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® Asphalt Shingles help protect commercial, institutional and residential buildings from the elements and severe weather and are manufactured in a broad array of aesthetically appealing colors and styles. Shingle product offerings include color blends ranging from subtle, natural hues to vibrant, eye-catching blends as well as styles that include specialty, architectural and traditional.

Building Materials products – primarily roofing and insulation are focused on making new and existing homes and buildings energy efficient, comfortable, and attractive. 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.

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

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

According to ISO 14025

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. 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, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Owens Corning
DECLARATION NUMBER	4786825641.101.1
DECLARED PRODUCT	Supreme® Shingles, Oakridge® Shingles, Duration® Series Shingles
REFERENCE PCR	PCR Asphalt Shingles, Built-up Asphalt Membrane Roofing and Modified Bituminous Membrane Roofing, v1.0, ASTM International, July 2014
DATE OF ISSUE	July 7, 2015
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications

The PCR review was conducted by:	Review Panel
	François Charron-Doucet, Quantis Canada (Chair)
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This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	
	Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	
	Thomas Gloria, Industrial Ecology Consultants

Product Definition and Information

Product Description

Owens Corning® asphalt shingles use a fiberglass mat as the core substrate material, which is coated on both sides with weathering-grade asphalt. These materials make the shingles flexible and provide their hydrophobic properties.

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. The descriptions and technical specifications for these products can be found in Table 1 below.

Table 1 Product Description and Specification for Owens Corning® Asphalt Shingles

	Supreme® Shingles	Oakridge® Shingles	Duration® Series Shingles
Shingle Type	3-Tab	Laminate	Laminate
Nominal Size	12" x 36"	13¼" x 39⅜"	13¼" x 39⅜"
Exposure	5"	5⅝"	5⅝"
Shingles per Square	80	64	64
Bundles per Square	3	3	3
Coverage per Square	100 sq. ft.	98.4 sq. ft.	98.4 sq. ft.

Informed Comparison and Applicability

This EPD covers only the cradle-to-gate and end-of-life (EoL) impacts of Owens Corning® asphalt roofing shingles using a declared unit and the results cannot be used to compare between products. Furthermore, although additional materials and components are used in conjunction with asphalt shingles to perform its function in a multilayer steep-slope roofing system, this EPD has been prepared for and applies to the asphalt shingles only.

Manufacturing Locations

Owens Corning Roofing and Asphalt operates multiple asphalt shingle manufacturing facilities across the United States. Primary data used in the underlying LCA study, upon which this EPD is based, came from four of these facilities. The names and locations of these facilities can be found in Table 2 below.

Table 2 Asphalt Shingle Manufacturing Facilities of LCA Study

Atlanta Roofing Plant	Irving Roofing Plant
4795 Frederick Dr SW, Atlanta, GA 30336	201 N Nursery Rd, Irving, TX 75061
Medina Roofing Plant	**Portland Roofing Plant**
890 W Smith Rd, Medina, OH 44256	3750 NW Yeon Ave, Portland, OR 97210

Product System and Model

Declared Unit

This declaration is a business-to-business (BtoB) EPD, which covers the cradle-to-gate and end-of-life (EoL) life-cycle stages of asphalt shingles. As defined in the PCR, the declared unit is 1 m^2 that corresponds 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.

System Boundaries

As an adaption from the PCR, Table 3 below indicates the particular life-cycle stages and individual modules included within the system boundaries of the underlying LCA study, which only considers the potential environmental impacts associated with the cradle-to-gate and EoL life-cycle stages for each of the three types of asphalt shingle products. For each of the life-cycle stages, the individual modules that have been included are indicated with a ✓.

