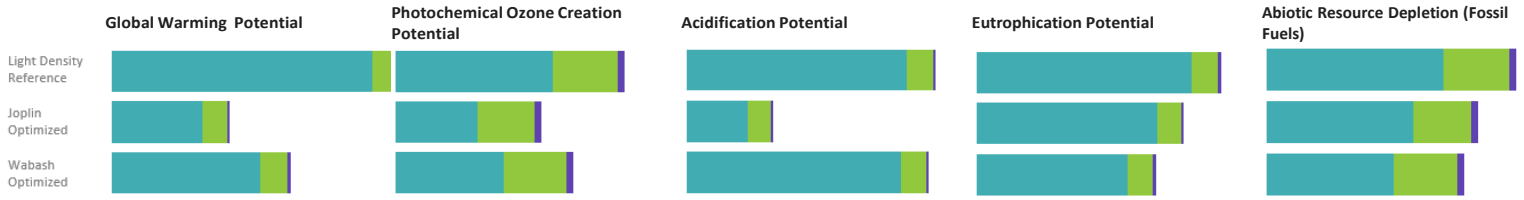
PRODUCT STAGE			CONSTRUCTION STAGE		USE STAGE							END OF LIFE STAGE			
Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/ Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/ demolition	Transport	Waste processing	Disposal
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
✔	✔	✔	✔	✔									✔		✔

Environmental Impact Reduction

Percent change is not an appropriate method to represent changes in Ozone Depletion Potential, due to large differences in orders of magnitude between results.



	Global Warming Potential			Photochemical Ozone Creation Potential			Acidification Potential			Eutrophication Potential			Abiotic Resource Depletion (Fossil Fuels)		
	Reference	Joplin Optimized	Wabash Optimized	Reference	Joplin Optimized	Wabash Optimized	Reference	Joplin Optimized	Wabash Optimized	Reference	Joplin Optimized	Wabash Optimized	Reference	Joplin Optimized	Wabash Optimized
PRODUCT	7.6	3.3	4.3	3.9E-01	2.4E-01	2.5E-01	4.5E-02	1.5E-02	4.2E-02	4.8E-03	4.7E-03	3.1E-03	4	5	3
CONSTRUCTION	0.9	0.8	0.8	1.6E-01	1.7E-01	1.4E-01	5.4E-03	5.8E-03	4.9E-03	5.7E-04	6.0E-04	5.1E-04	1.9	2.0	1.7
USE	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0	0.0	0.0
END OF LIFE	0.1	0.1	0.1	1.7E-02	1.9E-02	1.7E-02	5.7E-04	6.4E-04	5.7E-04	5.9E-05	6.6E-05	5.8E-05	0.2	0.2	0.2
		-50%	-40%		-25%	-28%		-58%	-8%		0%	-32%		13%	-17%



	Global Warming Potential			Photochemical Ozone Creation Potential			Acidification Potential			Eutrophication Potential			Abiotic Resource Depletion (Fossil Fuels)		
	Reference	Joplin Optimized	Wabash Optimized	Reference	Joplin Optimized	Wabash Optimized	Reference	Joplin Optimized	Wabash Optimized	Reference	Joplin Optimized	Wabash Optimized	Reference	Joplin Optimized	Wabash Optimized
PRODUCT	3.6	1.2	2.0	1.7E-01	8.8E-02	1.2E-01	2.0E-02	5.6E-03	2.0E-02	2.1E-03	1.8E-03	1.5E-03	2	2	2
CONSTRUCTION	0.4	0.4	0.4	7.1E-02	6.3E-02	6.8E-02	2.4E-03	2.2E-03	2.3E-03	2.5E-04	2.3E-04	2.4E-04	0.8	0.7	0.8
USE	0.0	0.0	0.0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0	0.0	0.0
END OF LIFE	0.0	0.0	0.0	7.5E-03	7.1E-03	8.0E-03	2.6E-04	2.4E-04	2.7E-04	2.6E-05	2.5E-05	2.8E-05	0.1	0.1	0.1
		-60%	-39%		-37%	-22%		-65%	-3%		-15%	-27%		-16%	-21%

Optimization Sources

Improvements in the environmental footprint of product produced in Joplin can be attributed to increased plant operating efficiency and improved cupola and manufacturing line operational stability. The earlier LCA study included some data that was collected within 12 months of the initial plant start up when much process fine tuning was still underway. By increasing the amount of saleable product from a similar of amount of raw materials, the overall impacts per functional unit decreased. Increases were achieved through density efficiency work and better consistency of the manufacturing line. Improved operational stability of the cupola also led to significant improvements in air emissions. Similarly, reductions in impacts for products produced at the Wabash facility were attributed to density efficiency efforts. The slight increase seen in fossil fuel depletion for heavy density Joplin product can be attributed to a slight shift in the utility balance to reflect a higher proportion of natural gas over electricity.

Interpretation

Using the comparability criteria, the comparison can be termed a robust comparison. All of the criteria were identical or equivalent. Both EPDs are product specific, cover the same system boundaries, use the same LCI background data, software, impact assessment method, PCR, and employ the same assumptions and calculations for use phase, end of life, allocation, cut-off rules and equivalent provision of additional environmental information. Due to a change from grouping results in light and heavy density products at the network level to reporting results in terms of a reference product at the facility level with scaling factors to convert to other products, the scope for the comparison is equivalent, rather than identical.

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION OPTIMIZATION
UL.COM/EPD

Comparability Criteria
Environmental Product Declaration

UL Environment Comparability Rating Results
Select as applicable; totals displayed on Summary front

● ● ● ●	**Representativeness**
● ● ● ●	**Scope**
● ● ● ●	**System Boundaries**
● ● ● ●	**LCI Background Data & LCA software**
● ● ● ●	**Data Quality**
● ● ● ●	**Impact Assessment**
● ● ● ●	**Use Phase Calculations**
● ● ● ●	**End of Life Assumptions**
● ● ● ●	**Allocation Rules**
● ● ● ●	**Cut-Off Rules**
● ● ● ●	**Materials & Additional Information**
● ● ● ●	**EPD Content & PCR Version**
Comparability Criteria Totals	11 1 0 0

Interpretation

Robust Comparison

- ≥7 More than half of criteria are equivalent or identical for comparison
- ≤5 Less than half of criteria require additional interpretation for comparison
- 0 No criteria are flagged that warrant significant justification for comparison
- 0 No criteria are flagged that prevent comparison

Compare with Caution

- ≤5 Less than half of criteria are equivalent or identical for comparison
- ≥7 More than half of criteria require additional interpretation for comparison
- ≤1 One or no criteria are flagged that warrant significant justification for comparison
- 0 No criteria are flagged that prevent comparison

Ineligible for Comparison

- >1 More than one criteria are flagged that warrant significant justification for comparison
- ≥1 One or more criteria are flagged that prevent comparison

Results and interpretation are further explained in the Optimization Addendum provided at: Addendum is Attached, Page 5

Comparability Criteria

Representativeness
- If benchmark EPD is industry average, the compared product specific EPD is represented in the average
- If benchmark EPD is product specific, the compared product is equivalent
- Product specific EPD is not represented in industry average EPD or not equivalent to benchmark

Scope
- Identical functional units, product category definition/description and equivalent period of validity
- Equivalent functional units, product category definition/description, and period of validity
- Different functional units, product category definition/description, and/or different period of validity

System Boundaries
- Equivalent system boundaries with equivalent modules excluded
- Includes A1-A3 with identical use phase and EOL options Includes
- A1 - A3, no use phase, no EOL options

LCI Background Data & Software
- Consistent LCI background data and software
- Consistent LCI background data, different software
- Consistent software, different LCI background data
- Different LCI background data, different software

Data Quality*
- Equivalent data quality with equivalent data collection procedures
- Some equivalent data quality and data collection procedures
- Different data quality with different data collection procedures

*Quality refers to coverage, precision, completeness, representativeness, consistency, reproducibility, and sources

Impact Assessment Method
- Identical inventory and impact assessment categories, method & version
- Equivalent inventory and impact assessment categories, method & version
- Different inventory and impact assessment categories, method & version

Assumptions & Calculations

Use phase
- Identical use phase calculations and units
- Different use phase calculations and units

End of Life
- Equivalent end of life assumptions by disposal option
- Different end of life assumptions by disposal option

Allocation
- Equivalent choice of allocation method(s)
- Different choice of allocation method(s) with robust sensitivity analysis showing allocation choice affects results by <5%
- Different choice of allocation method(s) w/o sensitivity analysis

Cut-off Rules
- Identical application of cut-off criteria for inclusion of flows
- Different application of cut-off criteria with robust sensitivity analysis showing cut-off criteria affects results by <5%
- Different application of cut-off criteria without sensitivity analysis

Materials & Additional Information

Equivalent provision of additional environmental information, declared materials and substances

Different additional environmental information, declared materials and substances

EPD Content and PCR Version

Equivalent EPD content, format, and reference PCR version numberDifferent EPD content, format, and reference PCR version number

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Optimization Addendum

Environmental Product Declaration

Thermafiber® Formaldehyde-Free Mineral Wool

According to ISO 14025 and ISO 21930

Manufacturer Name and Address	**Owens Corning, One Owens Corning Parkway, Toledo, OH, USA**
Optimization Summary Link	Optimization Summary Attached
Optimized EPD Name, Declaration Number, Certification Period	Thermafiber® Formaldehyde-Free Mineral Wool, , 4790011847.102.1
Optimized EPD Link	Safing®, UltraBatt®, FireSpan®40, FireSpan®90, SAFB™, Fire & Sound Guard™
Reference EPD Name, Declaration Number, Certification Period	Thermafiber® Formadlehyde-Free Mineral Wool, 4788956323.103.1, October 1, 2019 – October 1, 2024
Reference EPD Link	Included in Appendix - Reference EPD
Reference EPD	☒ Product specific ☐ Industry average
Product Category Rules and Version	UL Part B: Building Envelope Thermal Insulation EPD Requirements, UL 10010-1
This optimiziation was independently verified by:	Thomas P. Gloria, Industrial Ecology Consultants
Date of Issue	10/1/2021
Period of Validity	5 Years

The comparison of these construction products conforms to the requirements of ISO 14025 §5.6, §6.7.2 and ISO 21930 §5.5, §7.3.

Limitations

Full conformance with a 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.

1. Introduction

In our continuing effort to reduce the environmental footprint of our products and operations, we have chosen to evaluate our Thermafiber® Formaldehyde-Free Mineral Wool Insulation product produced in 2020 shown in the current, optimized EPD against the product which was produced in 2018 shown in the earlier reference EPD for the product. Improvements in the environmental footprint of product produced in Joplin can be attributed to increased plant operating efficiency and improved cupola and manufacturing line operational stability. The earlier LCA study included some data that was collected within 12 months of the initial plant start up when much process fine tuning was still underway. By increasing the amount of saleable product from a similar of amount of raw materials, the overall impacts per functional unit decreased. Increases were achieved through density efficiency work and better consistency of the manufacturing line. Improved operational stability of the cupola also led to significant improvements in air emissions. Similarly, reductions in impacts for products produced at the Wabash facility were attributed to density efficiency efforts. The slight increase seen in fossil fuel depletion for heavy density Joplin product can be attributed to a slight shift in the utility balance to reflect a higher proportion of natural gas over electricity.

2. Comparability Criteria

1.1. Representativeness

In order to allow for greater transparency at the product level, the results in the optimized EPD are reported in terms of a reference product with scaling factors to convert results to other products for each manufacturing location. The reference EPD grouped products into light and heavy density products as a production weighted average of all manufacturing facilities. The underlying products included in both LCA studies were the same, only the format for reporting results was changed. In order to make the comparison equivalent, optimized reference product results were scaled to the 2020 products whose density most closely matched the densities of the 2018 light and heavy density groups. For light density products, the comparison was made to UltraBatt™ FF R-24. For heavy density products, the comparison was made to FireSpan® FF 90.

1.2. Scope

The functional unit for the comparison is identical, 1 m^2 of insulation at R_{SI}=1. Due to a change from grouping results in light and heavy density products to reporting results in terms of a reference product with scaling factors to convert to other products, the scope for the comparison is equivalent, rather than identical. The original EPD is valid through October 1, 2024, while the optimized EPD is valid through October 1, 2026. Although not identical, the validity periods overlap.

1.3. System Boundaries

Since the energy savings during the use stage of thermal insulation can vary greatly depending on the installed conditions, the modules in the use stage were not declared for either product. Stages C1 and C3 from End of Life Stage were not declared for either product since the products are both sent with mixed construction waste to the landfill.

Table 1. Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCT-ION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
Optimized Product	☒	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐
Reference Product	☒	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐

1.4. LCI Background Data and Software

In order to have a robust comparison, the LCA model used in the reference EPD was updated to use the same data set (ecoinvent 3.6) which was used to create the LCA model for the optimized EPD. Due to increased transparency into the supply chain and enhanced modeling efforts, the 2018 data was updated as needed to match 2020 modeling choices around oxygen, slag and binder. The materials and manufacturing processes used in the old and new products were identical. The optimized and updated reference model were both analyzed using SimaPro 9.1.

1.5. Data Quality

Both the 2018 and 2020 sets of data were collected in a similar manner from the plants producing the product.

1.6. Impact Assessment Method

The TRACI 2.1 v1.05 impact assessment method was used to compare the model for the updated reference EPD and the optimized EPD.

1.7. Use Phase

The Use Phase was identical since it was not declared for either product.

1.8. End of Life

The End of Life for both products assumes the products are sent to landfill since no programs currently exist for the recycling or reuse of mineral wool insulation.

1.9. Allocation

The same allocation method, by product mass, was used by both analyses when it was not possible to attribute individual process inputs and outputs to individual product outputs.

1.10. Cut-off Rules

The cut-off criteria for inclusion of flows were identical for both products.

1.11. Materials and Additional Information

The optimized EPD has additional information regarding energy savings during the use phase which had not developed at the time of the reference EPD.

1.12. EPD Content and PCR Version

The same PCR version was used for both EPDs. There are no differences in content or format.

3. Life Cycle Impact Assessment Results

Optimized values in the tables below have been scaled to the appropriate product for comparison. To enable the light density product comparison, results of the reference product found in the EPD were multiplied by 1.22 for Joplin and 0.99 for Wabash. To enable the heavy density product comparison, results of the reference product found in the EPD were multiplied by 3.15 for Joplin and 2.11 for Wabash.

