Environmental Product Declaration

Owens Corning® Asphalt Shingles

OWENS CORNING ROOFING AND ASPHALT, LLC

TruDefinition® Duration® Shingles are specially formulated to provide great contrast and dimension to any roof. (*Estate Gray* shown)

Owens Corning, and its family of companies, are 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.

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UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

Owens Corning® Asphalt Shingles
Three-Tab and Laminated Asphalt Shingles

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 https://www.ul.com/ https://spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	General Program Instructions v.2.4 July 2018
MANUFACTURER NAME AND ADDRESS	Owens Corning, One Owens Corning Parkway, Toledo, OH, USA
DECLARATION NUMBER	4789400789.101.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Supreme®, Oakridge®, and Duration® Series Shingles 1 m^2 of constructed area using Asphalt Shingles
REFERENCE PCR AND VERSION NUMBER	Part B: Asphalt Shingles, Built-up Asphalt Membrane Roofing and Modified Bituminous Membrane Roofing EPD Requirements, UL 10010-11 (Second Edition, July 17, 2019)
DESCRIPTION OF PRODUCT APPLICATION/USE	Supreme®, Oakridge®, and Duration® Series of Asphalt Roofing Shingles
PRODUCT RSL DESCRIPTION (IF APPL.)	Not Applicable
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	July 1, 2020
PERIOD OF VALIDITY	5 Year
EPD TYPE	Product-Specific
RANGE OF DATASET VARIABILITY	N/A
EPD SCOPE	Cradle to gate with options (C1-C4)
YEAR(S) OF REPORTED PRIMARY DATA	2018
LCA SOFTWARE & VERSION NUMBER	SimaPro 9.0.0.30
LCI DATABASE(S) & VERSION NUMBER	US LCI (DATASMART)
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1 v1.05; Cumulative Energy Demand (LHV) v1.00

This 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	Grant R. Martin Grant R. Martin, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria 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 is a leader in insulation, roofing and fiberglass composites. It has a global presence with 19,000 people in 33 countries. Products covered by this Environmental Product Declaration were produced in the following locations:

Atlanta Roofing Plant Atlanta, GA 30336	Medina Roofing Plant Medina, OH 44256
Brookville Roofing Plant Brookville, IN 47012	Memphis Roofing Plant Memphis, TN 38107
Compton Roofing Plant Compton, CA 90222	Minneapolis Roofing Plant Minneapolis, MN 55430
Denver Roofing Plant Denver, CO 80216	Portland Roofing Plant Portland, OR 97210
Irving Roofing Plant Irving, TX 75061	Savannah Roofing Plant Savannah, GA 31408
Jacksonville Roofing Plant Jacksonville, FL 32206	Summit Roofing Plant Summit, IL 60501
Kearny Roofing Plant Kearny, NJ 07032	

All varieties of product described are not produced at all locations listed.

1.2. Product Description

Product Identification

Every Owens Corning® shingle line features:

- Fiberglas™ mat that adds weather protection, greater fire resistance and longer life.
- Weathering-grade asphalt that holds the granules on the shingle and protects the roof from water.
- Colorful mineral granules that help reflect the sun's rays while adding beauty and style to the roof.
- Heat-activated adhesive strip that bonds shingles into a single, watertight unit.

Owens Corning Roofing and Asphalt manufactures both traditional three-tab shingles and laminate fiberglass asphalt shingles. This EPD covers three of its major asphalt shingle products: Supreme® Shingles, Oakridge® Shingles and Duration® Series Shingles. It should be noted that from the Duration® Series product line, this study only includes Duration® and Duration® Designer Shingles.

Product Specification

Table 1. Product Description and Specification for Three Different Types of Asphalt Shingles

	SUPREME® SHINGLES	OAKRIDGE® SHINGLES	DURATION® SERIES SHINGLES
Shingle Type	3-Tab	Laminate	Laminate
Nominal Size	12" x 36" (30.48 cm x 91.44 cm)	13¼" x 39⅜" (33.66 cm x 100.01 cm)	13¼" x 39⅜" (33.66 cm x 100.01 cm)
Exposure	5" (12.70 cm)	5⅝" (14.29 cm)	5⅝" (14.29 cm)
Shingles per Square	80	64	64
Bundles per Square	3	3	3
Coverage per Square	100 sq. ft. (9.29 m^2)	98.4 sq. ft. (9.14 m^2)	98.4 sq. ft. (9.14 m^2)

