

ENVIRONMENTAL PRODUCT DECLARATION

ecore™

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PRODUCT:

Galaxy rx

Ecore's mission is to transform reclaimed waste into surfaces that aim to help improve people's lives via a wide range of flooring applications. Ecore's products, manufactured at its Pennsylvania facilities, contain recycled styrene butadiene (SBR), reducing waste. Galaxy rx is made by fusing Ecore's 5 mm recycled rubber backing to a rubber surface layer. These products are revolutionizing the flooring industry, providing sound control, improved ergonomics, and helping to prevent the severity of injury associated with falls.

FUNCTIONAL UNIT:

1 m² of floor covering provided and maintained for a period of 60 years.

EPD NUMBER AND PERIOD OF VALIDITY:

SCS-EPD-04033 ••• Valid June 6, 2016 to June 5, 2021

PRODUCT CATEGORY RULE:

Product Category Rule (PCR) for preparing an Environmental Product Declaration (EPD) for Flooring: Carpet, Resilient, Laminate, Ceramic, Wood. NSF International. Version 2. 2014.

PROGRAM OPERATOR:



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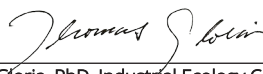
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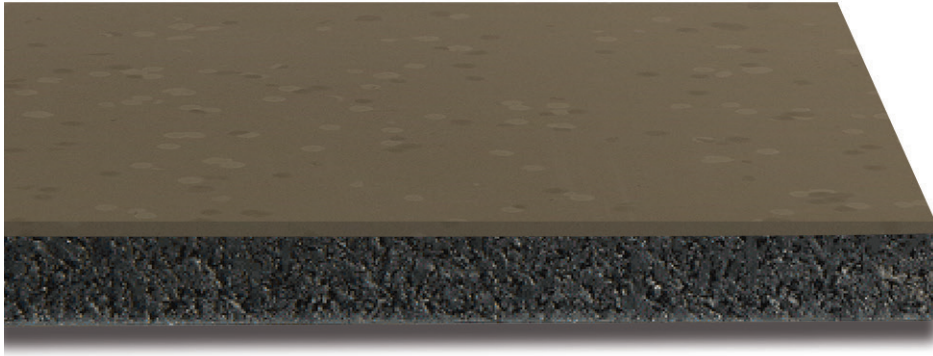
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Disclaimers: <i>This EPD conforms to ISO 14025, 14040, ISO 14044, and ISO 21930.</i>	
Scope of Results Reported: <i>The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.</i>	
Accuracy of Results: <i>Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.</i>	
Comparability: <i>The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.</i>	
PCR review, was conducted by	Jack Geibig, EcoForm; jgeibig@ecoform.com
Approved June 6, 2016. Valid until June 5, 2021.	
Independent verification of the declaration and data, according to ISO 14025:2006 and ISO 21930:2007.	<input type="checkbox"/> internal <input checked="" type="checkbox"/> external
Third party verifier	 Tom Gloria, PhD, Industrial Ecology Consultants



PRODUCT DESCRIPTION:

Galaxy rx is ideal for healthcare, senior living, hospitality, and education applications. Using Ecore's patented itstru technology, Galaxy rx is comprised of premium rubber sheet flooring fusion-bonded to a 5 mm Ecore backing made of 90% recycled rubber. The finished product is two layers of rubber designed to reduce the severity of patient or resident injuries while mitigating liability for the owners of facilities. It brings comfort to heavy commercial applications through energy absorption and energy return, improved ergonomics and acoustical benefits.

PRODUCT PERFORMANCE:

Table 1. Product performance test results for Galaxy rx.

ASTM F1860 Specification for Rubber Sheet Floor Covering With Backing	Test Method and Results	
Characteristic	ASTM Test Method	Test Results
Hardness Shore A Durometer	ASTM D 2240	Not less than 85 Shore A
Static Load Limit	ASTM F 970	@ 250 PSI - < 0.005"
Slip Resistance	ASTM D 2047	greater than 0.6
Color Heat Stability	ASTM F 1514	< 8.0
Color Light Stability	ASTM F 1515	< 8.0
Abrasion Resistance	ASTM D 3389	less than 1 gram loss after 1,000 cycles

PRODUCT APPLICATION:

Galaxy rx can be used for various applications including: healthcare, senior living, hospitality and education.