Table 2. TRACI Optimized EPD Impact Assessment Results – Joplin – FireSpan® FF 90 (Heavy Density)

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	3.23E+00	9.08E-01	1.13E-02	MND	MND	8.70E-02	MND	9.57E-03
ODP [kg CFC-11 eq]	4.17E-07	2.20E-07	5.44E-10	MND	MND	2.10E-08	MND	2.15E-09
AP [kg SO_2 eq]	1.48E-02	5.65E-03	1.85E-05	MND	MND	5.41E-04	MND	9.23E-05
EP [kg N eq]	4.63E-03	5.90E-04	4.06E-06	MND	MND	5.65E-05	MND	7.99E-06
POCP [kg O_3 eq]	2.32E-01	1.64E-01	4.88E-04	MND	MND	1.57E-02	MND	2.79E-03
ADP_{fossil} [MJ, LHV]	4.87E+00	1.95E+00	4.83E-03	MND	MND	1.86E-01	MND	1.92E-02

[GWP 100 - Global Warming Potential]; [ODP - Ozone Depletion Potential]; [AP - Acidification Potential]; [EP - Eutrophication Potential]; [POCP - Smog Formation Potential]; [ADPfossil - Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources]

Table 3. TRACI Optimized EPD Impact Assessment Results – Wabash – FireSpan® FF 90 (Heavy Density)

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	4.29E+00	7.94E-01	2.67E-03	MND	MND	7.90E-02	MND	8.69E-03
ODP [kg CFC-11 eq]	3.60E-07	1.92E-07	1.34E-10	MND	MND	1.91E-08	MND	1.95E-09
AP [kg SO_2 eq]	4.18E-02	4.94E-03	4.53E-06	MND	MND	4.91E-04	MND	8.38E-05
EP [kg N eq]	3.11E-03	5.16E-04	1.10E-06	MND	MND	5.13E-05	MND	7.26E-06
POCP [kg O_3 eq]	2.47E-01	1.43E-01	1.18E-04	MND	MND	1.43E-02	MND	2.53E-03
ADP_{fossil} [MJ, LHV]	3.40E+00	1.70E+00	1.19E-03	MND	MND	1.69E-01	MND	1.74E-02

Table 4. TRACI Optimized EPD Impact Assessment Results – Joplin – UltraBatt™ FF R-24 (Light Density)

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	1.25E+00	3.52E-01	4.36E-03	MND	MND	3.37E-02	MND	3.71E-03
ODP [kg CFC-11 eq]	1.61E-07	8.51E-08	2.11E-10	MND	MND	8.15E-09	MND	8.34E-10
AP [kg SO_2 eq]	5.72E-03	2.19E-03	7.16E-06	MND	MND	2.10E-04	MND	3.58E-05
EP [kg N eq]	1.79E-03	2.29E-04	1.57E-06	MND	MND	2.19E-05	MND	3.10E-06
POCP [kg O_3 eq]	8.98E-02	6.36E-02	1.89E-04	MND	MND	6.09E-03	MND	1.06E-03
ADP_{fossil} [MJ, LHV]	1.89E+00	7.53E-01	1.87E-03	MND	MND	7.22E-02	MND	7.42E-03

Table 5. TRACI Optimized EPD Impact Assessment Results – Wabash – UltraBatt™ FF R-24 (Light Density)

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	2.01E+00	3.73E-01	1.25E-03	MND	MND	3.71E-02	MND	4.08E-03
ODP [kg CFC-11 eq]	1.69E-07	9.01E-08	6.31E-11	MND	MND	8.97E-09	MND	9.17E-10
AP [kg SO_2 eq]	1.96E-02	2.32E-03	2.13E-06	MND	MND	2.30E-04	MND	3.93E-05
EP [kg N eq]	1.46E-03	2.42E-04	5.14E-07	MND	MND	2.41E-05	MND	3.41E-06
POCP [kg O_3 eq]	1.16E-01	6.73E-02	5.52E-05	MND	MND	6.70E-03	MND	1.19E-03
ADP_{fossil} [MJ, LHV]	1.59E+00	7.98E-01	5.59E-04	MND	MND	7.94E-02	MND	8.16E-03

Table 6. TRACI Reference EPD Impact Assessment Results – Heavy Density FF (Updated)

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	7.60E+00	8.75E-01	7.00E-04	MND	MND	7.89E-02	MND	8.68E-02
ODP [kg CFC-11 eq]	4.38E-07	2.12E-07	2.79E-11	MND	MND	1.91E-08	MND	1.95E-09
AP [kg SO_2 eq]	4.51E-02	5.44E-03	9.87E-07	MND	MND	4.91E-04	MND	8.37E-05
EP [kg N eq]	4.76E-03	5.68E-04	1.10E-07	MND	MND	5.13E-05	MND	7.25E-06
POCP [kg O_3 eq]	3.90E-01	1.58E-01	2.82E-05	MND	MND	1.43E-02	MND	2.53E-03
ADP_{fossil} [MJ, LHV]	4.25E+00	1.87E+00	2.48E-04	MND	MND	1.69E-01	MND	1.74E-02

Table 7. TRACI Reference EPD Impact Assessment Results – Light Density FF (Updated)

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	3.57E+00	3.91E-01	4.82E-03	MND	MND	3.53E-02	MND	3.88E-03
ODP [kg CFC-11 eq]	1.92E-07	9.46E-08	1.92E-10	MND	MND	8.53E-09	MND	8.73E-10
AP [kg SO_2 eq]	2.04E-02	2.43E-03	6.80E-06	MND	MND	2.19E-04	MND	3.74E-05
EP [kg N eq]	2.10E-03	2.54E-04	7.57E-07	MND	MND	2.29E-05	MND	3.24E-06
POCP [kg O_3 eq]	1.71E-01	7.06E-02	1.94E-04	MND	MND	6.37E-03	MND	1.13E-03
ADP_{fossil} [MJ, LHV]	2.25E+00	8.37E-01	1.71E-03	MND	MND	7.56E-02	MND	7.77E-03

Table 8. TRACI Reference EPD Impact Assessment Results – Heavy Density FF

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	8.65E+00	1.03E+00	7.28E-04	MND	MND	9.28E-02	MND	1.85E-02
ODP [kg CFC-11 eq]	5.69E-07	2.54E-07	3.93E-11	MND	MND	2.29E-08	MND	8.92E-09
AP [kg SO_2 eq]	5.38E-02	6.41E-03	1.18E-06	MND	MND	5.78E-04	MND	1.62E-04
EP [kg N eq]	3.06E-02	1.28E-03	3.23E-05	MND	MND	1.15E-04	MND	3.45E-05
POCP [kg O_3 eq]	4.48E-01	1.74E-01	3.13E-05	MND	MND	1.57E-02	MND	3.84E-03
ADP_{fossil} [MJ, LHV]	5.47E+01	2.29E+00	3.57E-04	MND	MND	2.06E-01	MND	8.28E-02

Table 9. TRACI Reference EPD Impact Assessment Results – Light Density FF

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	4.00E+00	4.60E-01	5.01E-03	MND	MND	4.15E-02	MND	8.25E-03
ODP [kg CFC-11 eq]	2.44E-07	1.14E-07	2.71E-10	MND	MND	1.02E-08	MND	3.99E-09
AP [kg SO_2 eq]	2.38E-02	2.86E-03	8.15E-06	MND	MND	2.58E-04	MND	7.22E-04
EP [kg N eq]	1.32E-02	5.71E-04	2.23E-04	MND	MND	5.16E-05	MND	1.54E-05
POCP [kg O_3 eq]	1.94E-01	7.77E-02	2.15E-04	MND	MND	7.01E-03	MND	1.72E-03
ADP_{fossil} [MJ, LHV]	2.75E+00	1.02E+00	2.46E-03	MND	MND	9.22E-02	MND	3.70E-02

4. Interpretation of Optimization Results

Improvements in the environmental footprint of product produced in Joplin can be attributed to increased plant operating efficiency and improved cupola and manufacturing line operational stability. The earlier LCA study included some data that was collected within 12 months of the initial plant start up when much process fine tuning was still underway. By increasing the amount of saleable product from a similar of amount of raw materials, the overall impacts per functional unit decreased. Increases were achieved through density efficiency work and better consistency of the manufacturing line. Improved operational stability of the cupola also led to significant improvements in air emissions. Similarly, reductions in impacts for products produced at the Wabash facility were attributed to density efficiency efforts. The slight increase seen in fossil fuel depletion for heavy density Joplin product can be attributed to a slight shift in the utility balance to reflect a higher proportion of natural gas over electricity.

Using the comparability criteria, the comparison can be termed a robust comparison. All of the criteria were identical or equivalent. Both EPDs are product specific, cover the same system boundaries, use the same LCI background data, software, impact assessment method, PCR, and employ the same assumptions and calculations for use phase, end of life, allocation, cut-off rules and equivalent provision of additional environmental information. Due to a change from grouping results in light and heavy density products at the network level to reporting results in terms of a reference product at the facility level with scaling factors to convert to other products, the scope for the comparison is equivalent, rather than identical.

5. Appendix - Reference EPD



10023691-EPD--The
rmafiber-Formaldeh

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Environmental Product Declaration

Thermafiber® Formaldehyde-Free Mineral Wool

OWENS CORNING



Owens Corning™ Thermafiber® Formaldehyde-Free Mineral Wool Insulation enhances comfort, savings and sustainability in new and existing structures.

Owens Corning, and its family of companies, is a leading global producer of residential and commercial building materials, glass fiber reinforcements, and engineered materials for composite systems. It uses a decision framework for managing the company as a sustainable enterprise. It is the foundation of the company's strategy of building market-leading businesses, global in scope – human in scale, and reflects the company's purpose: our people and products make the world a better place.

Owens Corning is committed to balancing economic growth with social progress and sustainable solutions to its building materials and composite customers around the world.

This Environmental Product Declaration is a component of our stated goal to provide life cycle information on all core products.

sustainability.owenscorning.com

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

Thermafiber® Mineral Wool

According to ISO 14025, EN 15804 and ISO 21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL ENVIRONMENT 333 PFINGSTEN ROAD NORTHBROOK, IL 60611
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	General Program Instructions v2.5 March 2020
MANUFACTURER NAME AND ADDRESS	Owens Corning, One Owens Corning Parkway, Toledo, OH, USA
DECLARATION NUMBER	4790011847.102.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	1 m^2 insulation at R_{SI}=1
REFERENCE PCR AND VERSION NUMBER	Part B: Building Envelope Thermal Insulation EPD Requirements, UL 10010-1
DESCRIPTION OF PRODUCT APPLICATION/USE	Thermafiber® Formaldehyde-Free Mineral Wool is a type of slag wool insulation product used in a variety of building applications, both residential and commercial, requiring the use of thermal insulation.
PRODUCT RSL DESCRIPTION (IF APPL.)	75 years
MARKETS OF APPLICABILITY	Building Material
DATE OF ISSUE	10/1/2021
PERIOD OF VALIDITY	5 Years
EPD TYPE	Product-specific
RANGE OF DATASET VARIABILITY	NA
EPD SCOPE	Cradle to gate with options (A4, A5, C1-C4)
YEAR(S) OF REPORTED PRIMARY DATA	2020
LCA SOFTWARE & VERSION NUMBER	SimaPro 9.1
LCI DATABASE(S) & VERSION NUMBER	ecoinvent 3.6
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1 v1.05

The PCR review was conducted by:	UL Environment PCR Review Panel epd@ulenvironment.com
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☐ EXTERNAL	Thomas P. Gloria, Industrial Ecology Consultants
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Aspire Sustainability
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

LIMITATIONS

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a 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.

1. Product Definition and Information

1.1. Description of Company/Organization

Founded in 1938, Owens Corning has been a leader in insulation, roofing and fiberglass composites. It has a global presence with 20,000 people in 33 countries. This Environmental Product Declaration is representative of product produced at the locations listed below.

Wabash Plant Wabash, IN 46992	Joplin Plant Joplin, MO 64804

1.2. Product Description

Product Identification

Thermafiber® Formahyde-Free Mineral Wool Insulation products are comprised of semi-rigid and rigid boards and batts. Mineral wool resists mold, fungi, and is vermin proof due to its being an inorganic material. The R-value of Thermafiber® Mineral Wool Insulation ranges from 3.7 - 4.3 per inch (25.4 mm) of thickness. It is available in multiple thicknesses and densities, with various facings by product type. Reflected by its R-value, mineral wool's insulating performance is achieved by its densely packed fibers. Its high resistance to heat flow translates into year-round comfort and energy savings.



Thermafiber® products covered by this EPD include:
FireSpan® 40 & 90 FF, Safing FF (4 pcf | 64 kg/m^3) & (6 pcf | 96 kg/m^3), SAFB™ FF (2.5 pcf | 40 kg/m^3) & (4 pcf | 64 kg/m^3), UltraBatt™ FF, and A60 Marine Board.

Product Specification

Select product specifications are included below. For additional information and current specifications refer to the Product Data Sheet on owenscorning.com.

	FireSpan® FF 40 & 90	Safing FF	SAFB™ FF	UltraBatt™ FF	A60 Marine Board
COMPLIANCE					
Classification ASTM C612 (Type)					
	IA, IB, II, III, IVA, IVB[3]	IA, IB, II, III, IVA	---	---	IVB
CAN/ULC-S702 (Type)					
	I[1], III[2]	I[1], III[2]	---	---	---
FIRE					
Combustibility ASTM E136 (Rated Non-combustible per NFPA Standard 220)					
	✓	✓	✓	✓	✓
CAN/ULC S114 (non-combustible)					
	✓	✓	✓	---	✓
Surface Burning Characteristics ASTM E84 (Flame Spread/Smoke Developed)					
	0/0[1] 25/0[2]	0/0[1] 25/0[2]	0/0	5/5[1] 25/0[2]	0/0
Surface Burning Characteristics CAN/ULC S102 (Flame Spread/Smoke Developed)					
	0/0[1] 25/0[2]	0/0[1] 25/0[2]	0/0	---	0/0
MOISTURE					
Water Vapor Sorption ASTM C1104 (Absorption by volume)					
	<1%	<1%	<1%		<1%[5]
Fungi Resistance ASTM C1338 (complies/pass)					
	✓	✓	✓	✓	✓
Stability ASTM C356 (Linear shrinkage @1200°F | 649°C)					
	<2%	---	---	---	<1%
Corrosion of Steel, Aluminum, and Copper ASTM C665 (non-corrosive)					
	✓	✓	✓	✓	✓[4]

[1] Unfaced
[2] Foil faced
[3] FireSpan® 90 only
[4] Aluminum and Copper
[5] by weight at 120°F (49°C), 95% R.H.)

Flow Diagram

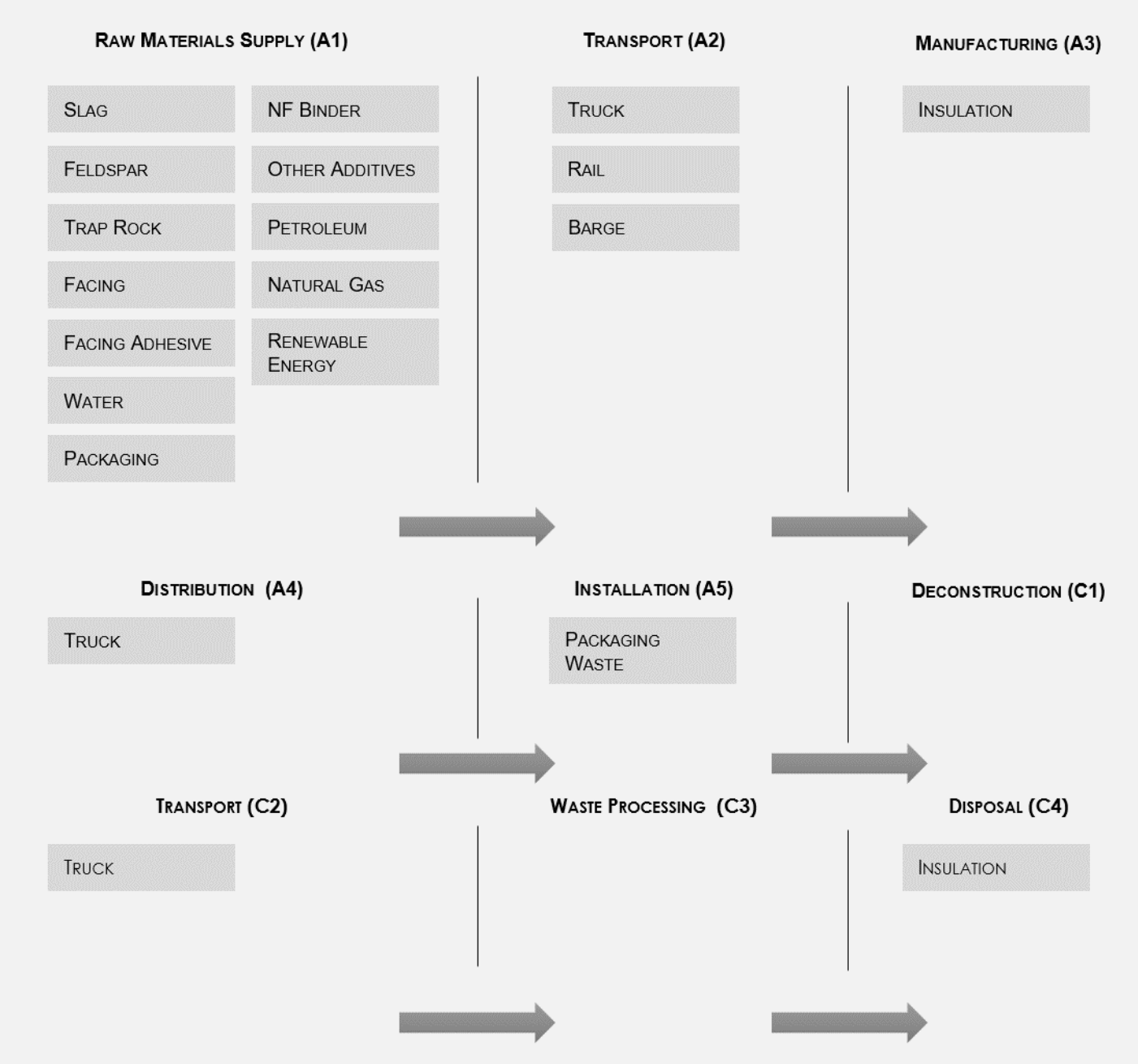


Figure 1. Flow Diagram of FF Thermafiber® Mineral Wool Insulation

Product Average

The results of this declaration represent an average performance for SAFB™ FF (2.5 pounds per cubic foot | 40 kg/m^3 density version) reference product at the functional unit of 1 m^2 at R_{SI} = 1 at each manufacturing location. These results were derived using reported densities, thermal conductivity, and facility-level production data of products covered by this EPD for each manufacturing location. Using scaling factors found in **Appendix A**, results can be converted to other products at the functional unit or the as supplied thickness and R-value.