Table 3 Life-cycle Stages and Modules Included in the System Boundaries

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE			
Raw material supply	Transport	Manufacturing	Transport	Construction installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**
✓	✓	✓	x	x	x	x	x	x	x	x	x	✓	✓	✓	✓

Life-cycle Stages Assessed

A description of the life-cycle stages and modules is as follows:

- Product Stage (A1-A3)
  - Raw material supply (A1)
    - Extraction of resources and production of raw material inputs used for product manufacturing
    - Collection and processing of recycled materials used for product manufacturing
    - Extraction of resources and production of packaging materials used for finished product
  - Transport (A2)
    - Transportation of all raw materials inputs and packaging materials to manufacturing facilities
  - Manufacturing (A3)
    - Process energy (electricity and natural gas) consumption and associated emissions
    - Water usage
    - Waste from manufacturing
- End-of-life Stage (C1-C4)
  - Transportation of used packaging materials from construction site to recycling facility
  - After useful service-life, transportation of asphalt shingles from deconstruction site to recycling facility or landfill site as waste

Material Content

The raw material composition of the three types of asphalt shingle products can be found in the tables below. The amounts of each of the raw material inputs listed correspond to the declared unit amount for each of the three types of shingles. These are production-weighted amounts, which have been averaged across the four facilities modeled in the LCA.

Table 4 Raw Material Composition of Supreme® Shingles (1 m^2)

Raw Materials	Amount (lb)	Percent of Total (wt%)
Fiberglass Mat	4.70E-01	2%
Asphalt	4.06E+00	19%
Limestone	7.40E+00	35%
Granules	4.45E+00	21%
Coal slag	3.69E+00	17%
Sand	7.82E-01	4%
Dolomite	2.63E-01	1%
Total	2.11E+01	100%

Table 5 Raw Material Composition of Oakridge® Shingles (1 m^2)

Raw Material	Amount (lb)	Percent of Total (wt%)
Fiberglass Mat	5.87E-01	2%
Asphalt	4.85E+00	20%
Limestone	9.19E+00	38%
Granules	6.60E+00	27%
Coal slag	7.76E-01	3%
Sand	2.06E+00	8%
Dolomite	2.80E-01	1%
Total	2.43E+01	100%

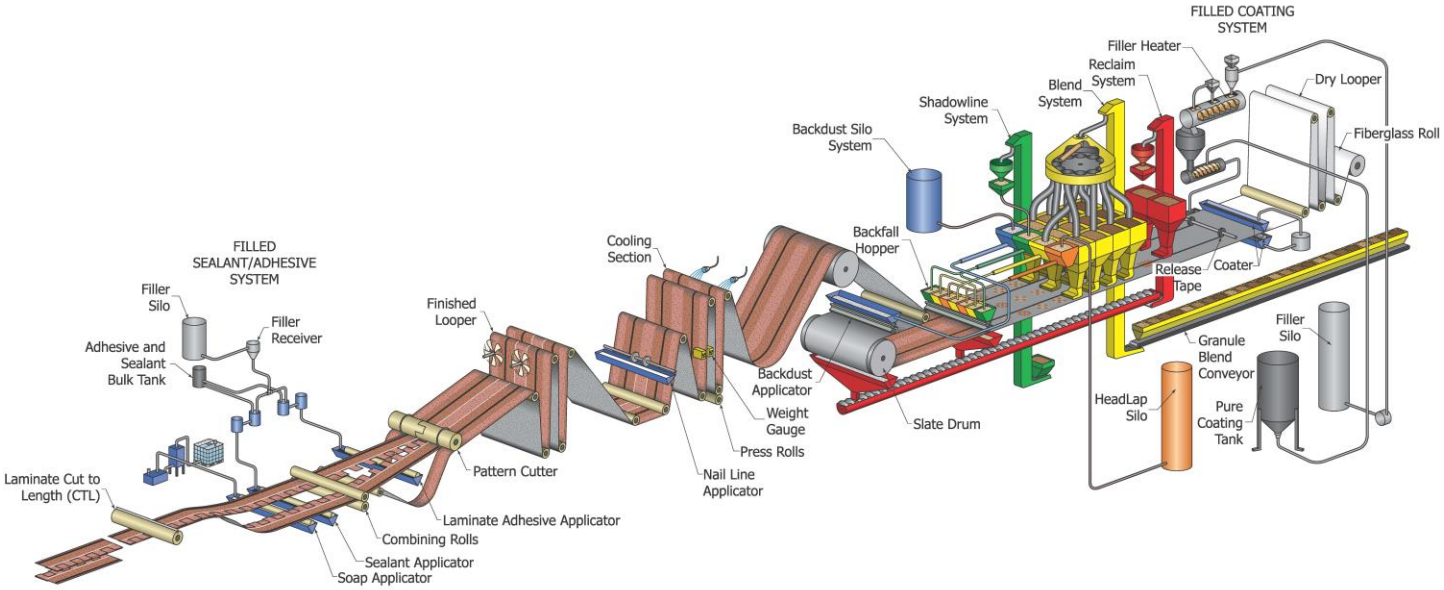
Table 6 Raw Material Composition of Duration® Series Shingles (1 m^2)