MATERIAL CONTENT

Table 2. Material content for Galaxy rx.

Component	Materials	Mass %	Availability			Origin of Raw Materials
			Renewable	Non-Renewable	Recycled	
Layer	Rubber, SBR, Crumb	49%			Fossil resource, limited	US
Layer	Rubber, SBR, Virgin	24%		Fossil resource, limited		US
Adhesive	Hot Melt Adhesive	13%		Fossil resource, limited		Global
Adhesive	Polymer Binder	6.5%		Fossil resource, limited		Global
Layer	Rubber, EPDM, Recycled	6.2%			Fossil resource, limited	US
Additive	Water	0.62%	Region dependent			US

In conformance with the PCR, product materials were reviewed for the presence of any toxic or hazardous chemicals. Based on a review of Material Safety Data Sheets (MSDS) provided by the manufacturer, the following regulated hazardous chemicals, including Chemical Abstract Service (CAS) numbers, may be present in the flooring product:

- 4,4'-Diphenylmethane Diisocyanate (MDI) (CAS# 101-68-8)
- Carbon Black (CAS# 1333-86-4)
- Diisocyanates (CAS# 9016-87-9; 26447-40-5)
- Polyisocyanate pre-polymer (CAS# proprietary)

PRODUCTION OF MAIN MATERIALS:

Hot Melt Adhesive:

Used to fuse the surface layer to the backing and derived from petrochemicals.

Polymer Binder:

A chemical compound derived from petrochemicals used to cross link polymers.

Rubber, EPDM:

A synthetic elastomer produced as a copolymer of ethylene and propylene, with small amounts of a cross linking agent.

Rubber, SBR (virgin):

Synthetic rubber derived from two monomers, styrene and butadiene, forming styrene-butadiene.

Rubber, SBR (Crumb):

Synthetic rubber derived from two monomers, styrene and butadiene, forming styrene-butadiene. Crumb is typically recovered from scrap tires and processed with a granulator, cracker mill, cryogenics, or other mechanical means to reduce the size.

Water:

The most widely used of all solvents, it is a natural resource that may be delivered from a public or private supplier, or be self-supplied.

PRODUCT CHARACTERISTICS:

Table 3. Product characteristics for Galaxy rx.

Characteristics			Value	Unit
Product Thickness			6.6 (0.26)	mm (in)
Wear Layer Thickness			1.6 (0.063)	mm (in)
Product Weight			5,859 (19.2)	g/m ² (oz/ft ²)
Product Form:	Rolls	Width:	1,830 (72)	mm (in)
		Length:	Customer specified	mm (in)
Tiles	Width x Length:		NA	mm (in)
VOC Emissions Test Method			CA Section 01350	

ADDITIONAL ENVIRONMENTAL INFORMATION:

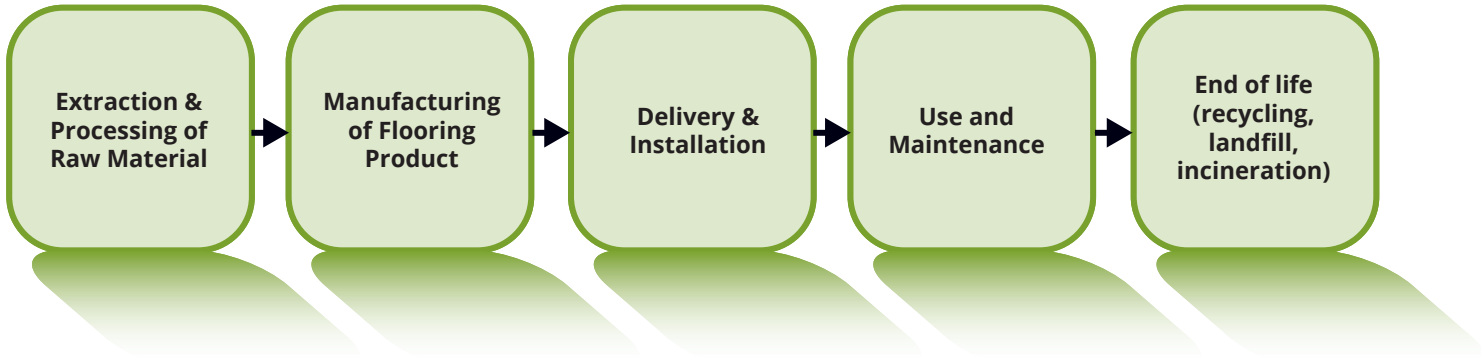
Ecore is a member of the U.S. Green Building Council (USGBC), a third-party organization that provides independent oversight of professional credentialing and project certification programs related to green building.