1.3. Application

In residential and light commercial construction, including multi-family construction, mineral wool insulation products are used as non-structural thermal-insulating materials in interior and exterior walls, floor-ceiling assemblies, attics and crawl spaces.

In commercial construction, mineral wool insulation can be used as continuous insulation in the building envelope, exterior wall cavity insulation, as acoustic insulation for partition interior walls, and a variety of other applications. Mineral wool is the only insulation approved for use in curtain wall perimeter fire containment applications because of its fire resistant properties.

In industrial applications, mineral wool can be used to insulate flatwork, large diameter pipes and tanks, and a variety of OEM applications.

1.4. Declaration of Methodological Framework

This declaration is a product-specific EPD and is cradle-to-installation with end-of-life. The underlying LCA upon which this EPD is based included the following life cycle modules: *Raw Material supply* (A1); *Inbound Transportation* (A2); *Manufacturing* (A3); *Distribution* (A4); *Installation* (A5); *End-of-life, Transport* (C2) and *End-of-life, Disposal* (C4). No known flows have been deliberately excluded. The product is expected to perform as claimed for the 75-year reference service life if it remains clean and dry in its installed state.

1.5. Technical Requirements

At a minimum, Thermafiber® FF Mineral Wool Insulation products for commercial applications meet or exceed one of the following:

- ***Corrosion Resistance***
  - Type I or III when tested in accordance with ASTM C665, *Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing*
- ***Classification***
  - Type IA, IB, II, III, IVA, or IVB when tested in accordance with ASTM C612, *Standard Specification for Mineral Fiber Block and Board Thermal Insulation*
- ***Combustibility***
  - Rated Non-combustible per NFPA Standard 220 when tested in accordance with ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*
- ***Formaldehyde-Free***
  - UL Validated Formaldehyde-Free

❖ ***Surface Burning Characteristics***[1]

- Flame Spread 0, Smoke Developed 0 for unfaced products when tested in accordance with ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*

1.6. Properties of Declared Product as Delivered

When installed in typical building and construction assemblies according to all applicable Owens Corning specifications, recommendations and guidelines, Thermafiber® FF Mineral Wool Insulation delivers its advertised R-value.

1.7. Material Composition

Thermafiber® FF Mineral Wool Insulation consists of two major components, charge and binder. The primary raw material used is blast furnace slag, a by-product of the steel industry. The reuse of slag into mineral wool prevents this material from being discarded into landfills and results in a minimum total recycled content of 70% in the final product. These materials are sourced locally and transported to manufacturing facilities.

Material Component	Material Component %	
	Wabash	Joplin
Charge		
Slag	75-80%	65-70%
Feldspar	8-10%	6-9%
Trap rock	6-9%	18-21%
Binder		
NF Binder	6-9%	6-9%
Other	< 1%	< 1%

1.8. Manufacturing

Manufacturing Locations

Owens Corning North American manufacturing locations can be found across the United States. Primary data from these two manufacturing facilities were used for the underlying life cycle assessment. Results provided in this declaration include facility-specific values for these two manufacturing facilities.

Wabash Plant Wabash, IN 46992	Joplin Plant Joplin, MO 64804

[1] Excludes Thermafiber® UltraBatt™ FF Mineral Wool Insulation

Manufacturing Process

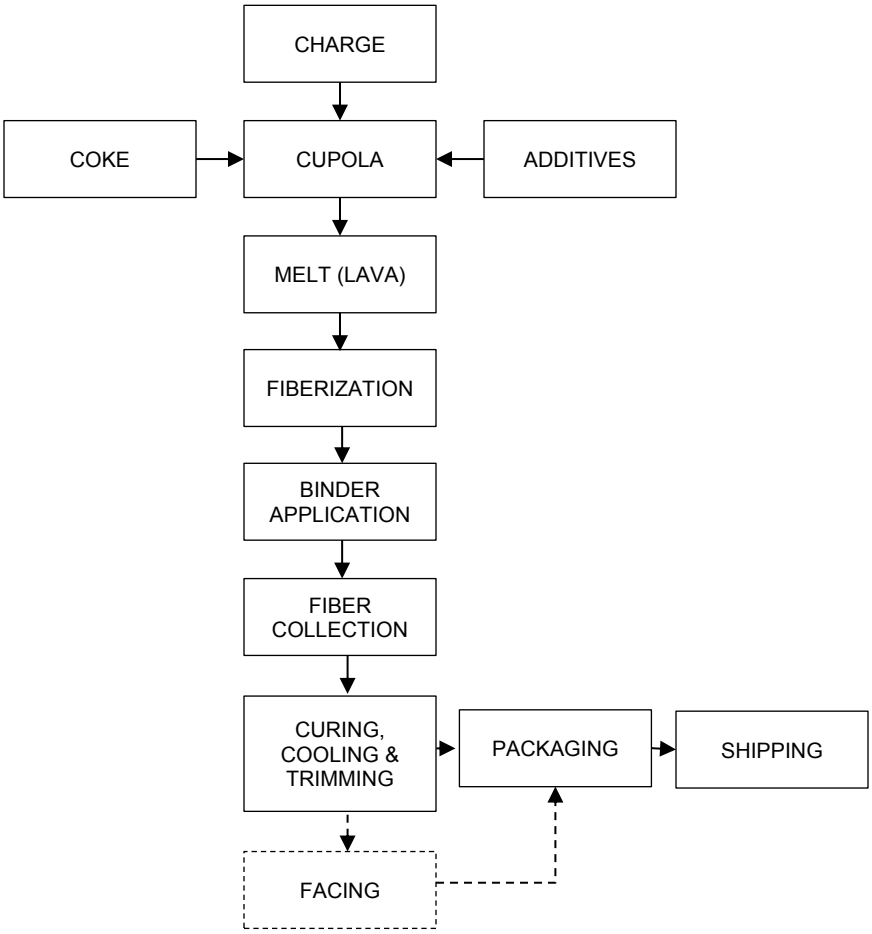


Figure 2. Process Flow Diagram for Manufacturing of Mineral Wool Insulation

The diagram above for Thermafiber® FF Mineral Wool Insulation is representative of the processes used by the manufacturing facilities. Although minor differences exist due to the availability of specific suppliers for materials, there are no significant process differences among manufacturing locations.

1.9. Packaging

Thermafiber® FF Mineral Wool Insulation products are packaged using LDPE (low-density polyethylene) film in the form of bags or plastic film. Regional disposal scenarios for the U.S. were used as a default assumption for the packaging waste generated during installation. Disposal rates used by material type and waste treatment method are shown in the table below.

Country/Region	Material Type	Recycling Rate	Landfill Rate	Incineration Rate
United States	Plastics	15%	68%	17%
	Metals	57%	34%	9%
	Pulp (cardboard, paper)	75%	20%	5%

1.10. Transportation

The product outbound transportation from manufacturing facility is by diesel-truck. The average distances from the Wabash and Joplin manufacturing facilities to construction site for Thermafiber® FF Mineral Wool Insulation are 1,007 mi (1,620 km) and 1,044 mi (1,680 km), respectively.

1.11. Product Installation



Thermafiber® FF Mineral Wool Insulation products are made for easy handling, fabrication and installation. As a semi-rigid product that is easy to cut and install, its flexibility allows it to conform to building shapes and construction irregularities. It comes in standard-sized sheets and is easily cut with a serrated knife. Custom sizes are available upon request.

The boards and batts can be friction fitted in between studs with the ends of each piece butted closely together to fill all voids.

Rainscreen and cavity wall systems vary greatly from types of hangers and how they are installed. Generally, mineral wool insulation is installed with abutted joints and mechanically secured and attached to the building substrate.

Mineral wool can also be mechanically attached depending on the application.

1.12. Use

Due to its nature, Thermafiber® FF Mineral Wool Insulation is a passive device requiring no utilities or maintenance over its useful life. Provided the mineral wool is used as intended, during the use phase, reductions in a building's energy consumption do occur; however, the energy savings from the use of thermal insulation have not been included within the system boundaries.

1.13. Reference Service Life and Estimated Building Service Life

The product is assumed to remain in service for the life of the building, 75 years.

1.14. Reuse, Recycling, and Energy Recovery

Thermafiber® FF Mineral Wool Insulation may be reused; however, no formal recycling programs currently exist for mineral wool insulation.

1.15. Disposal

The End of Life stage modeled for mineral wool insulation consisted of the transportation by tractor-trailer truck of the insulation for an assumed distance of 100 miles (161 km) to a landfill and the subsequent disposal of the used insulation in the landfill.

2. Life Cycle Assessment Background Information

2.1. Function and Functional Unit

The functional unit is 1 m^2 of insulation material with a thickness that gives an average thermal resistance R_{SI} = 1 m^2K/W and with a building service life of 75 years. Faced Thermafiber® FF Mineral Wool Insulation additionally has 1 m^2 of a facing, which is applied to the top surface of the insulation material. For this study, the declared unit amount of the facing is 1 m^2, and the amount of the declared unit required for the functional unit is 1 m^2.

Table 1. Functional Unit Properties of Thermafiber® FF Mineral Wool Insulation

Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), Wabash	
Functional unit	1 m² of insulation material with a thickness that gives an average thermal resistance R_{SI} = 1 m²K/W
Mass of Functional unit	1.67E+00 kg
Thickness to achieve Functional unit	3.47E-02 m
Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5pcf | 40 kg/m³), Joplin	
Functional unit	1 m² of insulation material with a thickness that gives an average thermal resistance R_{SI} = 1 m²K/W
Mass of Functional unit	1.23E+00 kg
Thickness to achieve Functional unit	3.07E-02 m

Table 2. Declared Unit Properties of Facing for Faced Thermafiber® FF Mineral Wool Insulation

Facing	Mass of Declared unit (1 m^2)	Description
3035/PE 2.0	1.37E-01 kg	Perforated Foil Scrim (2x3) Kraft
30J	1.42E-01 kg	White All Service Jacket (ASJ)
3114B	6.84E-02 kg	Black Nonwoven Glass Fiber Mat
5225T	5.37E-02 kg	Plain Foil Scrim (2x2) Polyethylene
5225T Printed	5.37E-02 kg	Printed Foil Scrim (2x2) Polyethylene
5225T-White	5.81E-02 kg	Plain White Foil Scrim (2x2) Polyethylene
5229	9.28E-02 kg	Plain Foil Scrim (1.8x1.8) Polyethylene
5229 Printed	9.28E-02 kg	Printed Foil Scrim (1.8x1.8) Polyethylene
5263 Printed 5x5	6.35E-02 kg	Printed Foil Scrim (5x5) Polyethylene
7503	7.08E-02 kg	White Nonwoven Glass Fiber Mat
G/47499	3.76E-02 kg	Black Nonwoven Polyester Fiber Mat
VL6307	6.20E-02 kg	Black Nonwoven Glass Fiber Mat
WMP-VR	8.30E-02 kg	White Polypropylene Scrim Kraft

2.2. System Boundary

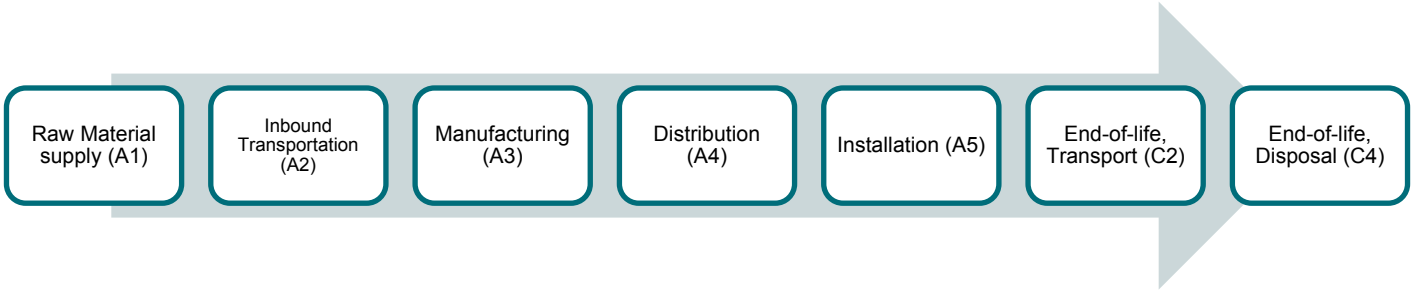


Figure 3. System Boundary of Thermafiber® FF Mineral Wool Insulation

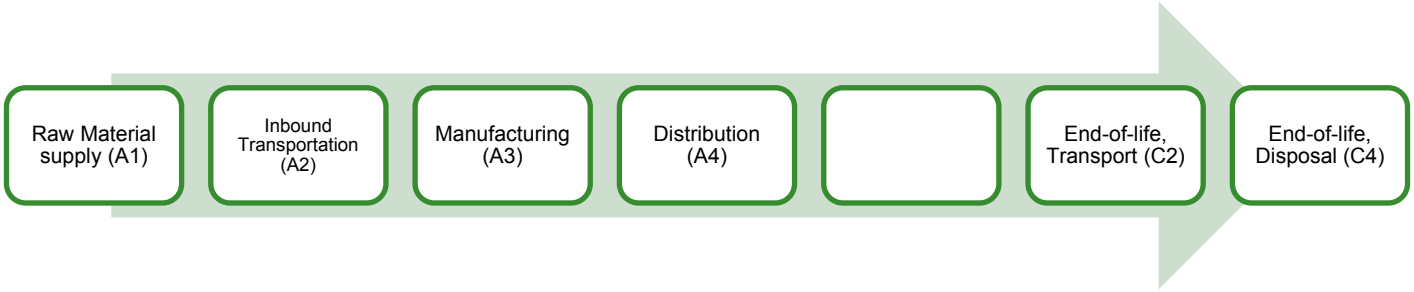


Figure 4. System Boundary of Facing for Faced Thermafiber® FF Mineral Wool Insulation

The system boundaries for this study include inputs and outputs for the following life cycle stages for mineral wool insulation:

- **Raw Material supply (A1)** – applicable to Thermafiber® FF Mineral Wool Insulation and Facing
  - extraction of resources and production of raw materials
  - collection and processing of recycled materials
  - extraction of resources and production of packaging materials for finished goods
- **Inbound Transportation (A2)** – applicable to Thermafiber® FF Mineral Wool Insulation and Facing
  - transportation of all input materials to manufacturing facilities
- **Manufacturing (A3)** – applicable to Thermafiber® FF Mineral Wool Insulation and Facing
  - electricity and water use and combustion of natural gas and coke (consumption and associated emissions)
  - transportation of fuels and consumable materials used in manufacturing
  - transportation of waste materials for recycling externally
  - transportation of waste-to-landfill waste to landfill as well as disposal in landfill
  - air emissions from fiber collection as well as from curing, cooling, cutting and trimming bonded mineral wool insulation including other releases to environmental media
- **Distribution (A4)** – applicable to Thermafiber® FF Mineral Wool Insulation and Facing
  - transportation from manufacturing facilities to distribution centers
  - transportation from distribution centers to construction site
- **Installation (A5)** – applicable to Thermafiber® FF Mineral Wool Insulation
  - transportation and disposal of packaging waste
- **End-of-life, Transport (C2)** – applicable to Thermafiber® FF Mineral Wool Insulation and Facing
  - transportation from building deconstruction site to landfill
- **End-of-life, Disposal (C4)** – applicable to Thermafiber® FF Mineral Wool Insulation and Facing
  - disposal in landfill

2.3. Estimates and Assumptions

Thermafiber® FF Mineral Wool Insulation is a passive device requiring no utilities or maintenance over its useful life; it is assumed that the product remains in service for the 75-year reference service.