Raw Material	Amount (lb)	Percent of Total (wt%)
Fiberglass Mat	6.08E-01	2%
Asphalt	4.99E+00	20%
Limestone	9.21E+00	38%
Granules	6.81E+00	28%
Coal slag	1.03E+00	4%
Sand	1.41E+00	6%
Dolomite	3.97E-01	2%
Total	2.45E+01	100%

Manufacturing Process

Figure 1 below 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 1 Process Diagram of Asphalt Shingle Manufacturing



Cut-off Criteria

The cut-off criteria used in the underlying LCA, the results of which are declared in this EPD, follow the guidelines set forth in the PCR and have been reproduced as follows:

> *Mass: If a flow is less than 1% of the cumulative mass of the model flows, it may be excluded, provided its environmental relevance is minor.*
>
> *Energy: If a flow is less than 1% of the cumulative energy of the system model, it may be excluded, provided its environmental relevance is minor.*
>
> *Environmental relevance: Material and energy flows known to have the potential to cause significant emissions into air, water, or soil related to the environmental indicators of these PCR shall be included even if such flows meet the above criteria for Mass and Energy.*
>
> *At least 95% of the energy usage and mass flow shall be included and the life-cycle impact data shall contain at least 95% of all elementary flows that contribute to each of the declared category indicators.*
>
> *A list of hazardous and toxic materials and substances shall be included in the inventory and the cutoff rules do not apply to such substances.*

The products studied in this analysis are all members of Owens Corning® Asphalt Shingles Collection. As indicated in Table 1, Oakridge® Shingles and Duration® Series Shingles are both laminate shingles. In addition to variation in shadow line and color schemes, the difference between Oakridge® and Duration® Series Shingles products is the nail area. Oakridge® Shingle products have a painted nail line, whereas Duration® Shingle products have a patented, engineered fabric strip called SureNail® Technology for nailing that enhances the sealing of the product. This reinforcement fabric, which meets the above cut-off criteria for exclusion, was not included in the LCA model.

The cut-off criteria were also applied when excluding empty backhauls in transportation modules. Although transportation, especially its associated fossil fuel consumption, has a significant impact on global warming, it has minor significance compared to the other flows within the system model.

Transportation

The inbound transportation stage has been modeled such that the transport of raw material inputs for product manufacturing are separate from the transport of packaging materials needed for finished asphalt shingle products. Primary data was collected from each of the four facilities on raw material inputs and packaging as well as their inbound transportation distances.

Period under Consideration

All Owens Corning Roofing and Asphalt, LLC primary data for each of the facilities modeled in the underlying LCA were from the fiscal year 2012.

Secondary Background Data

Life-cycle modeling and calculation of potential environmental impacts were conducted using the LCA software SimaPro

8 developed by PRé Consultants bv. The LCI database libraries provided were the source of the secondary data used in the study. Of the various databases available, the LCI databases used largely for secondary data were the US-EI and ecoinvent database. 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, raw material inputs or the manufacturing of the asphalt shingles themselves, 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.

Data Quality

To determine how representative the data used to model the life-cycle of asphalt shingles manufactured in 2012 is, the temporal, geographical and technological aspects of the data were assessed. For each of Owens Corning Roofing and Asphalt, LLC facilities analyzed in the underlying LCA study, the data used adequately represents the technology used in 2012 in the United States and Canada. The secondary data used from the SimaPro LCI databases was the most appropriate and current data available.