Table 2. Applicable Standards and Codes

	SUPREME® SHINGLES	OAKRIDGE® SHINGLES	DURATION® SERIES SHINGLES
ASTM D228	✓	✓	✓
ASTM D3018	Type 1	Type 1	Type 1
ASTM D3161	Class F Wind Resistance	Class F Wind Resistance	Class F Wind Resistance
ASTM D3462	✓	✓	✓
ASTM D7158	Class H Wind Resistance	Class H Wind Resistance	Class H Wind Resistance
ASTM E108/UL 790	Class A Fire Resistance	Class A Fire Resistance	Class A Fire Resistance
ICC-ES AC438	✓	✓	✓
PRI ER 1378E01	✓	✓	✓
Florida Product Approval	✓	✓	✓
Miami-Dade County Product Approval	✓	✓	✓
California Building Energy Efficiency Standards *	✓	✓	✓

* Shasta White color meets ENERGY STAR® requirements for initial solar reflectance of 0.25 and 3-year aged solar reflectance of 0.15; 2013 California Building Energy Efficiency Standards; Title 24, Part 6 requirements; Rated by the Cool Roof Rating Council (CRRC).

Flow Diagram

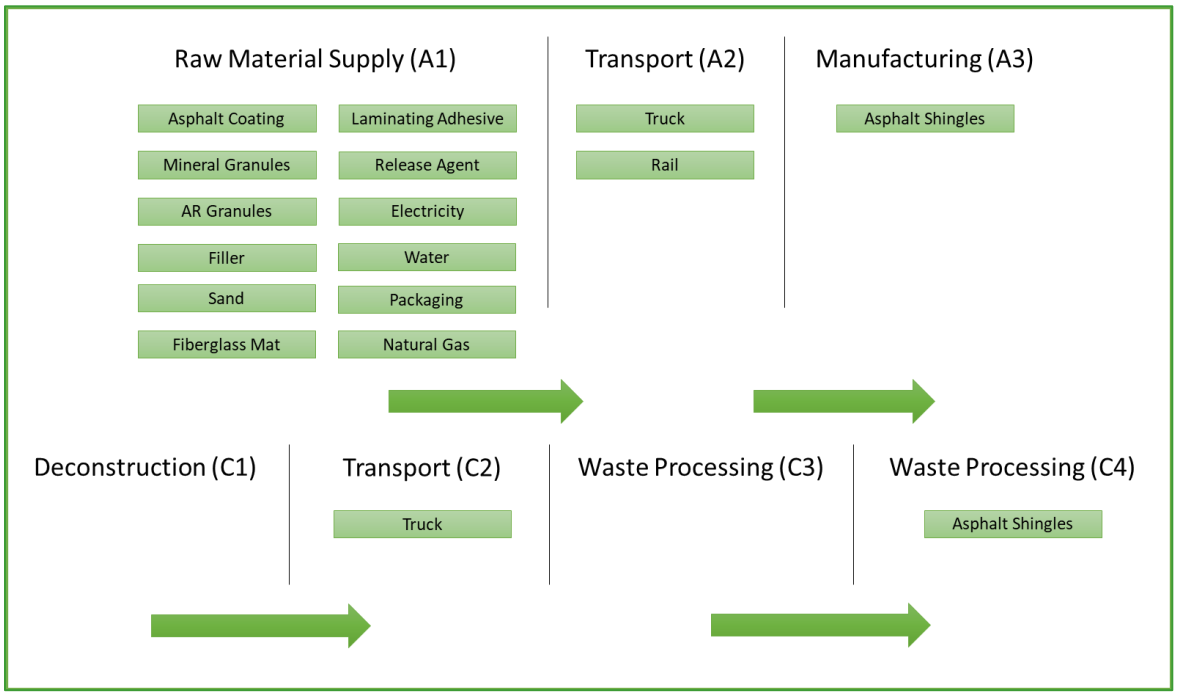


Figure 1. Shingles Process Flow

Product Average

The results of this declaration represent an average performance for the listed products and manufacturing locations. Reported basis weights for included products and production locations were taken from quality control data to create a weighted average which was used to determine the declared unit mass for the LCA.

1.3. Application

Asphalt Roofing Shingles are considered the first layer of protection against extreme weather conditions for steep slope applications. Owens Corning offers a wide range of shapes, sizes and color choices.

1.4. Declaration of Methodological Framework

This declaration is a product-specific EPD. It is cradle-to-gate with options. This includes modules A1-A3 plus end-of-life modules of C1-C4. The underlying LCA study included the following:

- Raw materials including extraction and production (A1)
- Transportation of raw materials to the manufacturing facility (A2)
- Shingle manufacturing (A3)
- End-of-life, including transport to landfill and landfill disposal (C1-C4)

No known flows are deliberately excluded from this EPD.