2.4. Cut-off Criteria

Per section 2.9 of the governing PCR, the procedure detailed in ISO 21930, section 7.1.8 was followed regarding the exclusion of inputs and outputs. For energy, mass and environmental impacts, the cut-off criteria were 1% per the standard. Per the standard "the total of neglected input flows per module shall be a maximum of 5% of energy usage, mass and environmental impacts." Flows excluded for this study include infrastructure, capital goods and workforce burdens. Inputs and outputs associated with infrastructure (construction, maintenance and demolition of buildings/plants, road surfaces, transport equipment, etc.) are not included. This choice is based on experience from previous LCAs where the contribution from these items was negligible due to the long lifetime of the equipment compared to the high production volume of material during that lifetime.

2.5. Data Sources

Primary data was collected from the locations listed in the Manufacturing section. Life cycle modeling and calculation of potential environmental impacts were conducted using the LCA software SimaPro 9, version 9.1, developed by PRé Consultants bv. The LCI database used for secondary data was the ecoinvent 3.6 database, provided with the Developer version of the software. In situations where LCI databases did not contain life cycle inventory data for certain specific materials or processes used in either the manufacturing of precursor, input raw materials or the manufacturing of the mineral wool insulation itself, LCI data for a similar material or process was used as a substitute. In order to determine the most representative substitute, preliminary analyses were conducted.

2.6. Data Quality

To determine how representative the data used to model the life cycle of Owens Corning® Thermafiber® FF Mineral Wool Insulation manufactured in 2020 is, the temporal, geographical and technological aspects of the data were assessed. For the Owens Corning facilities analyzed in the underlying LCA study, the data used adequately represents the technology used in 2020 in the United States.

2.7. Period under Review

For the manufacturing facilities considered in the LCA, Owens Corning primary data was collected for the 2020 calendar year.

2.8. Allocation

The products studied in this analysis are all members of the Thermafiber® FF Mineral Wool Insulation product family. Plants reported the total amount of Thermafiber® FF Mineral Wool Insulation produced as well as the amount produced of each individual product. In general, the characteristics that differentiate one product from another within the family are its density, form and the use and type of a binder. Particular product application can be considered another differentiating characteristic; however, these three attributes are the main physical properties that distinguish one product from another.

Exceptions to this are Faced Thermafiber® FF Mineral Wool Insulation. For these products, it was possible to avoid additional allocation by treating the facing materials as separate modular processes, the LCIs of which were analyzed separately. Aside from those mentioned, no other allocation modeling considerations were necessary.

3. Life Cycle Assessment Scenarios

Table 3. Transport to the building site (A4)

	Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), WABASH (1 m², R_{SI}=1)	Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), JOPLIN (1 m², R_{SI}=1)	
Fuel type	diesel, low-sulfur	diesel, low-sulfur	
Liters of fuel	7.26E-03	5.35E-03	l/100km
Vehicle type	Transport, freight, lorry 16-32 metric ton, EURO3	Transport, freight, lorry 16-32 metric ton, EURO3	
Transport distance	1.62E+03	1.68E+03	km
Capacity utilization (including empty runs, mass based)‡	63%	63%	%
Gross density of products transported	4.81E+01	4.00E+01	kg/m³
Weight of products transported (if gross density not reported)	1.67E+00	1.23E+00	kg
Volume of products transported (if gross density not reported)	3.47E-02	3.07E-02	m³
Capacity utilization volume factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaging products)	1	1	-

‡ EcoTransIT. World. Ecological Transport Information Tool for Worldwide Transports Methodology and Data - Update 4th December 2014. (https://www.ecotransit.org/download/EcoTransIT_World_Methodology_Report_2014-12-04.pdf)

Table 4. Transport to the building site (A4) for Facing, 1 m²

	3035 /PE 2.0	30J	3114B	5225T	5225T-Printed	5225T-White	5229	5229 Printed	5263 Printed 5x5	7503	G/47499	VL6307	WMP-VR
Fuel type	diesel, low-sulfur												
Liters of fuel (l/100km)	5.96E-04	6.18E-04	2.97E-04	2.34E-04	2.34E-04	2.53E-04	4.04E-04	4.04E-04	2.76E-04	3.08E-04	1.64E-04	2.70E-04	3.61E-04
Vehicle type	Transport, freight, lorry 16-32 metric ton, EURO3												
Transport distance (km)	1.68E+03	1.68E+03	1.68E+03	1.68E+03	1.68E+03	1.68E+03	1.68E+03	1.68E+03	1.68E+03	1.68E+03	1.68E+03	1.68E+03	1.68E+03
Capacity utilization (including empty runs, mass based)‡	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%	63%
Gross density of products transported (kg/m³)	5.98E+02	6.19E+02	1.42E+02	3.58E+02	3.58E+02	3.81E+02	6.09E+02	6.09E+02	3.25E+02	1.11E+02	1.64E+02	9.97E+01	4.08E+02
Weight of products transported (if gross density not reported) (kg)	1.37E-01	1.42E-01	6.84E-02	5.37E-02	5.37E-02	5.81E-02	9.28E-02	9.28E-02	6.35E-02	7.08E-02	3.76E-02	6.20E-02	8.30E-02
Volume of products transported (if gross density not reported) (m³)	2.29E-04	2.29E-04	4.83E-04	1.50E-04	1.50E-04	1.52E-04	1.52E-04	1.52E-04	1.96E-04	6.35E-04	2.29E-04	6.22E-04	2.03E-04
Capacity utilization volume factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaging products)	1	1	1	1	1	1	1	1	1	1	1	1	1

‡ EcoTransIT. World. Ecological Transport Information Tool for Worldwide Transports Methodology and Data - Update 4th December 2014. (https://www.ecotransit.org/download/EcoTransIT_World_Methodology_Report_2014-12-04.pdf)

Table 5. Installation into the building (A5)

	Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), WABASH (1 m², R_{SI}=1)	Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), JOPLIN (1 m², R_{SI}=1)	
Ancillary materials	0.00E+00	0.00E+00	kg
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	0.00E+00	0.00E+00	m^3
Other resources	0.00E+00	0.00E+00	kg
Electricity consumption	0.00E+00	0.00E+00	kWh
Other energy carriers	0.00E+00	0.00E+00	MJ
Product loss per functional unit	0.00E+00	0.00E+00	kg
Waste materials at the construction site before waste processing, generated by product installation	1.04E-02	1.37E-02	kg
Output materials resulting from on-site waste processing (specified by route; e.g. for recycling, energy recovery and/or disposal)	0.00E+00	0.00E+00	kg
Biogenic carbon contained in packaging	0.00E+00	0.00E+00	kg CO_2
Direct emissions to ambient air, soil and water	0.00E+00	0.00E+00	kg
VOC content‡	0.00E+00	0.00E+00	µg/m^3

‡ VOC content determined in accordance to "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers - version 1.2." CA Specification 01350.

Table 6. Reference Service Life

RSL	75 years
Declared product properties (at the gate) and finishes, etc.	Not applicable (Insulation properties require installation into a building.)
Design application parameters (if instructed by the manufacturer), including references to the appropriate practices and application codes)	Install per instructions
An assumed quality of work, when installed in accordance with the manufacturer's instructions	Will meet R-value (Installer should install per manufacturer instructions)
Outdoor environment, (if relevant for outdoor applications), e.g. weathering, pollutants, UV and wind exposure, building orientation, shading, temperature	Not applicable (Indoor or covered in outdoor applications)
Indoor environment, (if relevant for indoor applications), e.g. temperature, moisture, chemical exposure)	Product should be kept dry
Use conditions, e.g. frequency of use, mechanical exposure.	Not applicable (Insulation is a passive product which is not used directly during life)
Maintenance, e.g. required frequency, type and quality of replacement components	None needed (Insulation does not need maintenance during its use)

Table 7. End-of-life, Transport (C2)

		Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m^3), WABASH (1 m^2, R_{SI}=1)	Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m^3), JOPLIN (1 m^2, R_{SI}=1)	Facing (1 m^2)	
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation)	Although reuse and recycling of mineral wool insulation at its end of life is possible, there are no formal programs for collection and transport. It is assumed that all product is sent to landfill at end of life.				
Collection process (specified by type)	Collected separately	0.00E+00	0.00E+00	[0.00E+00]	kg
	Collected with mixed construction waste	1.67E+00	1.23E+00	[‡]	kg
Recovery (specified by type)	Reuse	0.00E+00	0.00E+00	[0.00E+00]	kg
	Recycling	0.00E+00	0.00E+00	[0.00E+00]	kg
	Landfill	0.00E+00	0.00E+00	[0.00E+00]	kg
	Incineration	0.00E+00	0.00E+00	[0.00E+00]	kg
	Incineration with energy recovery	0.00E+00	0.00E+00	[0.00E+00]	kg
	Energy conversion efficiency rate	0.00E+00	0.00E+00	[0.00E+00]	
Disposal (specified by type)	Product or material for final deposition	0.00E+00	0.00E+00	[0.00E+00]	kg
Removals of biogenic carbon (excluding packaging)		0.00E+00	0.00E+00	[0.00E+00]	kg CO_2

‡ Value [kg] for Facing (1 m^2) can be found in **Table 4** in row values for "Weight of products transported"

Table 8. End-of-life, Disposal (C4)

		Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), WABASH (1 m², R_{SI}-1)	Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), JOPLIN (1 m², R_{SI}-1)	Facing (1 m²)	
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation)	Although reuse and recycling of mineral wool insulation at its end of life is possible, there are no formal programs for collection and transport. It is assumed that all product is sent to landfill at end of life.				
Collection process (specified by type)	Collected separately	0.00E+00	0.00E+00	[0.00E+00]	kg
	Collected with mixed construction waste	0.00E+00	0.00E+00	[0.00E+00]	kg
Recovery (specified by type)	Reuse	0.00E+00	0.00E+00	[0.00E+00]	kg
	Recycling	0.00E+00	0.00E+00	[0.00E+00]	kg
	Landfill	0.00E+00	0.00E+00	[0.00E+00]	kg
	Incineration	0.00E+00	0.00E+00	[0.00E+00]	kg
	Incineration with energy recovery	0.00E+00	0.00E+00	[0.00E+00]	kg
	Energy conversion efficiency rate	0.00E+00	0.00E+00	[0.00E+00]	
Disposal (specified by type)	Product or material for final deposition	1.67E+00	1.23E+00	[‡]	kg
Removals of biogenic carbon (excluding packaging)		0.00E+00	0.00E+00	[0.00E+00]	kg CO_2

‡ Value [kg] for Facing (1 m²) can be found in **Table 4** in row values for "Weight of products transported"

4. Life Cycle Assessment Results

Table 9. Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY	
	A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**	
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential	Reference Service Life
Thermafiber® FF Mineral Wool Insulation (1 m^2, R_{SI}-1)	x	x	x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	x	MND	x	MND	75 years
Facing for Faced Thermafiber® FF Mineral Wool Insulation (1 m^2)	x	x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	x	MND	x	MND	75 years
EPD Type: Cradle to installation with end of life	Required					Optional (Based on scenarios)							Required					Required

4.1. Life Cycle Impact Assessment Results

Table 10 LCIA Results for North America (TRACI) for Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), WABASH, (1 m², R_{SI}=1)

TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4	A1-C4
GWP 100 [kg CO2 eq]	2.03E+00	3.76E-01	1.27E-03	MND	MND	3.74E-02	MND	4.12E-03	2.45E+00
ODP [kg CFC-11 eq]	1.71E-07	9.10E-08	6.38E-11	MND	MND	9.06E-09	MND	9.26E-10	2.72E-07
AP [kg SO2 eq]	1.98E-02	2.34E-03	2.15E-06	MND	MND	2.33E-04	MND	3.97E-05	2.24E-02
EP [kg N eq]	1.47E-03	2.44E-04	5.19E-07	MND	MND	2.43E-05	MND	3.44E-06	1.75E-03
POCP [kg O3 eq]	1.17E-01	6.80E-02	5.57E-05	MND	MND	6.76E-03	MND	1.20E-03	1.93E-01
ADP_{fossil} [MJ, LHV]	1.61E+00	8.06E-01	5.65E-04	MND	MND	8.02E-02	MND	8.24E-03	2.51E+00

[GWP 100 - Global Warming Potential]; [ODP - Ozone Depletion Potential]; [AP - Acidification Potential]; [EP - Eutrophication Potential]; [POCP - Smog Formation Potential]; [ADP_{fossil} - Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources]

Table 11 LCIA Results for North America (TRACI) for Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), JOPLIN (1 m², R_{SI}=1)

TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4	A1-C4
GWP 100 [kg CO2 eq]	1.03E+00	2.88E-01	3.58E-03	MND	MND	2.76E-02	MND	3.04E-03	1.35E+00
ODP [kg CFC-11 eq]	1.32E-07	6.98E-08	1.73E-10	MND	MND	6.68E-09	MND	6.83E-10	2.10E-07
AP [kg SO2 eq]	4.69E-03	1.79E-03	5.87E-06	MND	MND	1.72E-04	MND	2.93E-05	6.69E-03
EP [kg N eq]	1.47E-03	1.87E-04	1.29E-06	MND	MND	1.79E-05	MND	2.54E-06	1.68E-03
POCP [kg O3 eq]	7.36E-02	5.21E-02	1.55E-04	MND	MND	4.99E-03	MND	8.86E-04	1.32E-01
ADP_{fossil} [MJ, LHV]	1.55E+00	6.17E-01	1.53E-03	MND	MND	5.91E-02	MND	6.08E-03	2.23E+00

[GWP 100 - Global Warming Potential]; [ODP - Ozone Depletion Potential]; [AP - Acidification Potential]; [EP - Eutrophication Potential]; [POCP - Smog Formation Potential]; [ADP_{fossil} - Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources]

Table 12 LCIA Results for North America (TRACI) for Facing (1 m²), Cradle-to-Grave (A1-C4)