Allocation

Allocation has been avoided and system expansion has been used where possible following the precepts of the ISO 14044 standard. Whenever allocation was necessary, the method chosen was based upon the nature and purpose of the process. Allocation calculations that were made are consistent with the data quality and availability as well as the allocation method used. The physical relationship between flows (mass) was used to conduct allocation when system expansion was not possible.

End-of-Life

After the useful service-life, the end-of-life stage, which was modeled for the spent asphalt shingles, consisted of the transportation by tractor-trailer truck of the declared unit amounts of the asphalt shingles for an assumed distance of 100 miles to two separate disposal scenarios, recycling and waste-to-landfill.

Analysis of survey data collected by Owens Corning Roofing and Asphalt from shingle recyclers indicated that in 2012, the percent of shingles recycled at the end of the useful service-life was roughly 19%. Using this primary data, the recycling disposal scenario consisted of the transportation of the used asphalt shingles from the deconstruction site for the above noted distance of 100 miles to a recycling facility. In the second disposal scenario, the remainder of the declared unit amount (i.e., 81%) of the asphalt shingles is transported for the same, assumed distance of 100 miles to a landfill site and included its subsequent disposal as waste-to-landfill.

For the packaging materials, which consist of bundle wrappers and wooden pallets, the end-of-life processes consisted of the transportation of the amount of packaging materials, which are associated with the declared unit, from the construction site for a distance of 50 miles by diesel truck to a recycling facility.

Life Cycle Impact Assessment Results

Impact Categories and Assessment Methodology

The impact categories for which the impact assessment results have been calculated over the cradle-to-gate and EoL life-cycle stages are shown in Table 7 below. Following the guidelines of the PCR, the TRACI 2.1 impact assessment methodology was used for each of the required environmental impact categories shown. Unless otherwise indicated, all results are for the declared unit amount of each of the three asphalt shingle products.

Table 7 Impact Categories and Assessment Methodology

Impact Category	Indicator	LCIA Methodology Source
Environmental		
Global warming	kg CO2 eq	TRACI 2.1 V1.01
Acidification	kg SO2 eq	TRACI 2.1 V1.01
Eutrophication	kg N eq	TRACI 2.1 V1.01
Smog	kg O3 eq	TRACI 2.1 V1.01
Ozone depletion	kg CFC-11 eq	TRACI 2.1 V1.01
Primary Energy Demand		
Non-renewable, fossil (E)	MJ	CED V1.08
Non-renewable, nuclear (E)	MJ	CED V1.08
Non-renewable, biomass (E)	MJ	CED V1.08
Renewable, biomass (E)	MJ	CED V1.08
Renewable, wind, solar, geothermal (E)	MJ	CED V1.08
Renewable, water (E)	MJ	CED V1.08
Total Primary Energy Demand[1]	MJ	CED V1.08

1. "Total Primary Energy Demand" is the sum of the three non-renewable and three renewable impact categories listed.

Primary Energy Resources

Table 8 below shows the amount of each type of primary energy resource consumed over the cradle-to-gate and end-of-life life-cycle stages for the declared unit amount of each of the three types of asphalt shingles.

Table 8 Primary Energy Demand, (by Resource, 1 m^2)

Primary Energy Demand (by Resource, 1 m^2)	Unit	Supreme® Shingles	Oakridge® Shingles	Duration® Series Shingles
Non-renewable, fossil	MJ	140	166	170
Non-renewable, nuclear	MJ	4	5	5
Non-renewable, biomass	MJ	0	0	0
Non-renewable subtotal	**MJ**	**144**	**170**	**175**
Renewable, biomass	MJ	5	7	7
Renewable, wind, solar, geothermal	MJ	0	0	0
Renewable, hydroelectric	MJ	1	1	1
Renewable subtotal	**MJ**	**6**	**8**	**8**
Total	**MJ**	**150**	**178**	**184**

Primary energy resource consumption is shown Figures 2, 3 and 4, for Supreme® Shingles, Oakridge® Shingles and Duration® Series Shingles, respectively.