1.5. Technical Requirements

At a minimum, all Owens Corning® Roofing Shingles meet the following codes and standards:

- ASTM D228 - Standard Test Methods for Sampling, Testing, and Analysis of Asphalt Roll Roofing, Cap Sheets, and Shingles Used in Roofing and Waterproofing
- ASTM D3018 - Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules; Type 1
- ASTM D3161 - Standard Test Method for Wind Resistance of Steep Slope Roofing Products (Fan-Induced Method); Class F Wind Resistance
- ASTM D3462 - Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules
- ASTM D7158 - Standard Test Method for Wind Resistance of Asphalt Shingles (Uplift Force/Uplift Resistance Method); Class H Wind Resistance
- ASTM E108/UL 790 Standard Test Methods for Fire Tests of Roof Coverings; Class A Fire Resistance
- ICC-ES AC438 Acceptance Criteria for Alternative Asphalt Roofing Shingles

1.6. Properties of Declared Product as Delivered

Supreme® Shingles

Three-tab shingles offer a solid value with curb appeal and lasting durability. Constructed of durable weathering-grade asphalt and a tough Fiberglas™ mat core, Supreme® Shingles come with a 25-Year Limited Warranty,* a 60-MPH Wind Resistance Limited Warranty* and an Algae Resistance Limited Warranty* available on a regional basis. Supreme® Shingles are produced with StreakGuard® Protection to inhibit the growth of airborne blue-green algae* that can cause unsightly dark streaks on your roof. Owens Corning provides a 10-year Algae Resistance Limited Warranty.*

Oakridge® Shingles

Oakridge® Shingles are designed to provide long-lasting performance and striking beauty. In addition to a wide range of inviting, popular colors, they also offer a Limited Lifetime Warranty*/** (for as long as you own your home), a 110/130-MPH†† Wind Resistance Limited Warranty* and an Algae Resistance Limited Warranty* available on a regional basis. Oakridge® Shingles are produced with StreakGuard® Protection to inhibit the growth of airborne blue-green algae* that can cause unsightly dark streaks on your roof. Owens Corning provides a 10-year Algae Resistance Limited Warranty.*

Duration® Series Shingles

Duration® Series Shingles with patented SureNail® Technology are specially formulated to provide great contrast and dimension to any roof. Through the use of multiple granule colors and shadowing, they deliver an exclusive combination of color and depth that makes them like no other. Duration® SeriesShingles are available in popular colors and feature a Limited Lifetime Warranty*/** (for as long as you own your home), a 130-MPH Wind Resistance Limited Warranty* and Algae Resistance Limited Warranty* available on a regional basis. Duration® Series Shingles are produced with StreakGuard® Protection to inhibit the growth of airborne blue-green algae* that can cause unsightly dark streaks on your roof. Owens Corning provides a 10-year Algae Resistance Limited Warranty.*

* See actual warranty for complete details, limitations and requirements
** 40-year Limited Warranty on commercial projects
†† 110 MPH is standard with 4-nail application. 130 MPH is applicable only with 6-nail application and Owens Corning® Starter Shingle product application in eaves and rakes in accordance with installation instructions.

1.7. Material Composition

Primary materials used to manufacture roofing shingles are fiberglass mat, asphalt, filler, ceramic granules, sand and a release agent. Asphalt is used in multiple components of the shingle, including the coating, as laminating adhesives and sealants. Table 3 shows the raw material composition of the three shingle types considered in this study.

Table 3. Raw Material Compositions of Three Asphalt Shingle Types

Component	Supreme® Shingles	Oakridge® Shingles	Duration® Series Shingles
Fiberglas™ Mat	2%	3%	3%
Asphalt Coating	19%	18%	18%
Ceramic Granules	37%	37%	37%
Filler	36%	35%	36%
Hot Melt Adhesive	0.2%	0.2%	0.2%
Laminating Adhesive	1%	1%	1%
Release Agent	0.03%	0.02%	0.01%
Sand Backdusting	5%	5%	5%

1.8. Manufacturing

Owens Corning North American Insulation manufacturing locations can be found across the United States. Primary data from the manufacturing facilities listed in Section 1.1 were used for the underlying life cycle assessment. Results provided in this decleration are based on a production-weighted average of these manufacturing facilities.

Figure 2 illustrates the manufacturing process of asphalt shingles. The manufacture of both three-tab and laminate shingles are similar, and both processes are depicted. It should be noted, however, that certain laminating processes, which follow the finished looper in the diagram, are not applicable for Supreme® Shingles.

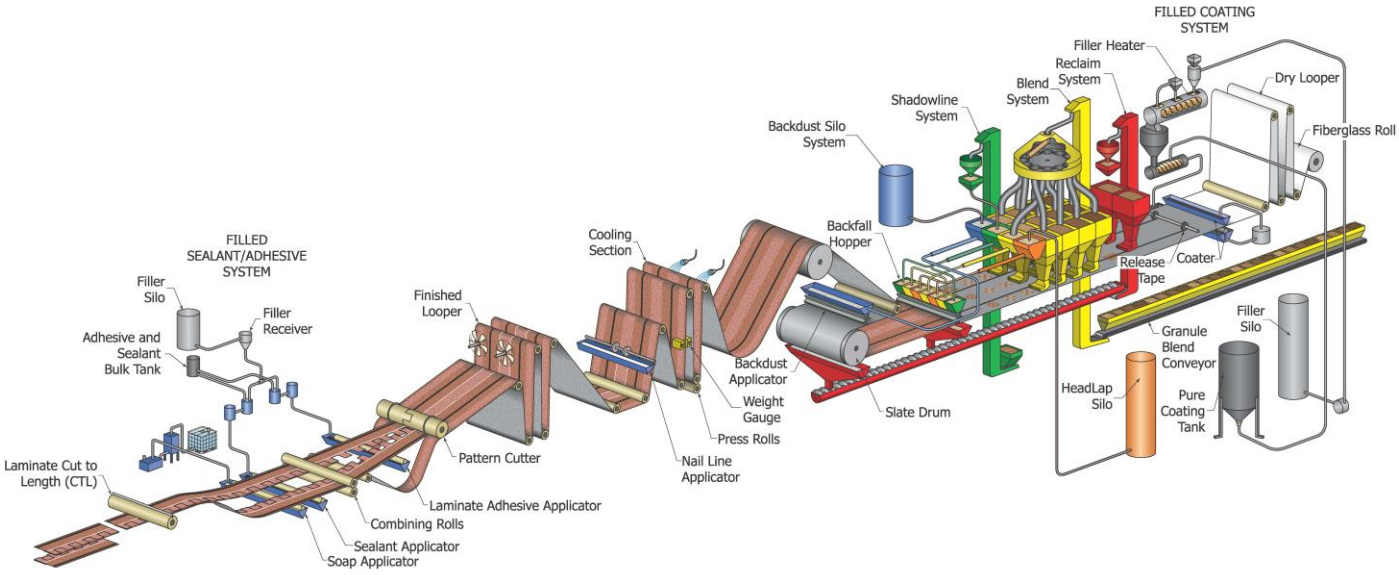


Figure 2. Process Diagram of Asphalt Shingle Manufacturing

1.9. Packaging

Packaging in the form of pallets was included in the analysis as part of the overhead calculation. The weight of the other packaging materials is non-significant compared to the weight of the final product. As such, it has been excluded from the analysis.

1.10. Transportation

The outbound transportation or distribution includes the transportation of the final product to distribution centers and customers. This stage was not included in study.

1.11. Product Installation

Owens Corning® Asphalt Roofing Shingles are installed by hand. Installation occasionally requires electric tools or various hand tools. Provided the low energy consumption of these devices, it was considered that this stage is non-significant compared to the energy consumed at the manufacturing stage. Therefore, energy and material usage in this stage were not included as part of this study.

1.12. Use

Roofing Shingles are passive devices that require no extra utlities or maintenance to operate over its useful life.

1.13. Reference Service Life and Estimated Building Service Life

As this EPD is cradle-to-gate with options (i.e., excludes use phase) no serice life was reported for the products.

1.14. Reuse, Recycling, and Energy Recovery

Although there is potential for recycling shingles at their end of life, typically into pavements, this opportunity is not readily available in all markets, and therefore has not been included in the study.

1.15. Disposal

At end of life, shingles are removed by hand and occasionally require electric tools or various hand tools. It was assumed that all materials removed from the decommissioning of a building undergo no further processing and are taken to a local construction waste landfill by truck, using 100 miles (161 km) as the average distance to landfill.

2. Life Cycle Assessment Background Information

2.1. Declared Unit

The declared unit is 1 m^2, corresponding to the amount of asphalt shingles required for 1 m^2 of constructed area. Specifically, this is the amount of asphalt shingles, which, when configured in an overlapping manner specified by the manufacturer's installation instructions, provides the component requirement of a multilayer steep-slope roofing assembly, which provides a water-shedding roof covering for 1 m^2 of constructed area.

Table 4. Declared Unit Properties

	Supreme® Shingles	Oakridge® Shingles	Duration® Series Shingles
Declared unit	1 m^2 of constructed area		
Mass associated with declared unit (kg)	9.26	9.93	10.12

2.2. System Boundary

This EPD is cradle-to-gate with end-of-life. Details of the system boundaries may be found in the Figure 3.

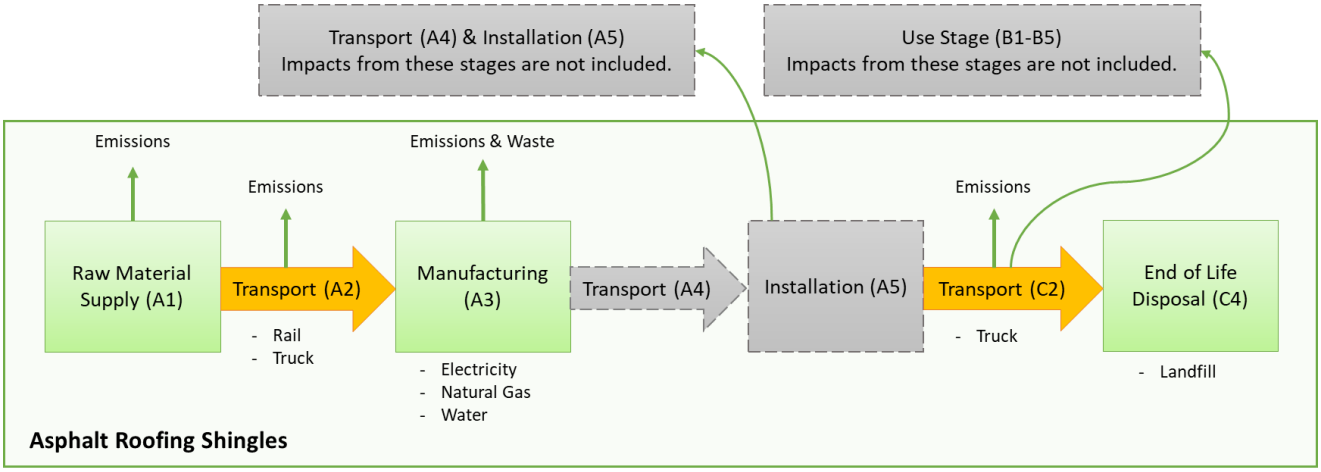


Figure 3. Asphalt Roofing Shingles System Boundary

2.3. Estimates and Assumptions

Removal of the shingles is done by hand and occasionally requires low energy electric tools. Also, as the product is not being widely reclaimed at this time, there is minimal deconstruction activity or waste processing, and therefore no impacts were associated with the C1 and C3 stages.

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.

Packaging in the form of pallets was included in the analysis as a part of the overhead calculation. The weight of the packaging materials is not significant compared to the weight of the final product, and previous studies of shingle products have shown the impact from the plastic packaging is not significant to the overall result. As such, it has not been included as part of this study.

2.5. Data Sources

Primary manufacturing data was collected from the included manufacturing locations listed in Section 1.1. Secondary data primarily references the US LCI database.

2.6. Data Quality

To determine how representative the data used to model the life-cycle of Owens Corning® Roofing Shingles manufactured in 2018 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 2018 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 2018 calendar year.

2.8. Allocation

Allocation calculations that were made are consistent with the requirements of the applicable PCR. Mass allocation was the preferred method. Where primary data of raw materials consumption was provided on the facility level instead of the product level, mass allocation was deemed the most accurate and reproducible way of calculating the quantity of raw materials consumed to manufacture each product.

3. Life Cycle Assessment Scenarios

As sections A4, A5, and B1-B7 were excluded from this study, their associated PCR-required tables have been omitted. Disposal information for C1-C4 stages for the three types of shingles have been reported in Tables 5.

Table 5. End of Life (C1-C4) for 1 m² of Roofing Shingles

Name		Supreme® Shingles	Oakridge® Shingles	Duration® Series Shingles	Unit
Assumptions for scenario development	Although reuse and recycling of asphalt shingles at their end of life is possible, there are no formal and consistent 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	8.65E+00	9.89E+00	9.68E+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	kg
Disposal (Landfill)	Product or material for final deposition	8.65E+00	9.89E+00	9.68E+00	kg
Removals of biogenic carbon (excluding packaging)		0.00E+00	0.00E+00	0.00E+00	kg CO_2

4. Life Cycle Assessment Results

Table 6. 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	Building Operational Water Use During	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	MND	X	MND

MND – Module Not Declared

4.1. Life Cycle Impact Assessment Results

Table 7. Impact Assessment (NA) for 1 m² of Duration® Series Shingles

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO_2 eq]	3.49E+00	MND	MND	MND	MND	3.17E-01	MND	8.46E-02
ODP [kg CFC-11 eq]	1.32E-06	MND	MND	MND	MND	6.24E-08	MND	2.96E-08
AP [kg SO_2 eq]	2.52E-02	MND	MND	MND	MND	1.90E-03	MND	5.98E-04
EP [kg N eq]	8.73E-03	MND	MND	MND	MND	3.33E-04	MND	9.28E-05
SFP [kg O_3 eq]	3.34E-01	MND	MND	MND	MND	5.39E-02	MND	1.69E-02
ADP_{fossil} [MJ, LHV]	1.88E+01	MND	MND	MND	MND	6.56E-01	MND	2.88E-01

[GWP – Global Warming Potential, ODP – Ozone Depletion Potential, AP – Acifdification Potential, EP – Eutrophication Potential, SFP – Smog Formation Potential, ADP_{fossil} – Abiotic Depletion Potential of Non-renewable (fossil) energy resources]

Table 8. Impact Assessment (NA) for 1 m² of Oakridge® Shingles

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO_2 eq]	3.21E+00	MND	MND	MND	MND	3.11E-01	MND	7.43E-02
ODP [kg CFC-11 eq]	1.24E-06	MND	MND	MND	MND	6.12E-08	MND	2.79E-08
AP [kg SO_2 eq]	2.35E-02	MND	MND	MND	MND	1.86E-03	MND	5.39E-04
EP [kg N eq]	8.72E-03	MND	MND	MND	MND	3.26E-04	MND	8.20E-05
SFP [kg O_3 eq]	3.00E-01	MND	MND	MND	MND	5.29E-02	MND	1.52E-02
ADP_{fossil} [MJ, LHV]	1.78E+01	MND	MND	MND	MND	6.43E-01	MND	2.70E-01

[GWP – Global Warming Potential, ODP – Ozone Depletion Potential, AP – Acifdification Potential, EP – Eutrophication Potential, SFP – Smog Formation Potential, ADP_{fossil} – Abiotic Depletion Potential of Non-renewable (fossil) energy resources]

Table 93. Impact Assessment (NA) for 1 m² of Supreme® Shingles

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO_2 eq]	2.75E+00	MND	MND	MND	MND	2.90E-01	MND	8.42E-02
ODP [kg CFC-11 eq]	1.13E-06	MND	MND	MND	MND	5.71E-08	MND	2.82E-08
AP [kg SO_2 eq]	2.11E-02	MND	MND	MND	MND	1.73E-03	MND	5.86E-04
EP [kg N eq]	7.21E-03	MND	MND	MND	MND	3.04E-04	MND	9.18E-05
SFP [kg O_3 eq]	2.61E-01	MND	MND	MND	MND	4.93E-02	MND	1.66E-02
ADP_{fossil} [MJ, LHV]	1.60E+01	MND	MND	MND	MND	6.00E-01	MND	2.75E-01

[GWP – Global Warming Potential, ODP – Ozone Depletion Potential, AP – Acifdification Potential, EP – Eutrophication Potential, SFP – Smog Formation Potential, ADP_{fossil} – Abiotic Depletion Potential of Non-renewable (fossil) energy resources]

4.2. Life Cycle Inventory Results

Table 10. Resource Use for 1 m² of Duration® Series Shingles

Parameter	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
RPR_E [MJ, LHV]	6.02E+00	MND	MND	MND	MND	3.29E-02	MND	9.38E-03
RPR_M [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
$NRPR_E$ [MJ, LHV]	5.18E+01	MND	MND	MND	MND	4.69E+00	MND	1.99E+00
$NRPR_M$ [MJ, LHV]	8.28E+01	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m^3]	1.08E-01	MND	MND	MND	MND	2.35E-03	MND	2.10E-03

[RPR_E – Renewable primary energy used as energy carrier (fuel), RPR_M – Renewable primary resources with energy content used as material, $NRPR_E$ – Non-renewable primary energy used as energy carrier (fuel), $NRPR_M$ – 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 11. Resource Use for 1 m² of Oakridge® Shingles

PARAMETER	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
RPR_E [MJ, LHV]	6.21E+00	MND	MND	MND	MND	3.23E-02	MND	8.32E-03
RPR_M [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
$NRPR_E$ [MJ, LHV]	4.76E+01	MND	MND	MND	MND	4.61E+00	MND	1.85E+00
$NRPR_M$ [MJ, LHV]	7.97E+01	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m^3]	1.26E-01	MND	MND	MND	MND	2.30E-03	MND	2.05E-03

[RPR_E – Renewable primary energy used as energy carrier (fuel), RPR_M – Renewable primary resources with energy content used as material, $NRPR_E$ – Non-renewable primary energy used as energy carrier (fuel), $NRPR_M$ – 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 12. Resource Use for 1 m² of Supreme® Shingles

PARAMETER	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
RPR_E [MJ, LHV]	5.35E+00	MND	MND	MND	MND	3.01E-02	MND	9.27E-03
RPR_M [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
$NRPR_E$ [MJ, LHV]	4.03E+01	MND	MND	MND	MND	4.29E+00	MND	1.91E+00
$NRPR_M$ [MJ, LHV]	7.28E+01	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
SM [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
RSF [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NRSF [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
RE [MJ, LHV]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
FW [m^3]	8.35E-02	MND	MND	MND	MND	2.15E-03	MND	1.94E-03

[RPR_E – Renewable primary energy used as energy carrier (fuel), RPR_M – Renewable primary resources with energy content used as material, $NRPR_E$ – Non-renewable primary energy used as energy carrier (fuel), $NRPR_M$ – 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 13. Output Flows and Waste Categories for 1 m² of Duration® Series Shingles

PARAMETER	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
HWD [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NHWD [kg]	1.64E-01	MND	MND	MND	MND	0.00E+00	MND	9.68E+00
HLRW [kg] or [m^3]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
ILLRW [kg] or [m^3]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CRU [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
R [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	MND	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, R – Materials for recycling, MER – Materials for energy recovery, EE – Exported energy]

Table 14. Output Flows and Waste Categories for 1 m² of Oakridge® Shingles

PARAMETER	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
HWD [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NHWD [kg]	1.75E-01	MND	MND	MND	MND	0.00E+00	MND	9.89E+00
HLRW [kg] or [m³]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
ILLRW [kg] or [m³]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CRU [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
R [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	MND	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, R – Materials for recycling, MER – Materials for energy recovery, EE – Exported energy]

Table 15. Output Flows and Waste Categories for 1 m² of Supreme® Shingles

PARAMETER	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
HWD [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
NHWD [kg]	8.18E-02	MND	MND	MND	MND	0.00E+00	MND	8.65E+00
HLRW [kg] or [m³]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
ILLRW [kg] or [m³]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CRU [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
R [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
MER [kg]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
EE [MJ, LHV]	0.00E+00	MND	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, R – Materials for recycling, MER – Materials for energy recovery, EE – Exported energy]

Table 16. Carbon Emissions and Removals for 1 m² of Duration® Series Shingles

PARAMETER	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	6.84E-05	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	MND	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 – Calcination Carbon Removals, CWNR – Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes]

Table 17. Carbon Emissions and Removals for 1 m² of Oakridge® Shingles

PARAMETER	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	6.84E-05	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	MND	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 – Calcination Carbon Removals, CWNR – Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes]

Table 18. Carbon Emissions and Removals for 1 m² of Supreme® Shingles

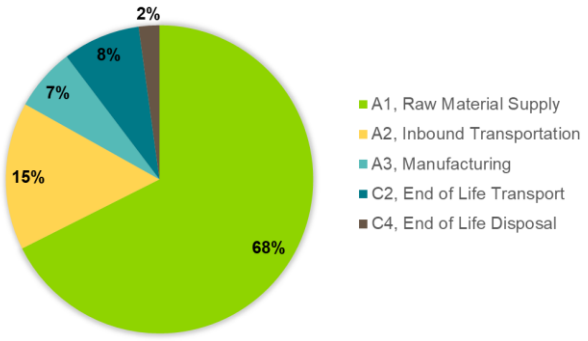
PARAMETER	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEP [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCRK [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEK [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
BCEW [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CCE [kg CO2]	6.84E-05	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CCR [kg CO2]	0.00E+00	MND	MND	MND	MND	0.00E+00	MND	0.00E+00
CWNR [kg CO2]	0.00E+00	MND	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 – Calcination Carbon Removals, CWNR – Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes]

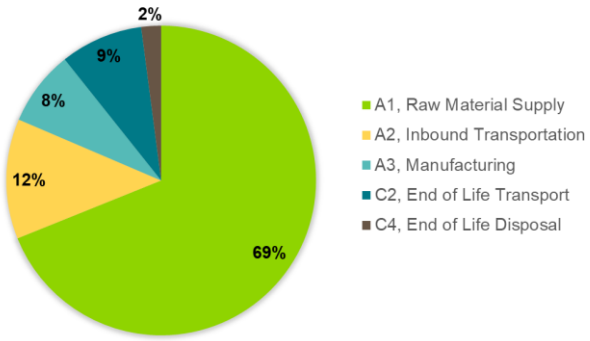
5. LCA Interpretation

For all shingle types, the largest contributor for all the impact categories considered here is the raw material supply stage (A1). Second most contributor being the transportation stage from suppliers to plants (A2), especially in the Smog category. This is true for all impact categories but the respiratory effects, where the plant air emissions during operation (in A3) were driving the effects.

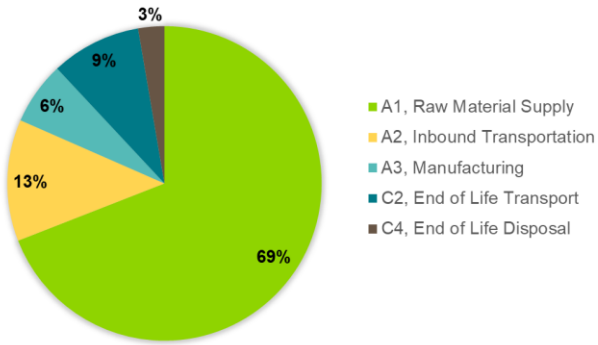
Global Warming Potential (kg CO_2 eq) by Stage for Owens Corning® Duration® Series Shingles



Global Warming Potential (kg CO_2 eq) by Stage for Owens Corning® Oakridge® Shingles



Global Warming Potential (kg CO_2 eq) by Stage for Owens Corning® Supreme® Shingles



6. Additional Environmental Information

6.1. Environment and Health During Manufacturing

Owens Corning manufacturing facilities of roofing shingles maintain quality management systems.

6.2. Environment and Health During Installation

Owens Corning Roofing products meet the definition of an article, as defined by the Occupational Safety and Health Administration (OSHA). An article is defined as follows:

> *"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."*

Articles are exempt from the requirement of publishing Safety Data Sheets (SDSs). Title 29 of the Code of Federal Regulations, Section 1910.1200 (amended), specifically states that it does not apply to articles.

6.3. Extraordinary Effects

Fire

This product is Class A fire resistant complying with ASTM E108/UL 790.

6.4. Delayed Emissions

No delayed emissions are expected from this product.

6.5. Environmental Activities and Certifications

Shasta White color meets ENERGY STAR® requirements for initial solar reflectance of 0.25 and 3-year aged solar reflectance of 0.15; 2013 California Building Energy Efficiency Standards, Title 24, Part 6 requirements; rated by the Cool Roof Rating Council (CRRC).

Made with Wind Energy and Reduced Carbon Footprint

Roofing Shingle products are available upon request in the Compton, CA facility with SCS Global Services certification for “Made with Wind Energy” and “Reduced Carbon Footprint”. The updated environmental impacts for the products by matching the amount of electricity used in manufacturing with wind energy produced as part of Owens Corning’s Power Purchase Agreement were calculated and can be found in Table 19. The values for life cycle stages A1-A3 reflect calculations based on the electricity impacts per the SimaPro implementation of the US LCI versions of the NERC power grids. Certificates published on the SCS Global Services website are based on calculations using updated NERC and eGrid power grid data and updated manufacturing production data per the certifcation guideline, so variation between values are expected.

Table 19. Comparison of Grid and REC Electricity for 1 m² of Shingles made in Compton, CA

	Supreme® Shingles			Oakridge® Shingles			Duration® Series Shingles		
TRACI v2.1	A1-A3 Standard Product	A1-A3 Certified Product	% Change	A1-A3 Standard Product	A1-A3 Certified Product	% Change	A1-A3 Standard Product	A1-A3 Certified Product	% Change
GWP 100 [kg CO2 eq]	2.71E+00	2.63E+00	3%	3.03E+00	2.95E+00	3%	3.34E+00	3.25E+00	3%
ODP [kg CFC-11 eq]	1.10E-06	1.10E-06	0%	1.16E-06	1.16E-06	0%	1.21E-06	1.20E-06	0%
AP [kg SO_2 eq]	1.88E-02	1.84E-02	2%	2.04E-02	2.00E-02	2%	2.24E-02	2.20E-02	2%
EP [kg N eq]	6.07E-03	5.85E-03	4%	6.66E-03	6.43E-03	4%	8.80E-03	8.56E-03	3%
SFP [kg O_3 eq]	2.30E-01	2.26E-01	1%	2.59E-01	2.55E-01	1%	2.87E-01	2.83E-01	1%
ADP_{fossil} [MJ, LHV]	1.66E+01	1.65E+01	0%	1.77E+01	1.76E+01	0%	1.86E+01	1.85E+01	0%

6.6. Further Information

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

For patent information, please visit www.owenscorning.com/patents

7. References

American Center for Life Cycle Assessment (ACLCA). Product Category Rule Development, v1.0, established by the Product Category Rule Guidance Development Initiative.

Part A: Life Cycle Assessment Calculation Rules and Report Requirements UL Environment (December 2018, version 3.2)

Part B: Asphalt Shingles, Built-up Asphalt Membrane Roofing and Modified Bituminous Membrane Roofing EPD Requirements, UL 10010-11 (Second Edition, July 17, 2019)

ISO 14025: 2006 - Environmental labels and declarations – Type III environmental declarations – Principles and procedures

ISO 14040: 2006 - Environmental management – Life cycle assessment – Principles and framework

ISO 14044:2006 - Environmental management – Life cycle assessment – Requirements and guidelines

ISO 14046:2013 – Environmental management – Water footprint – Principles, requirements and guidelines

ISO 15804:2012+A1:2013 - Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products

ISO 21930: 2017 - Sustainability in building construction -- Environmental declaration of building products

ASTM D228 - Standard Test Methods for Sampling, Testing, and Analysis of Asphalt Roll Roofing, Cap Sheets, and Shingles Used in Roofing and Waterproofing

ASTM D3018 - Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules

ASTM D3161 - Standard Test Method for Wind Resistance of Steep Slope Roofing Products (Fan-Induced Method)

ASTM D3462 - Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules

ASTM D7158 - Standard Test Method for Wind Resistance of Asphalt Shingles (Uplift Force/Uplift Resistance Method)

ASTM E108/UL 790 Standard Test Methods for Fire Tests of Roof Coverings

SCS Global Services Guideline for Claims of “Made with Renewable Energy” or “Reduced Carbon Footprint” Based on Power Purchase Agreement, February 2018