	GWP 100 [kg CO2 eq]	ODP [kg CFC-11 eq]	AP [kg SO2 eq]	EP [kg N eq]	POCP [kg O3 eq]	ADP_{fossil} [MJ, LHV]
Facing (1 m²)	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4
5225T-White	4.67E-01	2.81E-08	2.65E-03	2.21E-04	3.45-02	4.07E-01
5225T Printed	4.52E-01	2.70E-08	2.58E-03	2.14E-04	3.36E-02	3.75E-01
5263 Printed 5x5	4.84E-01	2.90E-08	2.71E-03	2.28E-04	3.58E-02	4.89E-01
30J	6.26E-01	4.54E-08	3.55E-03	3.71E-03	5.11E-02	6.62E-01
WMP-VR	1.75E-01	1.83E-08	1.02E-03	1.51E-04	1.81E-02	3.22E-01
3114B	1.76E-01	1.72E-08	1.11E-03	8.94E-05	1.85E-02	2.86E-01
7503	1.85E-01	1.78E-08	1.18E-03	9.30E-05	1.96E-02	2.92E-01
G/47499	1.18E-01	1.31E-08	4.90E-04	1.25E-04	7.95E-03	3.00E-01
3035/PE 2.0	6.44E-01	3.41E-08	2.77E-03	1.27E-03	3.94E-02	4.67E-01
5225T	5.59E-01	5.30E-08	3.24E-03	2.84E-04	5.30E-02	6.06E-01
5229	9.58E-01	5.16E-08	5.36E-03	4.18E-04	6.72E-02	8.06E-01
5229 Printed	9.58E-01	5.16E-08	5.36E-03	4.18E-04	6.72E-02	8.06E-01
VL6307	1.61E-01	1.59E-08	1.01E-03	8.18E-05	1.70E-02	2.62E-01

[GWP 100 - Global Warming Potential]; [ODP - Ozone Depletion Potential]; [AP - Acidification Potential]; [EP - Eutrophication Potential]; [POCP - Smog Formation Potential]; [ADP_{fossil} - Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources]

Results by life cycle module, the aggregate of which are shown in **Table 12**, can be found in **Appendix B.**

4.2. Life Cycle Inventory Results

Table 13 Resource Use for Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), WABASH (1 m², R_{SI}=1)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4	A1-C4
RPRE [MJ, LHV]	2.71E+00	6.53E-03	5.42E-06	MND	MND	6.50E-04	MND	2.12E-04	2.72E+00
RPRM [MJ, LHV]	1.63E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	1.63E+00
NRPRE [MJ, LHV]	2.49E+01	5.71E+00	4.01E-03	MND	MND	5.68E-01	MND	5.96E-02	3.12E+01
NRPRM [MJ, LHV]	5.55E-01	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	5.55E-01
SM [kg]	2.12E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	2.12E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
FW [m³]	9.32E-03	1.25E-04	1.65E-07	MND	MND	1.24E-05	MND	1.14E-06	9.46E-03

[RPRE - Renewable primary energy used as energy carrier (fuel)]; [RPRM - Renewable primary resources with energy content used as material]; [NRPRE - Non-renewable primary resources used as an energy carrier (fuel)]; [NRPRM - Non-renewable primary resources with energy content used as material]; [SM - Secondary materials]; [RSF - Renewable secondary fuels]; [NRSF - Non-renewable secondary fuels]; [RE - Recovered energy]; [FW - Use of net fresh water resources]

Table 14 Resource Use for Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), JOPLIN (1 m², R_{SI}=1)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4	A1-C4
RPRE [MJ, LHV]	3.17E+00	5.01E-03	1.50E-05	MND	MND	4.80E-04	MND	1.56E-04	3.17E+00
RPRM [MJ, LHV]	1.43E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	1.43E+00
NRPRE [MJ, LHV]	2.10E+01	4.38E+00	1.09E-02	MND	MND	4.19E-01	MND	4.39E-02	2.59E+01
NRPRM [MJ, LHV]	5.02E-01	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	5.02E-01
SM [kg]	1.27E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	1.27E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
FW [m³]	6.14E-03	9.55E-05	4.32E-07	MND	MND	9.15E-06	MND	8.43E-07	6.24E-03

[RPRE - Renewable primary energy used as energy carrier (fuel)]; [RPRM - Renewable primary resources with energy content used as material]; [NRPRE - Non-renewable primary resources used as an energy carrier (fuel)]; [NRPRM - Non-renewable primary resources with energy content used as material]; [SM - Secondary materials]; [RSF - Renewable secondary fuels]; [NRSF - Non-renewable secondary fuels]; [RE - Recovered energy]; [FW - Use of net fresh water resources]

Table 15 Resource Use for Facing (1 m²), Cradle-to-Grave (A1-C4)

	RPRE [MJ, LHV]	RPRM [MJ, LHV]	NRPRE [MJ, LHV]	NRPRM [MJ, LHV]	SM [kg]	RSF [MJ, LHV]	NRSF [MJ, LHV]	RE [MJ, LHV]	FW [m³]
Facing	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4
3035/PE 2.0	2.54E+00	1.73E+00	1.02E+01	4.82E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.48E-03
30J	5.59E+00	2.59E+00	7.92E+00	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.77E-03
3114B	1.03E-01	0.00E+00	2.71E+00	9.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-03
5225T	4.58E-01	0.00E+00	6.95E+00	5.18E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.87E-03
5225T Printed	4.26E-01	0.00E+00	5.23E+00	5.18E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.84E-03
5225T-White	4.33E-01	0.00E+00	5.59E+00	6.56E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.97E-03
5229	9.12E-01	0.00E+00	1.16E+01	2.10E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.23E-03
5229 Printed	9.12E-01	0.00E+00	1.16E+01	2.10E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.23E-03
5263 Printed 5x5	4.57E-01	0.00E+00	6.25E+00	1.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.36E-03
7503	1.10E-01	0.00E+00	2.79E+00	7.82E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-03
G/47499	7.31E-02	3.75E-01	2.47E+00	1.81E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.73E-03
VL6307	9.37E-02	0.00E+00	2.48E+00	8.56E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.25E-03
WMP-VR	2.05E+00	1.73E+00	2.96E+00	1.07E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E-03

[RPRE - Renewable primary energy used as energy carrier (fuel)]; [RPRM - Renewable primary resources with energy content used as material]; [NRPRE - Non-renewable primary resources used as an energy carrier (fuel)]; [NRPRM - Non-renewable primary resources with energy content used as material]; [SM - Secondary materials]; [RSF - Renewable secondary fuels]; [NRSF - Non-renewable secondary fuels]; [RE - Recovered energy]; [FW - Use of net fresh water resources]

Results by life cycle module, the aggregate of which are shown in **Table 15**, can be found in **Appendix** .

Table 16 Output Flows and Waste Categories for Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), WABASH (1 m², R_{SI}=1)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4	A1-C4
HWD [kg]	8.84E-05	1.45E-05	1.02E-08	MND	MND	1.44E-06	MND	1.41E-07	1.05E-04
NHWD [kg]	1.97E+00	1.39E-03	1.44E-02	MND	MND	1.38E-04	MND	3.33E+00	5.32E+00
HLRW [kg] or [m³]	8.42E-06	2.39E-08	2.04E-11	MND	MND	2.38E-09	MND	5.48E-10	8.45E-06
ILLRW [kg] or [m³]	5.63E-05	3.81E-05	2.66E-08	MND	MND	3.79E-06	MND	3.88E-07	9.87E-05
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
MR [kg]	7.44E-01	0.00E+00	7.19E-03	MND	MND	0.00E+00	MND	0.00E+00	7.51E-01
MER [kg]	0.00E+00	0.00E+00	6.41E-04	MND	MND	0.00E+00	MND	0.00E+00	6.41E-04
EE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00

[HWD - Hazardous waste disposed]; [NHWD - Non-hazardous waste disposed]; [HLRW - High-level radioactive waste, conditioned, to final repository]; [ILLRW - Intermediate- and low-level radioactive waste, conditioned, to final repository]; [CRU - Components for re-use]; [MR - Materials for recycling]; [MER - Materials for energy recovery]; [EE - Exported energy];

Table 17 Output Flows and Waste Categories for Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), JOPLIN (1 m², R_{SI}-1)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4	A1-C4
HWD [kg]	1.23E-05	1.11E-05	2.79E-08	MND	MND	1.07E-06	MND	1.04E-07	2.46E-05
NHWD [kg]	1.76E+00	1.06E-03	4.04E-02	MND	MND	1.02E-04	MND	2.46E+00	4.26E+00
HLRW [kg] or [m³]	1.57E-06	1.83E-08	5.66E-11	MND	MND	1.75E-09	MND	4.04E-10	1.59E-06
ILLRW [kg] or [m³]	2.45E-05	2.92E-05	7.22E-08	MND	MND	2.80E-06	MND	2.87E-07	5.69E-05
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
MR [kg]	3.55E-01	0.00E+00	7.85E-03	MND	MND	0.00E+00	MND	0.00E+00	3.63E-01
MER [kg]	0.00E+00	0.00E+00	1.16E-03	MND	MND	0.00E+00	MND	0.00E+00	1.16E-03
EE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00

[HWD - Hazardous waste disposed]; [NHWD - Non-hazardous waste disposed]; [HLRW - High-level radioactive waste, conditioned, to final repository]; [ILLRW - Intermediate- and low-level radioactive waste, conditioned, to final repository]; [CRU - Components for re-use]; [MR - Materials for recycling]; [MER - Materials for energy recovery]; [EE - Exported energy];

Table 18 Output Flows and Waste Categories for Facing (1 m²), Cradle-to-Grave (A1-C4)

	HWD [kg]	NHWD [kg]	HLRW [kg] or [m3]	ILLRW [kg] or [m3]	CRU [kg]	MR [kg]	MER [kg]	EE [MJ, LHV]
Facing	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4
3035/PE 2.0	8.73E-05	3.43E-01	1.44E-06	1.54E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30J	8.80E-05	3.55E-01	1.24E-06	1.44E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3114B	3.01E-06	1.49E-01	5.88E-07	5.79E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5225T	8.93E-05	1.73E-01	7.31E-07	1.90E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5225T Printed	8.52E-05	1.73E-01	7.24E-07	8.10E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5225T-White	8.53E-05	1.84E-01	7.52E-07	8.48E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5229	1.98E-04	3.30E-01	1.39E-06	1.61E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5229 Printed	1.98E-04	3.30E-01	1.39E-06	1.61E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5263 Printed 5x5	8.54E-05	1.93E-01	8.47E-07	9.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7503	3.18E-06	1.54E-01	6.24E-07	5.91E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
G/47499	1.10E-06	7.79E-02	2.34E-07	2.83E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VL6307	2.77E-06	1.35E-01	5.33E-07	5.37E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
WMP-VR	2.84E-06	1.74E-01	5.71E-07	6.63E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[HWD - Hazardous waste disposed]; [NHWD - Non-hazardous waste disposed]; [HLRW - High-level radioactive waste, conditioned, to final repository]; [ILLRW - Intermediate- and low-level radioactive waste, conditioned, to final repository]; [CRU - Components for re-use]; [MR - Materials for recycling]; [MER - Materials for energy recovery]; [EE - Exported energy];

Results by life cycle module, the aggregate of which are shown in Table 18, can be found in Appendix D.

Table 19 Carbon Emissions and Removals for Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), WABASH (1 m², R_{SI}=1)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4	A1-C4
BCRP [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00

[BCRP - Biogenic Carbon Removal from Product]; [BCEP - Biogenic Carbon Emission from Product]; [BCRK - Biogenic Carbon Removal from Packaging]; [BCEK - Biogenic Carbon Emission from Packaging]; [BCEW - Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes]; [CCE - Calcination Carbon Emissions]; [CCR - Carbonation Carbon Removals]; [CWNR - Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes]

Table 20 Carbon Emissions and Removals for Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m³), JOPLIN (1 m², R_{SI}=1)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4	A1-C4
BCRP [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	0.00E+00	MND	MND	0.00E+00	MND	0.00E+00	0.00E+00

[BCRP - Biogenic Carbon Removal from Product]; [BCEP - Biogenic Carbon Emission from Product]; [BCRK - Biogenic Carbon Removal from Packaging]; [BCEK - Biogenic Carbon Emission from Packaging]; [BCEW - Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes]; [CCE - Calcination Carbon Emissions]; [CCR - Carbonation Carbon Removals]; [CWNR - Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes]

Table 21 Carbon Emissions and Removals for Facing (1 m²), Cradle-to-Grave (A1-C4)

	BCRP [kg CO2]	BCEP [kg CO2]	BCRK [kg CO2]	BCEK [kg CO2]	BCEW [kg CO2]	CCE [kg CO2]	CCR [kg CO2]	CWNR [kg CO2]
Facing	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4	A1-C4
3035/PE 2.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
30J	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3114B	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5225T	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5225T Printed	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5225T-White	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5229	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5229 Printed	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5263 Printed 5x5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7503	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
G/47499	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VL6307	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
WMP-VR	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

[BCRP - Biogenic Carbon Removal from Product]; [BCEP - Biogenic Carbon Emission from Product]; [BCRK - Biogenic Carbon Removal from Packaging]; [BCEK - Biogenic Carbon Emission from Packaging]; [BCEW - Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes]; [CCE - Calcination Carbon Emissions]; [CCR - Carbonation Carbon Removals]; [CWNR - Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes]

Results by life cycle module, the aggregate of which are shown in **Table 21**, can be found in **Appendix E**.

4.3. Calculating Impact Category Results for Products with Specific Performance Properties

The environmental impact assessment results have been calculated for a reference mineral wool insulation product, SAFB™ FF (2.5 pounds per cubic foot | 40 kg/m^3 density version) for each manufacturing facility. These results, found in found in Table 10 and Table 11, are for the functional unit, which has a surface area of 1 m^2 and a thermal resistance of R_{SI} = 1 m^{2}K/W. In Imperial units, this thermal resistance, or R-value, is equivalent to 5.68 hr·ft$^{2\cdot}$·°F/BTU. Thermafiber® Mineral Insulation is manufactured in a variety of thicknesses and has a wide array of facing material options. In order to calculate impact values for Thermafiber® Mineral Wool Insulation having a specific thickness with or without a specific facing material, the following equation can be used:

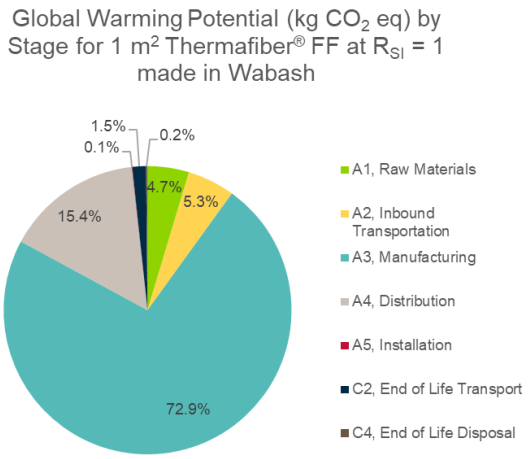
Impact = [Impact of Functional unit[a]] x [Product Scaling Factor[b]] + [Impact of Facing material[c]]

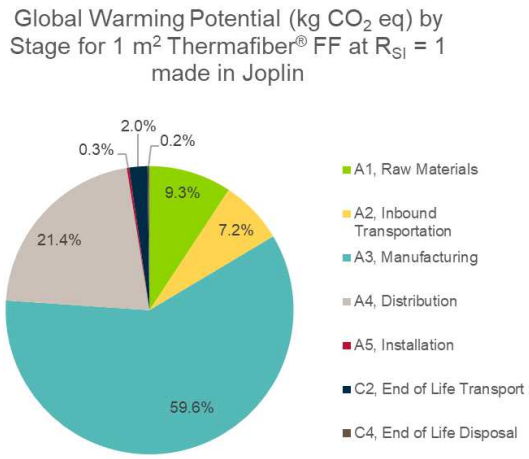
Notes:

a. Impact values can be found in **Table 10** and **Table 11**.
b. Scaling factors for each product and thickness can be found in **Appendix A**. Values for Wabash are found in **Table 25** through **Table 28,** while values for Joplin are found in
c. **Table** 29 through **Table 32**.
d. Impact values for 1 m^2 of various facing materials can be found in **Appendix B Table 33** through **Table 45**. If product is unfaced, the impact value is 0.