Figure 2 Primary Energy Demand for Supreme® Shingles (by Resource, 1 m^2)

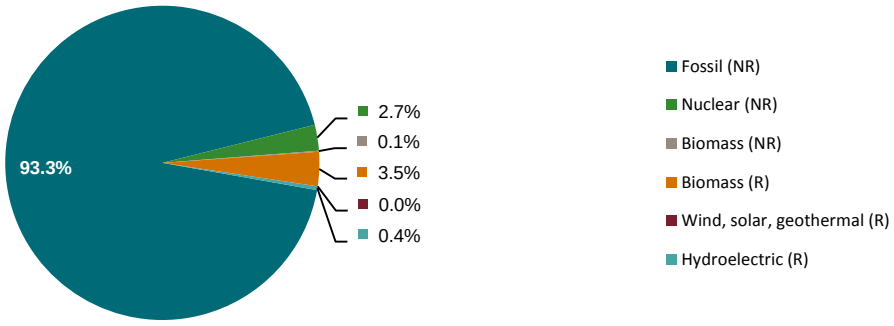


Figure 3 Primary Energy Demand for Oakridge® Shingles (by Resource, 1 m^2)

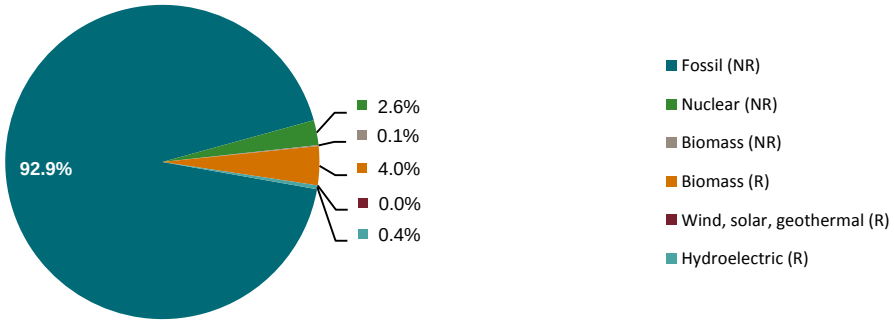
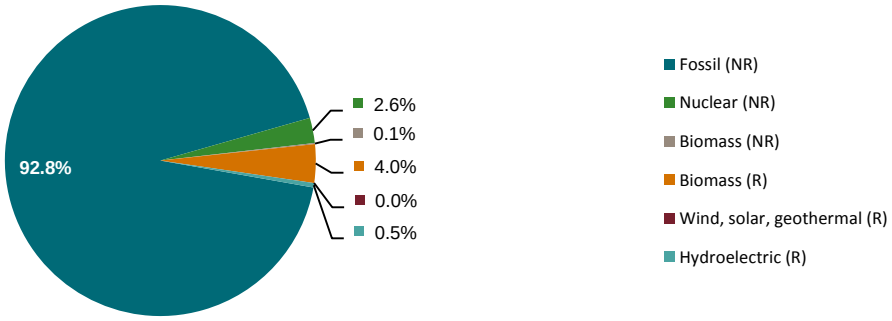


Figure 4 Primary Energy Demand for Duration® Series Shingles (by Resource, 1 m^2)



Providing an additional perspective, primary energy demand by individual life-cycle modules is shown Figures 5, 6 and 7, for Supreme® Shingles, Oakridge® Shingles and Duration® Series Shingles, respectively.