All Galaxy rx salvages, overages, and old material can be packaged and shipped back at the owner's expense to Ecore's Redeux Reclamation Program in Lancaster, Pennsylvania. Materials accepted into the Redeux program will be sorted, shredded, cleaned, and ground for the next generation of recycled rubber flooring, underlayment, and industrial products. For more information regarding Ecore's Redeux program, visit <http://www.ecoreintl.com/redeux.php>. Similarly, all of Ecore's rubber manufacturing scrap is collected and reground to be used in future flooring.

Ecore's E-Cleaner, the recommended cleaner used for daily cleaning and maintenance for Galaxy rx, is Green Seal™ GS-37 certified. For more information regarding E-Cleaner, visit: www.ecorecommercialflooring.com/literature_accessories.php

LIFE CYCLE ASSESSMENT:

A cradle-to-grave life cycle assessment (LCA) was completed for Galaxy rx in accordance with ISO 14040, ISO 14044, and Product Category Rule for Environmental Product Declarations Flooring: Carpet, Resilient, Laminate, Ceramic, Wood (Version 2).

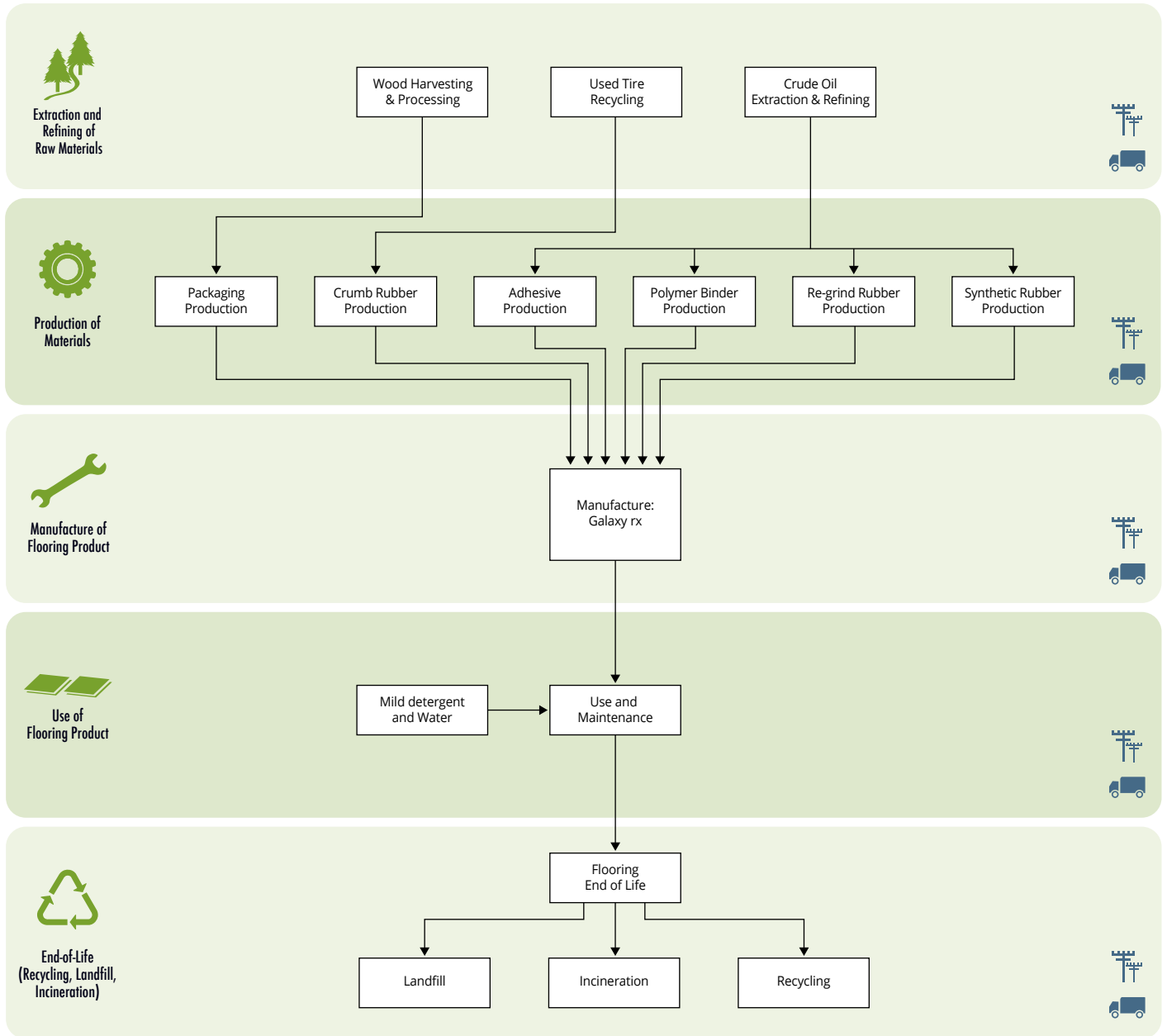


FUNCTIONAL UNIT:

The functional unit is according to the PCR the total impact for the expected life of the building (60 years). But the service life depends on the product lifetime, which is 7 years in this case. The PCR consequently requires separate reporting of LCA results: A) for 1 m² of floor covering - extraction/processing, manufacturing, delivery & installation and end-of-life; and B) the average 1-year use stage; and C) for the 60 year life of the building as combined using A) and B), calculated from the reference service life RSL of the product.

PRODUCT LIFE CYCLE FLOW DIAGRAM:

The diagram below is a representation of the most significant contributions to the life cycle of Galaxy rx. This includes raw material extraction and processing, component manufacturing, assembly, use and maintenance, and end-of-life.



LIFE CYCLE ASSESSMENT STAGES AND REPORTED EPD INFORMATION:

Raw Material Extraction & Processing stage:

This stage includes extraction of virgin materials and reclamation of non-virgin feedstock. Resource use and emissions associated with both the extraction of the raw materials used in the products, as well as those associated with the processing of raw materials are included. Impacts associated with the transport of the materials to manufacturing facilities (upstream transport) are also included in this stage.

Manufacturing stage:

Galaxy rx is manufactured in an ISO 9001 certified facility. This stage includes all the relevant manufacturing processes and flows, including the impacts from energy use and emissions associated with the processes occurring at the Lancaster and York, Pennsylvania facilities. This stage also includes the production and disposal (including transport) of the product packaging materials. Production of capital goods, infrastructure, production of manufacturing equipment, and personnel-related activities are not included.

Delivery and installation stage:

Delivery

This stage includes the delivery of Galaxy rx to the point of installation. Modeling used in the life cycle assessment assumed product distribution as 2,700 miles (4,370 km) by diesel truck and 153 miles (246 km) by ocean freighter.

Installation

The manufacturer recommends use of E-Grip III, a zero-VOC, low odor, one-component urethane adhesive. The recommended application rate is 0.011 gal/ft². Additionally, seams are prepared in the rubber sheet flooring with the manufacturer's special routing tool and heat welded with rubber thread.

Manufacturer recommended installation methods can be found online: http://www.ecorecommercialflooring.com/literature_rx.php

Waste

Waste generated during product installation can be disposed of in a landfill or incinerated.

Packaging

Table 4. Packaging material for Galaxy rx per m² of flooring.

Material	kg (lb)
Cardboard	9.3x10 ⁻⁴ (2.1x10 ⁻³)
Plastic	1.5x10 ⁻⁵ (3.3x10 ⁻⁵)
Wood	9.8x10 ⁻³ (2.2x10 ⁻²)

Use stage:

Cleaning and maintenance

Cleaning and maintenance of the Galaxy rx rubber flooring follows the guidelines recommended by the manufacturer, and are summarized in Table 5.

Table 5. Product installation, cleaning, and maintenance for Galaxy rx.

Product Installation			
• Ecore's E-Grip III: Zero-VOC, low odor, one-component urethane adhesive			
• Application rate approximately 0.011 gal/ft ²			
• Manufacturer's routing tool and heat welding with rubber thread for preparing seams			
Cleaning and maintenance			
Cleaning Process & Frequency	Recommended Cleaner	Dilution	Coverage (diluted)
Initial Cleaning	Ecore's E-Cleaner (1-5% detergent blend)	10 oz/gal water	2,000 ft ² /gal.
Daily Cleaning	Ecore's E-Cleaner (1-5% detergent blend)	2-4 oz/gal water	6,000 ft ² /gal.
Heavy Soil and Restorative Cleaning (once per product lifetime)	Ecore's E-Cleaner (1-5% detergent blend)	16 oz/gal water	1,200 ft ² /gal.

End-of-Life stage:

Recycling, reuse, or repurpose

Data for estimation of recycling rates for the product and packaging were taken from data prepared by the US Environmental Protection Agency's Municipal Solid Waste Report. These data provide US statistics on recycling rates.

Disposal

For materials not recycled, it is assumed that 20% are incinerated, and 80% go to a landfill, based on the US EPA data. Transportation of waste materials at end of life assumes a 20 mile average distance to disposal, consistent with assumptions used in the US EPA WARM model.

LIFE CYCLE INVENTORY:

In accordance with ISO 21930, the following aggregated inventory flows are included in the EPD:

- Use of renewable material resources
- Consumption of freshwater
- Hazardous wastes
- Non-hazardous wastes

All results are calculated using the SimaPro 8.0 model using primary and secondary inventory data. Classification for Use of Renewable Material Resources is based on review of elementary flows and resources considered renewable on a human time scale. Elementary flows related to use of wood, minerals, and land occupation were not included. Water consumption is not included, as it is reported separately. Based on this classification process, the use of renewable material resources for the product system is considered to be negligible.

Table 6. Results for consumption of freshwater and waste flows, shown per 1 m² of Galaxy rx flooring maintained for 60 years.

Parameter	Unit	Consumption of Freshwater	Hazardous Waste	Non-hazardous Waste
Galaxy rx	kg	6,400	2.5x10 ⁻³	62

LIFE CYCLE IMPACT ASSESSMENT:

Life cycle impact assessment is the process of converting the life cycle inventory results into a representation of environmental and human health impacts. For example, emissions such as carbon dioxide, methane, and nitrous oxide (inventory) together contribute to climate change (impact assessment). The impact assessment for the EPD is conducted in accordance with requirements of the PCR. Impact category indicators were estimated using the CML 2001 (Oct 2013) characterization method. Aggregated inventory flows for energy use and wastes were also calculated. The LCIA and inventory flow results were calculated using SimaPro 8.0.2 software.

Table 7 shows the total life cycle impact assessment results for Galaxy rx over 60 years. Table 8 shows results for 1 m² of flooring, including extraction of raw materials through installation and end of life. Table 9 shows the average use stage impacts for 1 m² of flooring over 1 year. Table 10 lists the assumptions used for product maintenance. Table 11 shows the life cycle impact assessment results by life cycle stage for 1 m² of flooring over a 60 year period.

Table 7. Life cycle impact assessment results for 1 m² Galaxy rx maintained for 60 years.

Impact Category	Units	1 m ² of Galaxy rx
Global warming potential, 100 years	kg CO ₂ eq	290
Acidification Potential	kg SO ₂ eq	1.0
Ozone depletion potential	kg CFC-11 eq	3.8x10 ⁻⁶
Photochemical oxidation Creation Potential	kg C ₂ H ₄	6.5x10 ⁻²
Eutrophication Potential	kg PO ₄ ³⁻ eq	0.36
Abiotic depletion, elements	kg Sb eq	2.3x10 ⁻⁴
Abiotic depletion, fossil fuels	MJ	5,100
Renewable Energy	MJ eq	120
Non-renewable Energy	MJ eq	5,600

Table 8. Cradle-to-install, and end of life for 1 m² Galaxy rx (Table A of the PCR).

Impact Category	Extraction & Processing	Extraction & Processing	Manufacturing	Delivery & Installation	Disposal	Total
Global warming potential, 100 years	kg CO ₂ eq	7.5	3.5	5.4	4.1	20
Acidification Potential	kg SO ₂ eq	2.2x10 ⁻²	2.6x10 ⁻²	2.3x10 ⁻²	3.0x10 ⁻³	7.4x10 ⁻²
Ozone depletion potential	kg CFC-11 eq	8.4x10 ⁻⁸	3.2x10 ⁻⁸	6.6x10 ⁻⁹	3.6x10 ⁻⁸	1.6x10 ⁻⁷
Photochemical Oxidation Creation Potential	kg C ₂ H ₄	1.5x10 ⁻³	1.2x10 ⁻³	1.1x10 ⁻³	2.5x10 ⁻⁴	4.0x10 ⁻³
Eutrophication Potential	kg PO ₄ ³⁻ eq	4.4x10 ⁻³	2.6x10 ⁻³	3.5x10 ⁻³	9.3x10 ⁻⁴	1.1x10 ⁻²
Abiotic depletion, elements	kg Sb eq	4.4x10 ⁻⁶	5.6x10 ⁻⁷	6.9x10 ⁻⁷	2.6x10 ⁻⁶	8.3x10 ⁻⁶
Abiotic depletion, fossil fuels	MJ	220	55	88	12	380
Renewable Energy	MJ eq	1.4	3.1	0.65	0.97	6.1
Non-renewable Energy	MJ eq	240	60	99	13	410

Table 9. Average 1 year use stage potential impacts for 1 m² Galaxy rx. (Table B of the PCR)

Impact Category	Units	Use & Maintenance
Global warming potential, 100 years	kg CO ₂ eq	0.66
Acidification Potential	kg SO ₂ eq	8.8x10 ⁻⁴
Ozone depletion potential	kg CFC-11 eq	1.8x10 ⁻⁸
Photochemical Oxidation Creation Potential	kg C ₂ H ₄	3.7x10 ⁻⁴
Eutrophication Potential	kg PO ₄ ³⁻ eq	1.5x10 ⁻²
Abiotic depletion, elements	kg Sb eq	2.1x10 ⁻⁷
Abiotic depletion, fossil fuels	MJ	2.0
Renewable Energy	MJ eq	8.9x10 ⁻²
Non-renewable Energy	MJ eq	2.5

Table 10. List of maintenance activities and frequency.

Maintenance Activity	Frequency over Reference Service Life (RSL) of product
Initial cleaning	Once over 7 year RSL
Daily Cleaning	Up to a maximum of 2,555 times over 7 year RSL
Heavy Soil and Restorative Cleaning	Once over 5 year RSL

Table 11. Life cycle stage impacts for a building life of 60 years (Table C of the PCR).

Impact Category	Units	Extraction & Processing	Manufacturing	Delivery & Installation	Use	End of life	Total
Global warming potential 100 year time horizon	kg CO ₂ eq	90	42	65	40	49	290
Acidification potential	kg SO ₂ eq	0.27	0.31	0.27	0.18	1.1x10 ⁻²	1.0
Ozone depletion potential	kg CFC-11 eq	1.0x10 ⁻⁶	3.8x10 ⁻⁷	8.0x10 ⁻⁸	2.2x10 ⁻⁶	2.1x10 ⁻⁷	3.8x10 ⁻⁶
Photochemical Oxidation Creation Potential	kg C ₂ H ₄	1.8x10 ⁻²	1.4x10 ⁻²	1.3x10 ⁻²	1.5x10 ⁻²	4.5x10 ⁻³	6.5x10 ⁻²
Eutrophication Potential	kg PO ₄ ³⁻ eq	5.3x10 ⁻²	3.2x10 ⁻²	4.2x10 ⁻²	5.6x10 ⁻²	0.18	0.36
Abiotic depletion, elements	kg Sb eq	5.3x10 ⁻⁵	6.7x10 ⁻⁶	8.2x10 ⁻⁶	1.6x10 ⁻⁴	2.5x10 ⁻⁶	2.3x10 ⁻⁴
Abiotic depletion, fossil fuels	MJ	2,700	660	1,100	720	24	5,100
Renewable Energy	MJ eq	16	37	7.8	58	1.1	120
Non-renewable Energy	MJ eq	2,900	730	1,200	800	30	5,600

SUPPORTING TECHNICAL INFORMATION:

Data sources:

Unit processes were developed with SimaPro 8.0.2 software, drawing upon data from multiple sources. Primary data were provided by Ecore and some of its suppliers for their manufacturing processes. The primary source of secondary LCI data was Ecoinvent, with some data from the US LCI database.

Table 12. *Data sources used for the LCA.*

Material	Data Source	Flow Name	Date
Hot Melt Adhesive	Ecoinvent v2.2	Nylon 6, at plant/RER	2010
Polymer Binder	Ecoinvent v2.2	Methylene diphenyl diisocyanate, at plant/kg/RER	2010
Rubber, EPDM	Ecoinvent v2.2	Synthetic rubber, at plant/RER	2010
Rubber, SBR, Crumb	Supplier Data	SBR – Crumb, recycled	2013
Rubber, SBR, recycled	Supplier Data	SBR, recycled	2013
Water	Ecoinvent v2.2	Process water (unspecified origin)	2007
Corrugated board	Ecoinvent v2.2	Packaging, corrugated board, mixed fibre, single wall, at plant/RER	2003
Packaging film; plastic banding	Ecoinvent v2.2	Packaging film, LDPE, at plant/RER; polypropylene, granulate, at plant/ RER	2003; 2003
Pallet	US-EI	Pallet (22kg)/US	2009
Truck	US LCI	Transport, combination truck, diesel powered/US	2008
Ship	US LCI	Transport, transoceanic freight ship/OCE	2008

Data Quality:

Table 6. Data Quality assessment of Life Cycle Inventory.

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data should be collected	Manufacturer-supplied data (primary data) are based on 2014 annual production. Representative datasets (secondary data) used for upstream and background processes are generally less than 10 years old (typically 2007 or more recent). All of the data used represented an average of at least one year's worth of data collection, and up to three years in some cases.
Geographical Coverage: Geographical area from which data for unit processes should be collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Actual processes for upstream operations are primarily North American. Surrogate data used in the assessment are representative of North American or European operations. Data representative of European operations are considered sufficiently similar to actual processes. Data representing product disposal are based on US statistics.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Representative fabrication datasets, specific to the type of material, are used to represent the actual processes, as appropriate.
Precision: Measure of the variability of the data values for each data expressed.	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of the rubber flooring products. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded. In total, these missing data represent less than 5% of the mass or energy flows.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest.	Data used in the assessment represent typical or average processes as currently reported from multiple data sources, and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis.	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent data where available. Different portions of the product life cycle are equally considered; however, it must be noted that final disposition of the product is based on assumptions of current average practices in the United States.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study.	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the data: Description of all primary and secondary data sources.	Data representing energy use at Ecore's Pennsylvania manufacturing facilities represent an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI datasets, both Ecoinvent and the US LCI data are used, with a bias towards Ecoinvent data.
Uncertainty of the information: Uncertainty related to data, models, and assumptions	Uncertainty related to the rubber flooring product materials and packaging is low. Actual supplier data for upstream operations was sought but not available for all suppliers and the study relied upon use of existing representative datasets. These datasets contained relatively recent data (<10 years), but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

Allocation:

Economic allocation is used for the manufacturing life cycle phase. Resource use at the York and Lancaster, Pennsylvania facilities (e.g., water and energy) is allocated to the product based on the unit price as a fraction of the total facility sales.

The Ecore Galaxy rx flooring product system includes recycled materials, which are allocated using the recycled content allocation method (also known as the 100-0 cut off method). Using the recycled content allocation approach, system inputs with recycled content do not receive any burden from the previous life cycle other than reprocessing of the waste material. At end of life, materials which are recycled leave the system boundaries with no additional burden.

Impacts from transportation, including product distribution to point of sale, are allocated based on the mass of material and distance transported.

System boundaries:

The system boundaries of the life cycle assessment for Galaxy rx was cradle to grave. A description of the system boundaries for the LCA are as follows:

- Raw material extraction and processing stage – This stage includes extraction of virgin materials and reclamation of non-virgin feedstock. This may include the growth or extraction and processing of all raw materials, including the transport to the manufacturing site.
- Manufacturing stage – This stage includes relevant manufacturing processes and flows, including packaging. Production of capital goods, infrastructure, production of manufacturing equipment, and personnel-related activities are not included.
- Delivery and installation stage – This stage includes the delivery of the Galaxy rx to the point of installation.
- Use stage – The use stage includes the cleaning and maintenance of the floor covering during its lifetime, as well as extraction, manufacturing and transport of all sundry material for maintenance and cleaning.
- End of life stage – The end of life stage includes the transport of the floor covering to end of life processes including landfill, incineration, and recycling.

Cut-off criteria:

According to the PCR, processes contributing greater than 1% of the total environmental impact indicator for each impact must be included in the inventory. In the present study, except as noted, all known materials and processes were included in the life cycle inventory.

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