5. LCA Interpretation

The underlying LCA upon which this EPD is based considered the following six environmental impact categories: Global Warming Potential (GWP 100); Ozone Depletion Potential (ODP); Acidification Potential (AP); Eutrophication Potential (EP); Smog Formation Potential (POCP); and Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADP_{fossil}). The impact assessment results from both manufacturing facilities indicate that among the life cycle modules declared for Thermafiber® FF Mineral Wool Insulation, the *Manufacturing* (A3) life cycle module accounted for the majority of the potential environmental impact of each of these six impact categories.





Although the intended application of mineral wool is for building envelope thermal insulation, the affected reductions in a building's energy consumption when the mineral wool is used for this purpose were not included in the *Use* life cycle stage.

6. Additional Environmental Information

6.1. Environment and Health During Manufacturing

Owens Corning manufacturing facilities of Thermafiber® FF Mineral Wool Insulation maintain quality management systems.

6.2. Energy Savings During Use

Insulation is a passive device that requires no extra utilities to operate over its useful life. Insulation of a building is responsible for reducing the energy burden associated with heating and cooling of a building. The example below provides the net energy savings (energy saved minus life cycle energy of mineral wool insulation), as well as the carbon dioxide equivalent savings computed using the US EPA Greenhouse Gas Equivlancies Calculator[2].

Example Basis:

- A two-story 2400 square foot home located insulated with Thermafiber® FF insulations[3] to meet the 2015 International Energy Conservation Code for US locations and Ontario Building Code A3 Package 2017 for Toronto.

Table 22. Energy and Carbon Equivalent Savings from Use of WABASH FF Products in a Home

	Zone 2 OBC	Zone 1A	Zone 2A	Zone 3A	Zone 3C	Zone 4A	Zone 5B	Zone 5 A	Zone 6A	Zone 7
	Toronto	Miami	New Orleans	Atlanta	San Francisco	Baltimore	Seattle	Chicago	Minneapolis	Duluth
Heating and Cooling Energy Savings										
Total Life Cycle MJ for Thermafiber® FF Insulation Products Used in Home	113,702	48,732	55,867	77,989	77,989	86,479	86,479	86,479	109,381	109,381
Total Annual MJ Energy Saved for an Insulated vs. Non-insulated Home	167,754	4,220	17,936	51,698	77,019	97,065	92,845	122,386	174,084	213,121
Payback Time (months) for Heating and Cooling Energy Saved	8.1	138.6	37.4	18.1	12.2	10.7	11.2	8.5	7.5	6.2
MJ Saved over the 75 Year Use Phase of Building	12,467,839	267,784	1,289,329	3,799,341	5,698,441	7,193,407	6,876,890	9,092,507	12,946,935	15,874,715
Carbon Dioxide Equivalent Savings										
Total kg CO_2 eq for Thermafiber® FF Products Used in Home (Embodied Carbon)	8,214	3,520	4,036	5,634	5,634	6,247	6,247	6,247	7,902	7,902
Annual Savings kg CO_2 eq from heating and cooling (Operational Carbon)	29,937	754	3,175	9,253	13,789	17,327	16,601	21,863	31,116	38,102
Payback Time (months) for CO_2 eq. Saved	3.3	56.0	15.3	7.3	4.9	4.3	4.5	3.4	3.0	2.5
Annual Number of Passenger Vehicles Driven	7.2	0.2	0.8	2.2	3.3	4.2	4.0	5.2	7.5	9.1

[2] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

[3] If an FF version of a needed product was not available, the standard version was used in the calculation.

Table 23. Energy and Carbon Equivalent Savings from Use of JOPLIN FF Products in a Home

	Zone 2 OBC	Zone 1A	Zone 2A	Zone 3A	Zone 3C	Zone 4A	Zone 5B	Zone 5 A	Zone 6A	Zone 7
	Toronto	Miami	New Orleans	Atlanta	San Francisco	Baltimore	Seattle	Chicago	Minneapolis	Duluth
Heating and Cooling Energy Savings										
Total Life Cycle MJ for Thermafiber® FF Insulation Products Used in Home	101,007	44,863	51,690	68,303	68,303	75,721	75,721	75,721	95,308	95,308
Total Annual MJ Energy Saved for an Insulated vs. Non-insulated Home	167,754	4,220	17,936	51,698	77,019	97,065	92,845	122,386	174,084	213,121
Payback Time (months) for Heating and Cooling Energy Saved	7.2	127.6	34.6	15.9	10.6	9.4	9.8	7.4	6.6	5.4
MJ Saved over the 75 Year Use Phase of Building	12,480,534	271,653	1,293,507	3,809,027	5,708,128	7,204,164	6,887,647	9,103,264	12,961,008	15,888,788
Carbon Equivalent Savings										
Total kg CO2 eq for Thermafiber® FF Products Used in Home (Embodied Carbon)	4,691	2,083	2,400	3,172	3,172	3,517	3,517	3,517	4,426	4,426
Annual Savings kg CO2 eq from heating and cooling (Operational Carbon)	29,937	754	3,175	9,253	13,789	17,327	16,601	21,863	31,116	38,102
Payback Time (months) for CO2 eq. Saved	1.9	33.2	9.1	4.1	2.8	2.4	2.5	1.9	1.7	1.4
Annual Number of Passenger Vehicles Driven	7.2	0.2	0.8	2.2	3.3	4.2	4.0	5.2	7.5	9.1

6.3. Environment and Health During Installation

This product is considered an article. 29 CFR 1910.1200(c) definition of an article is as follows: "Article" means a manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical (as determined under paragraph (d) of this section), and does not pose a physical hazard or health risk to employees WHMIS Regulatory Status This product is considered an article per the Canadian Hazardous Products Regulation SOR/2015-17.

Manufactured articles which meet the definition of the Canadian Hazardous Products Act (any article that is formed to a specific shape or design during manufacture, the intended use of which when in that form is dependent in whole or in part on its shape or design, and that, when being installed, if the intended use of the article requires it to be installed, and under normal conditions of use, will not release or otherwise cause an individual to be exposed to a hazardous product) are not regulated by the Canadian Hazardous Products Regulation SOR/2015-17. The product's Safe Use Instruction Sheet includes exposure guidelines, engineering controls and individual potection measures.

6.4. Extraordinary Effects

No extraordinary effects or environmental impacts are expected due to destruction of the product by fire, water or mechanical means.

6.5. Delayed Emissions

No delayed emissions are expected from this product.

6.6. Environmental Activities and Certifications

Recycled Content

The material recycled content of Thermafiber® FF Mineral Wool Insulation has been verified by ICC-ES. The amounts and type of recycled content for Thermafiber® FF Mineral Wool Insulation products can be found in **Table 24** below.

Table 24 Thermafiber® Mineral Wool Insulation Material Recycled Content by Weight

Product Name	% Pre-Consumer Recycled Content		% Post-Consumer Recycled Content	%Total Recycled Content
	Standard Fiber	EPA Choice Fiber		
Thermafiber® SAFB™ FF Sound Control Insulation	70	N/A	0	70
Thermafiber® Safing™ FF Insulation	70	N/A	0	70
Thermafiber® FireSpan® 40 and 90 FF Curtain Wall Insulation	70	75	0	70 – 75[1]
Thermafiber® UltraBatt™ FF Exterior Wall Insulation	70	N/A	0	70

[1]The values represent the minimum and maximum range of available recycled content for the product. The actual recycled content amount for the product provided to the end user depends on the product formulation requested by the customer.

Formaldehyde-Free

UL validates claims that a product does not contain formaldehyde (or formaldehyde precursors). Products with UL Validated Formaldeyhdye-Free can be found in UL SPOT, and include the products covered by this EPD.

Product Optimization

The results of this EPD have been compared with the previous EPD for the product. Full results are available in the UL Optimization Summary for the product.

Due to the level of reduction documented, the product qualifies for **LEED v4** Building product disclosure and optimtization – environmental product declarations, Option 2. Multi-attribute optimization.

For **LEED v4.1** Environmental Product Declaration, Option 2. Embodied Carbon/LCA Optimization, the product is valued as 2 products due to 20%+ reduction in GWP and 5%+ reduction in two additional impact categories relative to baseline.

Made with Wind Energy and Reduced Carbon Footprint

Thermafiber® FF Mineral Wool Insulation products carry SCS Global Services certification for "Made with Wind Energy" and "Reduced Carbon Footprint". Impact category results when electricity used during manufacturing is matched with wind energy produced as part of Owens Corning's Power Purchase Agreement can be found in the tables below. Cradle-to-gate (A1 - A3) values shown are based on the results from this EPD, which reflect the 2020 production year and are based on NERC regional grid values from the ecoinvent 3.6 LCI database implemented in SimaPro. Dataset and other methodological differences introduce a degree of variability leading to the reduction values shown below to differ from those that appear on certificates which reflect recent production data from both facilities.

Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m^3), WABASH (1 m^2, R_{SI}-1)			
TRACI v2.1	A1 - A3 STANDARD PRODUCT	A1 - A3 CERTIFIED PRODUCT	% CHANGE
GWP 100 [kg CO2 eq]	1.33E+00	1.09E+00	-18%
ODP [kg CFC-11 eq]	1.19E-07	9.46E-08	-21%
AP [kg SO_2 eq]	1.26E-02	1.18E-02	-6%
EP [kg N eq]	5.93E-04	4.60E-04	-22%
POCP [kg O_3 eq]	7.44E-02	6.79E-02	-9%
ADP_{fossil} [MJ, LHV]	1.24E+00	1.09E+00	-12%

Thermafiber® Mineral Wool Insulation, SAFB™ FF (2.5 pcf | 40 kg/m^3), JOPLIN (1 m^2, R_{SI}-1)			
TRACI v2.1	A1 - A3 STANDARD PRODUCT	A1 - A3 CERTIFIED PRODUCT	% CHANGE
GWP 100 [kg CO2 eq]	2.03E+00	1.67E+00	-18%
ODP [kg CFC-11 eq]	1.71E-07	1.33E-07	-22%
AP [kg SO_2 eq]	1.98E-02	1.86E-02	-6%
EP [kg N eq]	1.47E-03	1.28E-03	-13%
POCP [kg O_3 eq]	1.17E-01	1.07E-01	-8%
ADP_{fossil} [MJ, LHV]	1.61E+00	1.39E+00	-14%

6.7. Further Information

Additional information may be found at www.owenscorning.com/thermafiber

7. References

Product Category Rules (PCR) Guidance for Building-Related Products and Services - Part B: Building Envelope Thermal Insulation EPD Requirements, UL 10010-1 Version 2.0, Second Edition, UL Environment, April 10, 2018.

Product Category Rules for Building Related Products and Services - Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010 Version 3.2, Fifth Edition, UL Environment, December 12, 2018.

ISO 14025:2006(E), Environmental labels and declarations -Type III environmental declarations -Principles and procedures

ISO 14040:2006(E), Environmental management - Life cycle assessment - Principles and framework

ISO 14044:2006(E), Environmental management - Life cycle assessment - Requirements and guidelines

BS EN 15804:2012, Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

ISO 21930:2017(E), Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services

PRé Consultants: SimaPro 9.1 LCA Software. 2021. The Netherlands.

ASTM C518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C665: Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

ASTM C612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation

ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E96, Standard Test Methods for Water Vapor Transmission Materials

ASTM C1104, Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation

ASTM C1338, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings

ASTM C356: Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat

Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers - version 1.2, CA Specification 01350, January 2017.

CCMC. Canadian Construction Materials Centre. nrc.canada.ca/en/certifications-evaluations-standards/canadian-construction-materials-centre

NFPA 101: Life Safety Code

CAN/ULC S702: Standard for Mineral Fibre Thermal Insulation for Buildings

CAN/ULC S102: Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies

CAN/ULC S129: Fire test for smoulder resistance of insulation

8. Appendices

8.1. Appendix A

The following tables provide scaling factors necessary to convert results from Table 10 and Table 11 to other available products and thicknesses as described in Section 4.3. For faced products, results from Table 12 need to be added to the scaled results. Product availability may vary by geography.

Table 25. Product Scaling Factors for LIGHT DENSITY products produced in WABASH (<5 in | 127 mm thickness)

Product	Scaling Factor for Functional Unit (1 m^2) at R_{SI} = 1	Scaling Factor Based on Product Thickness (inches | mm) for 1 m^2								
		1"	1.25"	1.5"	2"	2.5"	3"	3.5"	4"	4.5"
		25 mm	32 mm	38 mm	51 mm	64 mm	76 mm	89 mm	102 mm	114 mm
FireSpan® 40 FF	1.32	--	--	--	1.95	2.44	2.93	3.41	3.90	4.39
Safing FF (4 pcf)	1.32	0.98	--	1.46	1.95	2.44	2.93	3.41	3.90	4.39
SAFB™ FF (2.5 pcf)	1.00	--	--	1.10	1.46	1.83	2.19	2.56	2.93	3.29
SAFB™ FF (4 pcf)	0.99	0.73	--	--	--	--	--	--	--	--
UltraBatt™ FF R-10	1.32	--	--	--	--	2.44	--	--	--	--
UltraBatt™ FF R-15	1.32	--	--	--	--	--	--	3.41	--	--
UltraBatt™ FF R-23	1.32	--	--	--	--	--	--	--	--	--
UltraBatt™ FF R-24	0.99	--	--	--	--	--	--	--	--	--
UltraBatt™ FF R-30	1.32	--	--	--	--	--	--	--	--	--

Table 26. Product Scaling Factors for LIGHT DENSITY products produced in WABASH (≥5 in | 127 mm thickness)

Product	Scaling Factor for Functional Unit (1 m^2) at R_{SI} = 1	Scaling Factor Based on Product Thickness (inches | mm) for1 m^2					
		5"	5.5"	6"	6.5"	7"	7.1"
		127 mm	140 mm	152 mm	165 mm	179 mm	180 mm
FireSpan® 40 FF	1.32	4.88	5.37	5.85	6.34	6.83	--
Safing FF (4 pcf)	1.32	4.88	5.37	5.85	6.34	6.83	--
SAFB™ FF (2.5 pcf)	1.00	3.66	4.02	4.39	4.76	5.12	--
SAFB™ FF (4 pcf)	0.99	--	--	--	--	--	--
UltraBatt™ FF R-10	1.32	--	--	--	--	--	--
UltraBatt™ FF R-15	1.32	--	--	--	--	--	--
UltraBatt™ FF R-23	1.32	--	5.37	--	--	--	--
UltraBatt™ FF R-24	0.99	--	--	4.39	--	--	--
UltraBatt™ FF R-30	1.32	--	--	--	--	--	6.93

Table 27. Product Scaling Factors for HEAVY DENSITY products produced in WABASH (<5 in | 127 mm thickness)

Product	Scaling Factor for Functional Unit (1 m²) at R_{SI} = 1	Scaling Factor Based on Product Thickness (inches | mm) for 1 m²								
		1"	1.25"	1.5"	2"	2.5"	3"	3.5"	4"	4.5"
		25 mm	32 mm	38 mm	51 mm	64 mm	76 mm	89 mm	102 mm	114 mm
FireSpan® FF 90	2.11	1.59	--	2.38	3.17	3.96	4.76	5.55	6.34	7.13
Safing FF (6 pcf)	1.32	0.98	--	1.46	1.95	2.44	2.93	3.41	3.90	4.39

Table 28. Product Scaling Factors for HEAVY DENSITY products produced in WABASH (≥ 5 in | 127 mm thickness)