Figure 5 Primary Energy Demand for Supreme® Shingles (by Life Cycle Stage, 1 m²)

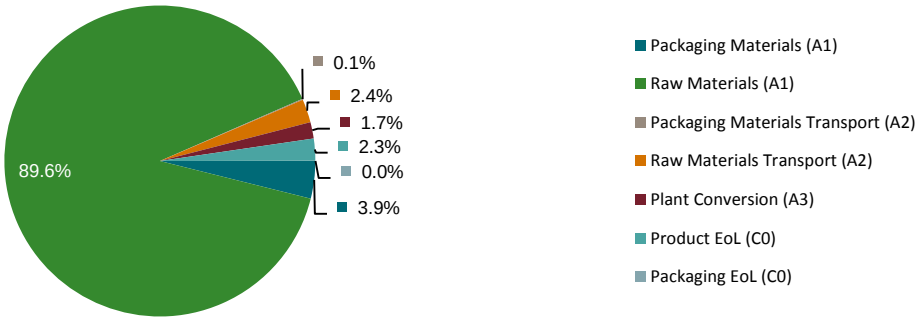


Figure 6 Primary Energy Demand for Oakridge® Shingles (by Life Cycle Stage, 1 m²)

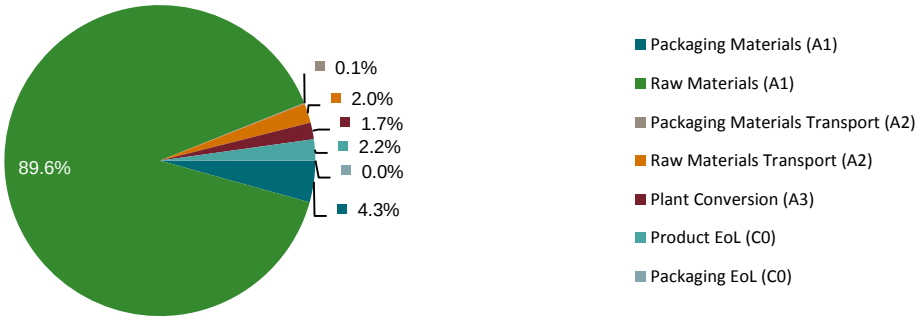
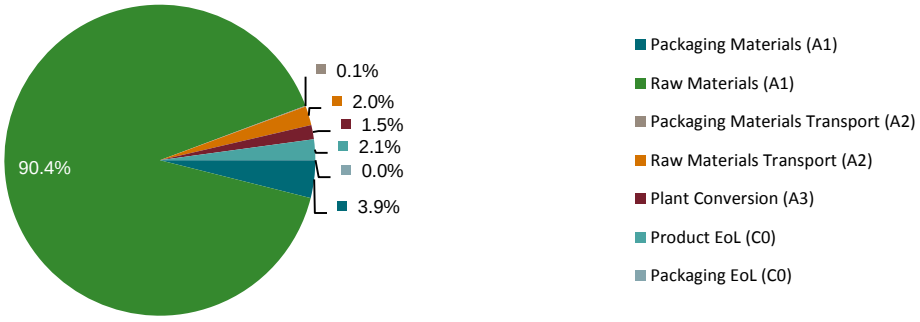


Figure 7 Primary Energy Demand for Duration® Series Shingles (by Life Cycle Stage, 1 m²)



The cradle-to-gate and end-of-life environmental impact assessment results for each of the categories listed in Table 7 are shown in Tables 9, 10 and 11 for Supreme® Shingles, Oakridge® Shingles and Duration® Series Shingles, respectively.

Table 9 LCIA Results for Supreme® Shingles (by Life Cycle Stage, 1 m²)

Impact category	Unit	Total	Raw material supply		Transport		Manufacturing	End of Life	
			Packaging Materials (A1)	Raw Materials (A1)	Packaging Materials Transport (A2)	Raw Materials (A2)	Plant Conversion (A3)	Product EoL (C0)	Packaging EoL (C0)
Global warming	kg CO2 eq	5.08E+00	1.01E-01	4.08E+00	1.32E-02	3.22E-01	2.59E-01	3.03E-01	2.58E-03
Acidification	kg SO2 eq	3.31E-02	5.02E-04	2.60E-02	8.19E-05	2.43E-03	2.11E-03	1.90E-03	1.60E-05
Eutrophication	kg N eq	4.18E-03	5.05E-05	3.86E-03	4.40E-06	1.34E-04	2.83E-05	1.02E-04	8.61E-07
Smog	kg O3 eq	4.33E-01	6.56E-03	2.85E-01	2.26E-03	7.05E-02	1.58E-02	5.26E-02	4.43E-04
Ozone depletion	kg CFC-11 eq	1.34E-06	4.41E-09	1.33E-06	5.74E-13	1.40E-11	2.34E-10	7.42E-09	1.12E-13