Product	Scaling Factor for Functional Unit (1 m²) at R_{SI} = 1	Scaling Factor Based on Product Thickness (inches | mm) for 1 m²					
		5"	5.5"	6"	6.5"	7"	7.1"
		127 mm	140 mm	152 mm	165 mm	179 mm	180 mm
FireSpan® FF 90	2.11	7.93	8.72	9.51	10.30	11.10	--
Safing FF (6 pcf)	1.32	4.88	5.37	5.85	6.34	6.83	--

Table 29. Product Scaling Factors for LIGHT DENSITY products produced in JOPLIN (<5 in | 127 mm thickness)

Product	Scaling Factor for Functional Unit (1 m²) at R_{SI} = 1	Scaling Factor Based on Product Thickness (inches | mm) for 1 m²								
		1"	1.25"	1.5"	2"	2.5"	3"	3.5"	4"	4.5"
		25 mm	32 mm	38 mm	51 mm	64 mm	76 mm	89 mm	102 mm	114 mm
FireSpan® 40 FF	1.79	--	--	--	2.64	3.31	3.97	4.63	5.29	5.95
Safing FF (4 pcf)	1.71	1.32	--	1.98	2.64	3.31	3.97	4.63	5.29	5.95
SAFB™ FF (2.5 pcf)	1.00	--	--	1.24	1.65	2.07	2.48	2.89	3.31	3.72
SAFB™ FF (4 pcf)	1.71	1.32	--	--	--	--	--	--	--	--
UltraBatt™ FF R-10	1.36	--	--	--	--	2.73	--	--	--	--
UltraBatt™ FF R-15	1.36	--	--	--	--	--	--	3.82	--	--
UltraBatt™ FF R-23	1.19	--	--	--	--	--	--	--	--	--
UltraBatt™ FF R-24	1.22	--	--	--	--	--	--	--	--	--
UltraBatt™ FF R-30	1.22	--	--	--	--	--	--	--	--	--

Table 30. Product Scaling Factors for LIGHT DENSITY products produced in JOPLIN (≥5 in | 127 mm thickness)

Product	Scaling Factor for Functional Unit (1 m^2) at R_{SI} = 1	Scaling Factor Based on Product Thickness (inches | mm) for 1 m^2					
		5"	5.5"	6"	6.5"	7"	7.1"
		127 mm	140 mm	152 mm	165 mm	179 mm	180 mm
FireSpan® 40 FF	1.79	6.61	7.27	7.93	8.59	9.26	--
Safing FF (4 pcf)	1.71	6.61	7.27	7.93	8.59	9.26	--
SAFB™ FF (2.5 pcf)	1.00	4.13	4.55	4.96	5.37	5.78	--
SAFB™ FF (4 pcf)	1.71	--	--	--	--	--	--
UltraBatt™ FF R-10	1.36	--	--	--	--	--	--
UltraBatt™ FF R-15	1.36	--	--	--	--	--	--
UltraBatt™ FF R-23	1.19	--	5.45	--	--	--	--
UltraBatt™ FF R-24	1.22	--	--	5.95	--	--	--
UltraBatt™ FF R-30	1.22	--	--	--	--	--	7.04

Table 31. Product Scaling Factors for HEAVY DENSITY products produced in JOPLIN (<5 in | 127 mm thickness)

Product	Scaling Factor for Functional Unit (1 m^2) at R_{SI} = 1	Scaling Factor Based on Product Thickness (inches | mm) for 1 m^2								
		1"	1.25"	1.5"	2"	2.5"	3"	3.5"	4"	4.5"
		25 mm	32 mm	38 mm	51 mm	64 mm	76 mm	89 mm	102 mm	114 mm
FireSpan® FF 90	3.15	2.15	--	3.22	4.30	5.37	6.45	7.52	8.59	9.67
Safing FF (6 pcf)	2.84	1.98	--	2.98	3.97	4.96	5.95	6.94	7.93	8.93
A60 Marine Board	2.97	--	--	3.07	4.10	--	6.15	--	8.20	--

Table 32. Product Scaling Factors for HEAVY DENSITY products produced in JOPLIN (≥ 5 in | 127 mm thickness)

Product	Scaling Factor for Functional Unit (1 m^2) at R_{SI} = 1	Scaling Factor Based on Product Thickness (inches | mm) for 1 m^2					
		5"	5.5"	6"	6.5"	7"	7.1"
		127 mm	140 mm	152 mm	165 mm	179 mm	180 mm
FireSpan® FF 90	3.15	10.74	11.82	12.89	13.97	15.04	--
Safing FF (6 pcf)	2.84	9.92	10.91	11.90	12.89	13.88	--
A60 Marine Board	2.97	--	--	--	--	--	--

8.2. Appendix B

The tables below contain results for 1 m^2 of various facing materials only. These results need to be added to the appropriately scaled results as described in Section 4.3.

Table 33 LCIA Results for North America (TRACI) for 3035/PE 2.0 Facing (1 m^2)

3035/PE 2.0 (1 m^2)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	6.09E-01	3.19E-02	MND	MND	MND	3.09E-03	MND	3.38E-04
ODP [kg CFC-11 eq]	2.56E-08	7.71E-09	MND	MND	MND	7.47E-10	MND	7.59E-11
AP [kg SO2 eq]	2.55E-03	1.98E-04	MND	MND	MND	1.92E-05	MND	3.25E-06
EP [kg N eq]	1.24E-03	2.07E-05	MND	MND	MND	2.00E-06	MND	2.82E-07
POCP [kg O3 eq]	3.30E-02	5.76E-03	MND	MND	MND	5.58E-04	MND	9.84E-05
ADP_{fossil} [MJ, LHV]	3.91E-01	6.83E-02	MND	MND	MND	6.61E-03	MND	6.75E-04

[GWP 100 - Global Warming Potential]; [ODP - Ozone Depletion Potential]; [AP - Acidification Potential]; [EP - Eutrophication Potential]; [POCP - Smog Formation Potential]; [ADP_{fossil} - Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources]

Table 34 LCIA Results for North America (TRACI) for 30J Facing (1 m^2)

30J (1 m^2)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	5.89E-01	3.30E-02	MND	MND	MND	3.20E-03	MND	3.50E-04
ODP [kg CFC-11 eq]	3.66E-08	7.99E-09	MND	MND	MND	7.73E-10	MND	7.86E-11
AP [kg SO2 eq]	3.32E-03	2.05E-04	MND	MND	MND	1.99E-05	MND	3.37E-06
EP [kg N eq]	3.47E-04	2.15E-05	MND	MND	MND	2.08E-06	MND	2.92E-07
POCP [kg O3 eq]	4.45E-02	5.97E-03	MND	MND	MND	5.78E-04	MND	1.02E-04
ADP_{fossil} [MJ, LHV]	5.84E-01	7.07E-02	MND	MND	MND	6.85E-03	MND	7.00E-04

Table 35 LCIA Results for North America (TRACI) for 3114B Facing (1 m^2)

3114B (1 m^2)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	1.58E-01	1.60E-02	MND	MND	MND	1.54E-03	MND	1.69E-04
ODP [kg CFC-11 eq]	1.29E-08	3.86E-09	MND	MND	MND	3.74E-10	MND	3.80E-11
AP [kg SO2 eq]	9.95E-04	9.92E-05	MND	MND	MND	9.60E-06	MND	1.63E-06
EP [kg N eq]	7.79E-05	1.04E-05	MND	MND	MND	1.00E-06	MND	1.41E-07
POCP [kg O3 eq]	1.53E-02	2.88E-03	MND	MND	MND	2.79E-04	MND	4.92E-05
ADP_{fossil} [MJ, LHV]	2.48E-01	3.42E-02	MND	MND	MND	3.31E-03	MND	3.38E-04

Table 36 LCIA Results for North America (TRACI) for 5225T Facing (1 m^2)

5225T (1 m^2)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	4.38E-01	1.20E-01	MND	MND	MND	1.21E-03	MND	1.33E-04
ODP [kg CFC-11 eq]	2.37E-08	2.90E-08	MND	MND	MND	2.93E-10	MND	2.98E-11
AP [kg SO2 eq]	2.49E-03	7.46E-04	MND	MND	MND	7.54E-06	MND	1.28E-06
EP [kg N eq]	2.05E-04	7.80E-05	MND	MND	MND	7.88E-07	MND	1.11E-07
POCP [kg O3 eq]	3.11E-02	2.17E-02	MND	MND	MND	2.19E-04	MND	3.87E-05
ADP_{fossil} [MJ, LHV]	3.46E-01	2.57E-01	MND	MND	MND	2.60E-03	MND	2.65E-04

Table 37 LCIA Results for North America (TRACI) for 5225T Printed Facing (1 m²)

5225T Printed (1 m²)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	4.38E-01	1.25E-02	MND	MND	MND	1.21E-03	MND	1.33E-04
ODP [kg CFC-11 eq]	2.37E-08	3.03E-09	MND	MND	MND	2.93E-10	MND	2.98E-11
AP [kg SO2 eq]	2.49E-03	7.79E-05	MND	MND	MND	7.54E-06	MND	1.28E-06
EP [kg N eq]	2.05E-04	8.14E-06	MND	MND	MND	7.88E-07	MND	0.00E+00
POCP [kg O3 eq]	3.11E-02	2.26E-03	MND	MND	MND	2.19E-04	MND	3.87E-05
ADP_{fossil} [MJ, LHV]	3.46E-01	2.68E-02	MND	MND	MND	2.60E-03	MND	0.00E+00

Table 38 LCIA Results for North America (TRACI) for 5225T-White Facing (1 m²)

5225T-White (1 m²)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	4.38E-01	1.20E-01	MND	MND	MND	1.21E-03	MND	1.33E-04
ODP [kg CFC-11 eq]	2.37E-08	2.90E-08	MND	MND	MND	2.93E-10	MND	2.98E-11
AP [kg SO2 eq]	2.49E-03	7.46E-04	MND	MND	MND	7.54E-06	MND	1.28E-06
EP [kg N eq]	2.05E-04	7.80E-05	MND	MND	MND	7.88E-07	MND	1.11E-07
POCP [kg O3 eq]	3.11E-02	2.17E-02	MND	MND	MND	2.19E-04	MND	3.87E-05
ADP_{fossil} [MJ, LHV]	3.46E-01	2.57E-01	MND	MND	MND	2.60E-03	MND	2.65E-04

Table 39 LCIA Results for North America (TRACI) for 5229 Facing (1 m²)

5229 (1 m²)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	9.34E-01	2.16E-02	MND	MND	MND	2.10E-03	MND	2.29E-04
ODP [kg CFC-11 eq]	4.58E-08	5.24E-09	MND	MND	MND	5.07E-10	MND	5.15E-11
AP [kg SO2 eq]	5.21E-03	1.35E-04	MND	MND	MND	1.30E-05	MND	2.21E-06
EP [kg N eq]	4.03E-04	1.41E-05	MND	MND	MND	1.36E-06	MND	1.91E-07
POCP [kg O3 eq]	6.28E-02	3.91E-03	MND	MND	MND	3.79E-04	MND	6.68E-05
ADP_{fossil} [MJ, LHV]	7.55E-01	4.63E-02	MND	MND	MND	4.49E-03	MND	4.58E-04

Table 40 LCIA Results for North America (TRACI) for 5229 Printed Facing (1 m²)

5229 Printed (1 m²)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	9.34E-01	2.16E-02	MND	MND	MND	2.10E-03	MND	2.29E-04
ODP [kg CFC-11 eq]	4.58E-08	5.24E-09	MND	MND	MND	5.07E-10	MND	5.15E-11
AP [kg SO2 eq]	5.21E-03	1.35E-04	MND	MND	MND	1.30E-05	MND	2.21E-06
EP [kg N eq]	4.03E-04	1.41E-05	MND	MND	MND	1.36E-06	MND	1.91E-07
POCP [kg O3 eq]	6.28E-02	3.91E-03	MND	MND	MND	3.79E-04	MND	6.68E-05
ADP_{fossil} [MJ, LHV]	7.55E-01	4.63E-02	MND	MND	MND	4.49E-03	MND	4.58E-04

Table 41 LCIA Results for North America (TRACI) for 5263 Printed 5x5 Facing (1 m²)

5263 Printed 5x5 (1 m²)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	4.68E-01	1.48E-02	MND	MND	MND	1.43E-03	MND	1.57E-04
ODP [kg CFC-11 eq]	2.50E-08	3.58E-09	MND	MND	MND	3.47E-10	MND	3.53E-11
AP [kg SO2 eq]	2.60E-03	9.21E-05	MND	MND	MND	8.91E-06	MND	1.51E-06
EP [kg N eq]	2.17E-04	9.62E-06	MND	MND	MND	9.31E-07	MND	1.31E-07
POCP [kg O3 eq]	3.28E-02	2.68E-03	MND	MND	MND	2.59E-04	MND	4.57E-05
ADP_{fossil} [MJ, LHV]	4.54E-01	3.17E-02	MND	MND	MND	3.07E-03	MND	3.14E-04

Table 42 LCIA Results for North America (TRACI) for 7503 Facing (1 m²)

7503 (1 m²)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	1.67E-01	1.65E-02	MND	MND	MND	1.60E-03	MND	1.75E-04
ODP [kg CFC-11 eq]	1.33E-08	3.99E-09	MND	MND	MND	3.87E-10	MND	3.93E-11
AP [kg SO2 eq]	1.06E-03	1.03E-04	MND	MND	MND	9.94E-06	MND	1.69E-06
EP [kg N eq]	8.11E-05	1.07E-05	MND	MND	MND	1.04E-06	MND	1.46E-07
POCP [kg O3 eq]	1.63E-02	2.98E-03	MND	MND	MND	2.89E-04	MND	5.10E-05
ADP_{fossil} [MJ, LHV]	2.53E-01	3.54E-02	MND	MND	MND	3.42E-03	MND	3.50E-04

Table 43 LCIA Results for North America (TRACI) for G/47499 Facing (1 m²)

G/47499 (1 m²)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	1.09E-01	8.77E-03	MND	MND	MND	8.49E-04	MND	9.28E-05
ODP [kg CFC-11 eq]	1.08E-08	2.12E-09	MND	MND	MND	2.05E-10	MND	2.09E-11
AP [kg SO2 eq]	4.29E-04	5.45E-05	MND	MND	MND	5.28E-06	MND	8.95E-07
EP [kg N eq]	1.19E-04	5.70E-06	MND	MND	MND	5.51E-07	MND	7.75E-08
POCP [kg O3 eq]	6.18E-03	1.58E-03	MND	MND	MND	1.53E-04	MND	2.71E-05
ADP_{fossil} [MJ, LHV]	2.79E-01	1.88E-02	MND	MND	MND	1.82E-03	MND	1.86E-04

Table 44 LCIA Results for North America (TRACI) for VL6307 Facing (1 m²)

VL6307 (1 m²)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	1.45E-01	1.45E-02	MND	MND	MND	1.40E-03	MND	1.53E-04
ODP [kg CFC-11 eq]	1.20E-08	3.50E-09	MND	MND	MND	3.39E-10	MND	3.44E-11
AP [kg SO2 eq]	9.09E-04	8.99E-05	MND	MND	MND	8.70E-06	MND	1.48E-06
EP [kg N eq]	7.13E-05	9.39E-06	MND	MND	MND	9.09E-07	MND	1.28E-07
POCP [kg O3 eq]	1.40E-02	2.61E-03	MND	MND	MND	2.53E-04	MND	4.46E-05
ADP_{fossil} [MJ, LHV]	2.27E-01	3.10E-02	MND	MND	MND	3.00E-03	MND	3.06E-04

Table 45 LCIA Results for North America (TRACI) for WMP-VR Facing (1 m²)

WMP-VR (1 m²)								
TRACI v2.1	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	1.54E-01	1.94E-02	MND	MND	MND	1.87E-03	MND	2.05E-04
ODP [kg CFC-11 eq]	1.32E-08	4.68E-09	MND	MND	MND	4.53E-10	MND	4.61E-11
AP [kg SO2 eq]	8.83E-04	1.20E-04	MND	MND	MND	1.17E-05	MND	1.98E-06
EP [kg N eq]	1.37E-04	1.26E-05	MND	MND	MND	1.22E-06	MND	1.71E-07
POCP [kg O3 eq]	1.42E-02	3.50E-03	MND	MND	MND	3.39E-04	MND	5.97E-05
ADP_{fossil} [MJ, LHV]	2.77E-01	4.15E-02	MND	MND	MND	4.01E-03	MND	4.10E-04

8.3. Appendix C

The tables below contain results for 1 m^2 of various facing materials only. These results need to be added to the appropriately scaled results as described in Section 4.3.

Table 46 Resource Use for 3035/PE 2.0 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	2.54E+00	5.54E-04	MND	MND	MND	5.36E-05	MND	1.74E-05
RPRM [MJ, LHV]	1.73E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	9.63E+00	4.84E-01	MND	MND	MND	4.68E-02	MND	4.88E-03
NRPRM [MJ, LHV]	4.82E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m^3]	7.47E-03	1.06E-05	MND	MND	MND	1.02E-06	MND	9.37E-08

[RPRE - Renewable primary energy used as energy carrier (fuel)]; [RPRM - Renewable primary resources with energy content used as material]; [NRPRE - Non-renewable primary resources used as an energy carrier (fuel)]; [NRPRM - Non-renewable primary resources with energy content used as material]; [SM - Secondary materials]; [RSF - Renewable secondary fuels]; [NRSF - Non-renewable secondary fuels]; [RE - Recovered energy]; [FW - Use of net fresh water resources]

Table 47 Resource Use for 30J Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	5.58E+00	5.73E-04	MND	MND	MND	5.55E-05	MND	1.80E-05
RPRM [MJ, LHV]	2.59E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	7.36E+00	5.01E-01	MND	MND	MND	4.85E-02	MND	5.05E-03
NRPRM [MJ, LHV]	7.40E-01	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m^3]	5.76E-03	1.09E-05	MND	MND	MND	1.06E-06	MND	9.70E-08

Table 48 Resource Use for 3114B Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	1.03E-01	2.77E-04	MND	MND	MND	2.68E-05	MND	8.69E-06
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	2.44E+00	2.42E-01	MND	MND	MND	2.34E-02	MND	2.44E-03
NRPRM [MJ, LHV]	9.44E-01	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m^3]	1.38E-03	5.28E-06	MND	MND	MND	5.11E-07	MND	4.69E-08

Table 49 Resource Use for 5225T Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	4.26E-01	2.08E-03	MND	MND	MND	2.10E-05	MND	6.82E-06
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	5.11E+00	1.82E+00	MND	MND	MND	1.84E-02	MND	1.92E-03
NRPRM [MJ, LHV]	5.18E-01	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m³]	2.83E-03	3.97E-05	MND	MND	MND	4.01E-07	MND	3.68E-08

Table 50 Resource Use for 5225T Printed Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	4.26E-01	2.17E-04	MND	MND	MND	2.10E-05	MND	6.82E-06
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	5.11E+00	1.90E-01	MND	MND	MND	1.84E-02	MND	1.92E-03
NRPRM [MJ, LHV]	5.18E-01	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m³]	2.83E-03	4.15E-06	MND	MND	MND	4.01E-07	MND	3.68E-08

Table 51 Resource Use for 5225T-White Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	4.32E-01	2.35E-04	MND	MND	MND	2.28E-05	MND	7.38E-06
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	5.37E+00	2.06E-01	MND	MND	MND	1.99E-02	MND	2.07E-03
NRPRM [MJ, LHV]	6.56E-01	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m³]	2.97E-03	4.49E-06	MND	MND	MND	4.34E-07	MND	3.98E-08

Table 52 Resource Use for 5229 Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	9.11E-01	3.76E-04	MND	MND	MND	3.64E-05	MND	1.18E-05
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	1.12E+01	3.28E-01	MND	MND	MND	3.18E-02	MND	3.31E-03
NRPRM [MJ, LHV]	2.10E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m³]	6.22E-03	7.17E-06	MND	MND	MND	6.94E-07	MND	6.36E-08

Table 53 Resource Use for 5229 Printed Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	9.11E-01	3.76E-04	MND	MND	MND	3.64E-05	MND	1.18E-05
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	1.12E+01	3.28E-01	MND	MND	MND	3.18E-02	MND	3.31E-03
NRPRM [MJ, LHV]	2.10E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m³]	6.22E-03	7.17E-06	MND	MND	MND	6.94E-07	MND	6.36E-08

Table 54 Resource Use for 5263 Printed 5x5 Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	4.57E-01	2.57E-04	MND	MND	MND	2.49E-05	MND	8.06E-06
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	6.01E+00	2.25E-01	MND	MND	MND	2.18E-02	MND	2.27E-03
NRPRM [MJ, LHV]	1.48E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m³]	3.35E-03	4.90E-06	MND	MND	MND	4.75E-07	MND	4.35E-08

Table 55 Resource Use for 7503 Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	1.09E-01	2.87E-04	MND	MND	MND	2.78E-05	MND	8.99E-06
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	2.51E+00	2.51E-01	MND	MND	MND	2.43E-02	MND	2.53E-03
NRPRM [MJ, LHV]	7.82E-01	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m³]	1.38E-03	5.47E-06	MND	MND	MND	5.29E-07	MND	4.85E-08

Table 56 Resource Use for G/47499 Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	7.29E-02	1.52E-04	MND	MND	MND	1.47E-05	MND	4.77E-06
RPRM [MJ, LHV]	3.75E-01	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	2.32E+00	1.33E-01	MND	MND	MND	1.29E-02	MND	1.34E-03
NRPRM [MJ, LHV]	1.81E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m³]	1.72E-03	2.90E-06	MND	MND	MND	2.81E-07	MND	2.58E-08

Table 57 Resource Use for VL6370 Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	9.35E-02	2.51E-04	MND	MND	MND	2.43E-05	MND	7.87E-06
RPRM [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	2.23E+00	2.19E-01	MND	MND	MND	2.12E-02	MND	2.21E-03
NRPRM [MJ, LHV]	8.56E-01	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m³]	1.25E-03	4.79E-06	MND	MND	MND	4.64E-07	MND	4.25E-08

Table 58 Resource Use for F-140024, WMP-VR (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
RPRE [MJ, LHV]	2.05E+00	3.36E-04	MND	MND	MND	3.25E-05	MND	1.05E-05
RPRM [MJ, LHV]	1.73E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRPRE [MJ, LHV]	2.64E+00	2.94E-01	MND	MND	MND	2.84E-02	MND	2.96E-03
NRPRM [MJ, LHV]	1.07E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m3]	3.47E-03	6.41E-06	MND	MND	MND	6.21E-07	MND	5.69E-08

8.4. Appendix D

The tables below contain results for 1 m² of various facing materials only. These results need to be added to the appropriately scaled results as described in Section 4.3.

Table 59 Output Flows and Waste Categories for 3035/PE 2.0 Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	8.59E-05	1.23E-06	MND	MND	MND	1.19E-07	MND	1.16E-08
NHWD [kg]	6.98E-02	1.17E-04	MND	MND	MND	1.14E-05	MND	2.73E-01
HLRW [kg] or [m³]	1.44E-06	2.03E-09	MND	MND	MND	1.96E-10	MND	4.49E-11
ILLRW [kg] or [m³]	1.18E-05	3.23E-06	MND	MND	MND	3.13E-07	MND	3.18E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

[HWD - Hazardous waste disposed]; [NHWD - Non-hazardous waste disposed]; [HLRW - High-level radioactive waste, conditioned, to final repository]; [ILLRW - Intermediate- and low-level radioactive waste, conditioned, to final repository]; [CRU - Components for re-use]; [MR - Materials for recycling]; [MER - Materials for energy recovery]; [EE - Exported energy];

Table 60 Output Flows and Waste Categories for 30J Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	8.66E-05	1.27E-06	MND	MND	MND	1.23E-07	MND	1.20E-08
NHWD [kg]	7.18E-02	1.22E-04	MND	MND	MND	1.18E-05	MND	2.83E-01
HLRW [kg] or [m^3]	1.24E-06	2.10E-09	MND	MND	MND	2.03E-10	MND	4.65E-11
ILLRW [kg] or [m^3]	1.07E-05	3.35E-06	MND	MND	MND	3.24E-07	MND	3.30E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 61 Output Flows and Waste Categories for 3114B Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	2.33E-06	6.15E-07	MND	MND	MND	5.96E-08	MND	5.79E-09
NHWD [kg]	1.19E-02	5.88E-05	MND	MND	MND	5.69E-06	MND	1.37E-01
HLRW [kg] or [m^3]	5.86E-07	1.01E-09	MND	MND	MND	9.81E-11	MND	2.25E-11
ILLRW [kg] or [m^3]	4.01E-06	1.62E-06	MND	MND	MND	1.56E-07	MND	1.59E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 62 Output Flows and Waste Categories for 5225T Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	8.47E-05	4.63E-06	MND	MND	MND	4.68E-08	MND	4.54E-09
NHWD [kg]	6.51E-02	4.42E-04	MND	MND	MND	4.47E-06	MND	1.07E-01
HLRW [kg] or [m^3]	7.23E-07	7.62E-09	MND	MND	MND	7.70E-11	MND	1.76E-11
ILLRW [kg] or [m^3]	6.70E-06	1.22E-05	MND	MND	MND	1.23E-07	MND	1.25E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 63 Output Flows and Waste Categories for 5225T Printed Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	8.47E-05	4.83E-07	MND	MND	MND	4.68E-08	MND	4.54E-09
NHWD [kg]	6.51E-02	4.61E-05	MND	MND	MND	4.47E-06	MND	1.07E-01
HLRW [kg] or [m^3]	7.23E-07	7.96E-10	MND	MND	MND	7.70E-11	MND	1.76E-11
ILLRW [kg] or [m^3]	6.70E-06	1.27E-06	MND	MND	MND	1.23E-07	MND	1.25E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 64 Output Flows and Waste Categories for 5225T-White Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	8.48E-05	5.23E-07	MND	MND	MND	5.06E-08	MND	4.92E-09
NHWD [kg]	6.78E-02	4.99E-05	MND	MND	MND	4.83E-06	MND	1.16E-01
HLRW [kg] or [m^3]	7.51E-07	8.61E-10	MND	MND	MND	8.33E-11	MND	1.91E-11
ILLRW [kg] or [m^3]	6.96E-06	1.37E-06	MND	MND	MND	1.33E-07	MND	1.35E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 65 Output Flows and Waste Categories for 5229 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	1.97E-04	8.35E-07	MND	MND	MND	8.08E-08	MND	7.85E-09
NHWD [kg]	1.44E-01	7.97E-05	MND	MND	MND	7.72E-06	MND	1.86E-01
HLRW [kg] or [m^3]	1.39E-06	1.37E-09	MND	MND	MND	1.33E-10	MND	3.05E-11
ILLRW [kg] or [m^3]	1.36E-05	2.19E-06	MND	MND	MND	2.12E-07	MND	2.16E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 66 Output Flows and Waste Categories for 5229 Printed Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	1.97E-04	8.35E-07	MND	MND	MND	8.08E-08	MND	7.85E-09
NHWD [kg]	1.44E-01	7.97E-05	MND	MND	MND	7.72E-06	MND	1.86E-01
HLRW [kg] or [m^3]	1.39E-06	1.37E-09	MND	MND	MND	1.33E-10	MND	3.05E-11
ILLRW [kg] or [m^3]	1.36E-05	2.19E-06	MND	MND	MND	2.12E-07	MND	2.16E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 67 Output Flows and Waste Categories for 5263 Printed 5x5 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	8.48E-05	5.71E-07	MND	MND	MND	5.53E-08	MND	5.37E-09
NHWD [kg]	6.60E-02	5.45E-05	MND	MND	MND	5.28E-06	MND	1.27E-01
HLRW [kg] or [m^3]	8.46E-07	9.41E-10	MND	MND	MND	9.11E-11	MND	2.09E-11
ILLRW [kg] or [m^3]	7.34E-06	1.50E-06	MND	MND	MND	1.45E-07	MND	1.48E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 68 Output Flows and Waste Categories for 7503 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	2.47E-06	6.37E-07	MND	MND	MND	6.16E-08	MND	5.99E-09
NHWD [kg]	1.28E-02	6.08E-05	MND	MND	MND	5.89E-06	MND	1.42E-01
HLRW [kg] or [m^3]	6.23E-07	1.05E-09	MND	MND	MND	1.02E-10	MND	2.32E-11
ILLRW [kg] or [m^3]	4.06E-06	1.67E-06	MND	MND	MND	1.62E-07	MND	1.65E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 69 Output Flows and Waste Categories for G/47499 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	7.26E-07	3.38E-07	MND	MND	MND	3.27E-08	MND	3.18E-09
NHWD [kg]	2.65E-03	3.23E-05	MND	MND	MND	3.13E-06	MND	7.52E-02
HLRW [kg] or [m^3]	2.34E-07	5.57E-10	MND	MND	MND	5.39E-11	MND	1.23E-11
ILLRW [kg] or [m^3]	1.84E-06	8.89E-07	MND	MND	MND	8.60E-08	MND	8.75E-09
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 70 Output Flows and Waste Categories for V6307 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	2.16E-06	5.58E-07	MND	MND	MND	5.40E-08	MND	5.24E-09
NHWD [kg]	1.08E-02	5.33E-05	MND	MND	MND	5.16E-06	MND	1.24E-01
HLRW [kg] or [m^3]	5.32E-07	9.19E-10	MND	MND	MND	8.89E-11	MND	2.04E-11
ILLRW [kg] or [m^3]	3.75E-06	1.47E-06	MND	MND	MND	1.42E-07	MND	1.44E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 71 Output Flows and Waste Categories for F-140024, WMP-VR (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
HWD [kg]	2.01E-06	7.47E-07	MND	MND	MND	7.23E-08	MND	7.02E-09
NHWD [kg]	8.36E-03	7.13E-05	MND	MND	MND	6.90E-06	MND	1.66E-01
HLRW [kg] or [m^3]	5.69E-07	1.23E-09	MND	MND	MND	1.19E-10	MND	2.73E-11
ILLRW [kg] or [m^3]	4.46E-06	1.96E-06	MND	MND	MND	1.90E-07	MND	1.93E-08
CRU [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MR [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

8.5. Appendix E

The tables below contain results for 1 m^2 of various facing materials only. These results need to be added to the appropriately scaled results as described in Section 4.3.

Table 72 Carbon Emissions and Removals for 3035/PE 2.0 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

[BCRP - Biogenic Carbon Removal from Product]; [BCEP - Biogenic Carbon Emission from Product]; [BCRK - Biogenic Carbon Removal from Packaging]; [BCEK - Biogenic Carbon Emission from Packaging]; [BCEW - Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes]; [CCE - Calcination Carbon Emissions]; [CCR - Carbonation Carbon Removals]; [CWNR - Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes]

Table 73 Carbon Emissions and Removals for 30J Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 74 Carbon Emissions and Removals for 3114B Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 75 Carbon Emissions and Removals for 5225T Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 76 Carbon Emissions and Removals for 5225T Printed Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 77 Carbon Emissions and Removals for 5225T-White Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 78 Carbon Emissions and Removals for 5229 Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 79 Carbon Emissions and Removals for 5229 Printed Facing (1 m²)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 80 Carbon Emissions and Removals for 5263 Printed 5x5 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 81 Carbon Emissions and Removals for 7503 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 82 Carbon Emissions and Removals for G/47499 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 83 Carbon Emissions and Removals for V6307 Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

Table 84 Carbon Emissions and Removals for WMP-VR Facing (1 m^2)

Parameter	A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	MND	MND	MND	0.00E+00	MND	0.00E+00

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