Table 10 LCIA Results for Oakridge® Shingles (by Life Cycle Stage, 1 m²)

Impact category	Unit	Total	Raw material supply		Transport		Manufacturing	End of Life	
			Packaging Materials (A1)	Raw Materials (A1)	Packaging Materials Transport (A2)	Raw Materials (A2)	Plant Conversion (A3)	Product EoL (C0)	Packaging EoL (C0)
Global warming	kg CO2 eq	5.40E+00	1.23E-01	4.30E+00	1.61E-02	3.17E-01	2.94E-01	3.43E-01	3.62E-03
Acidification	kg SO2 eq	3.83E-02	6.32E-04	3.02E-02	1.00E-04	2.76E-03	2.38E-03	2.15E-03	2.25E-05
Eutrophication	kg N eq	4.94E-03	6.77E-05	4.56E-03	5.38E-06	1.56E-04	3.19E-05	1.15E-04	1.21E-06
Smog	kg O3 eq	4.98E-01	8.48E-03	3.25E-01	2.77E-03	8.24E-02	1.84E-02	5.95E-02	6.22E-04
Ozone depletion	kg CFC-11 eq	1.61E-06	6.06E-09	1.59E-06	7.03E-13	1.38E-11	2.41E-10	8.39E-09	1.58E-13

Table 11 LCIA Results for Duration® Series Shingles (by Life Cycle Stage, 1 m²)

Impact category	Unit	Total	Raw material supply		Transport		Manufacturing	End of Life	
			Packaging Materials (A1)	Raw Materials (A1)	Packaging Materials Transport (A2)	Raw Materials (A2)	Plant Conversion (A3)	Product EoL (C0)	Packaging EoL (C0)
Global warming	kg CO2 eq	5.61E+00	1.16E-01	4.54E+00	1.30E-02	3.23E-01	2.74E-01	3.47E-01	3.36E-03
Acidification	kg SO2 eq	3.96E-02	5.92E-04	3.16E-02	8.10E-05	2.86E-03	2.24E-03	2.17E-03	2.09E-05
Eutrophication	kg N eq	5.14E-03	6.31E-05	4.76E-03	4.34E-06	1.62E-04	2.96E-05	1.17E-04	1.12E-06
Smog	kg O3 eq	5.15E-01	7.93E-03	3.42E-01	2.24E-03	8.57E-02	1.70E-02	6.01E-02	5.78E-04
Ozone depletion	kg CFC-11 eq	1.65E-06	5.64E-09	1.63E-06	5.67E-13	1.41E-11	2.45E-10	8.47E-09	1.47E-13

Water Consumption and Non-hazardous Waste

Table 12 Water Consumption and Non-hazardous Waste from Asphalt Shingle Manufacturing

	Unit	Supreme® Three-Tab Shingles (1 m²)	Oakridge® Shingles (1 m²)	Duration® Shingles (1 m²)
Water consumption	kg	3.01E-01	2.00E+00	2.04E+00
Non-hazardous Waste	lb	3.74E-02	1.41E-01	1.13E-01

References

- Product Category Rules for Preparing an Environmental Product Declaration for Product Group: Asphalt Shingles, Built-up Asphalt Membrane Roofing and Modified Bituminous Membrane Roofing, Version 1.0, 31 July 2014
- ISO 14025:2006(E), Environmental labels and declarations – Type III environmental declarations – Principles and procedures, 1 July 2006
- ISO 14040:2006(E), Environmental management – Life cycle assessment – Principles and framework, 1 July 2006
- ISO 14044:2006(E), Environmental management – Life cycle assessment – Requirements and guidelines, 1 July 2006
- ASTM D3462/D3462M REV A, Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules