REGENFiber
Top Performance. Truly Sustainable.

Environmental Product Declaration

Environmental Product Declaration for reinforcement fiber products produced by REGEN Fiber LLC at their facility in Des Moines, IA

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers reinforcement fiber products produced by REGEN Fiber LLC. Declared unit: 1 lb of reinforcement fiber
Declaration Owner:	REGEN Fiber LLC
	2111 Dixon St.
	DesMoines, IA
	www.regenfiber.com
Program Operator:	Labeling Sustainability
	Address, 11670 W Sunset Blvd.
	City, State, Los Angeles, CA
	http://labelingsustainability.com/
Product Category Rule:	ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction product and services
	PCR Program Operator: International Organization of Standardization
	PCR review was conducted by: Technical Committee: ISO/TC 59/SC 17 Sustainability in buildings and civil engineering works
Independent LCA Reviewer and EPD Verifier:	This declaration was independently verified in accordance with ISO 14025:2006
	Independent verification of the declaration, according to ISO 14025:2006
	Internal External X
	Third Party Verifier
	Geoffrey Guest, Certified 3rd Party Verifier under Labeling Sustainability Program (www.labelingsustainability.com), CSA Group (www.csaregistries.ca)
Date of Issue:	19 September 2023
Period of Validity:	5 years; valid until 19 September 2028
EPD Number:	5d7349e7-e677-46eb-87ac-4e4478cd4aa7

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COMPANY DESCRIPTION

REGEN Fiber delivers a circular solution by reprocessing a range of composite materials into reinforcement fibers and additives for asphalt, composite, and concrete applications.

As the world's first company to sustainably #FreeTheFiber from wind turbine blades without using a thermal or chemical process, we're helping solve the wind industry's growing challenge of finding environmentally friendly ways for disposing of wind turbine components.

STUDY GOAL

The intended application of this life cycle assessment (LCA) is to comply with the procedures for creating a Type III environmental product declaration (EPD) and publish the EPD for public review on the website, wwwlabelingsustainability.com . This level of study is in accordance with EPD Product Category Rule (PCR) for Reinforcement Fiber published by; International Standards Organization (ISO) 14025:2006 Environmental labels and declarations, Type III environmental declarations-Principles and procedures; ISO 14044:2006 Environmental management, Life cycle assessment- Requirements and guidelines; and ISO 14040:2006 Environmental management, Life cycle assessment-Principles and framework. The performance of this study and its subsequent publishing is in alignment with the business-to-business (B2B) communication requirements for the environmental assessment of building products. The study does not intend to support comparative assertions and is intended to be disclosed to the public.

This project report was commissioned to differentiate REGEN Fiber LLC from their competition for the following reasons: generate an advantage for the organization; offer customers information to help them make informed product decisions; improve the environmental performance of REGEN Fiber LLC by continuously measuring, controlling and reducing the environmental impacts of their products; help project facilitators working on Leadership in Energy and Environmental Design (LEED) projects achieve their credit goal; and to strengthen REGEN Fiber LLC's license to operate in the community. The intended audience for this LCA report is REGEN Fiber LLC's employees, their suppliers, project specifiers of their products, architects, and engineers. The EPD report is also available for policy makers, government officials interested in sustainability, academic professors, and LCA professionals. This LCA report does not include product comparisons from other facilities.

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DESCRIPTION OF PRODUCT AND SCOPE

In the evolving landscape of construction and composite materials, fibers play a pivotal role in enhancing various applications' strength, durability, and overall performance. This study delves into three prominent types of fibers that have garnered significant attention in recent years: fiber-reinforced polymer (FRP) fibers, recycled FRP fibers, and chopped glass gibers. Each of these fibers, derived from distinct sources and processed uniquely, offers advantages that cater to specific industry needs. From the robustness of FRP fibers and the sustainable approach of recycled FRP fibers derived from wind turbine blades to the versatility of chopped glass fibers in asphalt and construction, this comprehensive analysis aims to shed light on their properties, applications, and the transformative potential they hold for the future.

Recycled FRP fibers are produced using premium FRP materials sourced from wind turbine blades, enhancing concrete and mortar applications with heightened tensile strength, durability, toughness, and freeze-thaw resistance. Compatible with various concrete formulations, these fibers seamlessly mix, disperse, and finish, ensuring optimal workability. They are ideal for use in slabs-on-grade concrete decks, overlays, pavements, bridge decks, shotcrete, and precast products. The key advantages include improved durability, toughness, ductility, energy absorption, and fatigue resistance. Additionally, they bolster the load-bearing capacity crack resistance and provide uniform reinforcement in concrete, enhancing its impact, shear, and chemical resistance. The fibers also disperse rapidly during mixing.

Recycled FRP Micro Fibers are crafted from reprocessed FRP materials derived from wind turbine blades, offering enhanced strength and functionality for diverse applications in the construction and composite product sectors. These fibers ensure robustness and longevity and exhibit a rapid dispersion when mixed, resulting in a uniform surface that takes on pigments effectively, ensuring vibrant colors with minimal fiber visibility. They are suitable for concrete and mortar, composites, and soil stabilization. The primary advantages encompass increased flexural toughness, ductility, energy absorption, and fatigue resistance. Furthermore, they elevate durability, load-bearing capacity, mechanical attributes, and stability while showcasing superior melt flow with minimal warping at elevated temperatures. These fibers also have a notable chemical resistance and pigment exceptionally well.

Chopped glass fibers are premium products that offer enhanced strength and performance, catering to diverse needs in the asphalt, construction, and composite product sectors. These fibers not only provide robustness and longevity but also blend swiftly when mixed, resulting in a consistent surface that is highly pigmentable, showcasing vibrant colors with minimal fiber visibility. They are ideal for asphalt paving and engineered BMC and composite materials. The primary benefits include heightened flexural toughness, ductility, energy absorption, and fatigue resistance. They also boost impact and shear resistance in asphalt applications, elevate durability load-bearing capacity, and enhance mechanical characteristics and stability. Moreover, they demonstrate superior melt flow with minimal deformation at high temperatures, disperse rapidly during mixing, and possess significant chemical resistance.

This LCA assumes the impacts from products manufactured in accordance with the standards outlined in this report. This LCA is a cradle-to-gate study, and therefore, stages extending beyond the plant gate are not included in this LCA. Excluded stages include transportation of the manufactured material to the construction site; on-site construction processes and components; building (infrastructure) use and maintenance; and “end-of-life” effects.

REINFORCEMENT FIBER DESIGN SUMMARY

The following tables provide a list of the reinforcement fiber products considered in this EPD along with key performance parameters.

Composites Glass Fiber

Table 1: **Declared products with Composites glass fiber considered in this environmental product declaration.**

Prod #	Unique name/ID	Short description	Product type	Unit	Density, dry kg/Unit	product Group	Height (cm)	Length (cm)	Width (cm)
1	REGEN-R8 1/4" Chopped Glass Fiber 50# Bag	Chopped glass fiber (screened) for BMC, SMC & composite materials.	Composites glass fiber	lb	0.45	Composites glass fiber	7.62	76.2	45.72
2	REGEN-R8 1/4" Chopped Glass Fiber 2,000# Supersack	Chopped glass fiber (screened) for BMC, SMC & composite materials.	Composites glass fiber	lb	0.45	Composites glass fiber	101.6	88.9	88.9

Asphalt Paving Fiber

Table 2: **Declared products with Asphalt paving fiber considered in this environmental product declaration**

Prod #	Unique name/ID	Short description	Product type	Unit	Density, dry kg/Unit	product Group	Height (cm)	Length (cm)	Width (cm)
3	REGEN-R8 1/4" Asphalt Fiber 1# Dose Bag	Chopped glass fiber (unscreened) for asphalt paving applications.	Asphalt paving fiber	lb	0.45	Asphalt paving fiber	0.635	15.24	10.16
4	REGEN-R8 1/4" Asphalt Fiber 50# Bag	Chopped glass fiber (unscreened) for asphalt paving applications.	Asphalt paving fiber	lb	0.45	Asphalt paving fiber	7.62	76.2	45.72
5	REGEN-R8 1/4" Asphalt Fiber 2,000# Supersack	Chopped glass fiber (unscreened) for asphalt paving applications.	Asphalt paving fiber	lb	0.45	Asphalt paving fiber	101.6	88.9	88.9

REINFORCEMENT FIBER DESIGN COMPOSITION

The following figures provide mass breakdown (kg per functional unit) of the material composition of each reinforcement fiber design considered.

Composites Glass Fiber

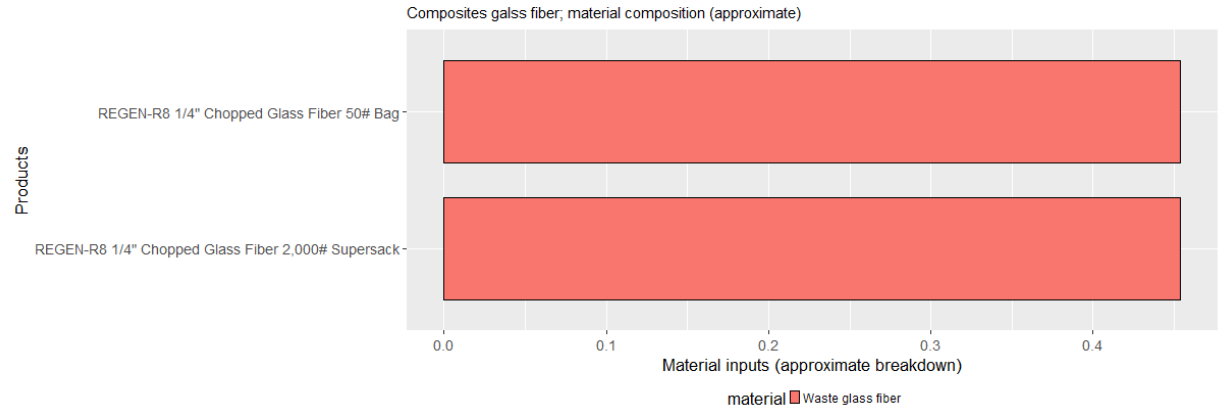

Figure 1: **Material composition - Composites galss fiber per 1 lb of reinforcement fiber**

Asphalt Paving Fiber

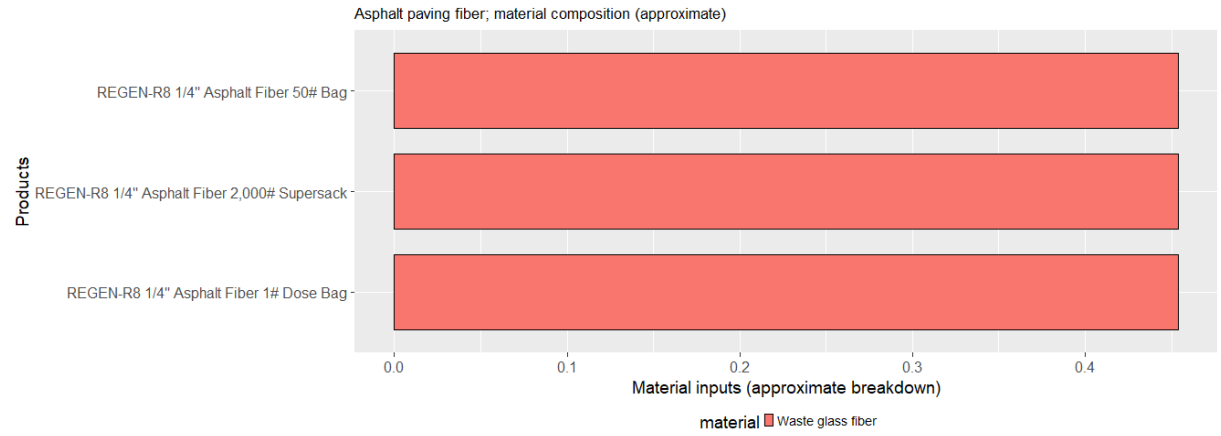

Figure 2: **Material composition - Asphalt paving fiber per 1 lb of reinforcement fiber**

A1 RAW MATERIAL RECYCLED CONTENT AND MATERIAL LOSSES

The following table provides a list of the raw material inputs (module A1) across all products considered, their recyclability content and assumed material losses.

Table 3: **Module A1 raw material inputs, the recyclability content and assumed material losses (dry basis)**.

product.name	mix.category	primary.content	post.industrial.content	post.consumer.content	material.losses
Fiber glass	glass fiber	0%	100%	0%	2%
Fiber glass	glass fiber	0%	100%	0%	2%
Fiber glass	glass fiber	0%	100%	0%	2%

SYSTEM BOUNDARIES

The following figure depicts the cradle-to-grave system boundary considered in this study:

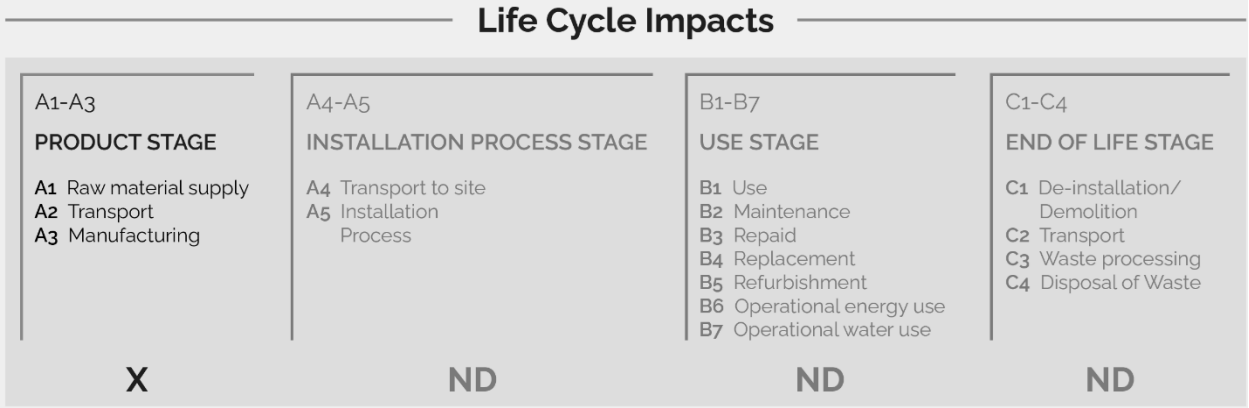

Figure 3: **General life cycle phases for consideration in a construction works system.**

This is a Cradle-to-gate life cycle assessment and the following life cycle stages are included in the study:

- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e. A3).
- A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacturer the declared products and to operate the facility.

As according to the PCR, the following figure illustrates the general activities and input requirements for producing reinforcement fiber products and is not necessarily exhaustive.

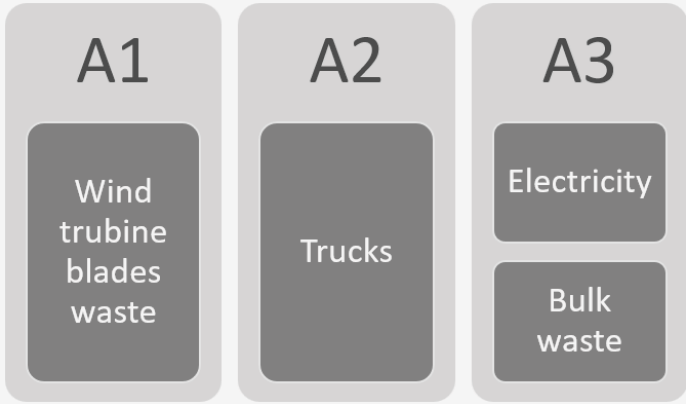

Figure 4: **General system inputs considered in the product system and categorized by modules in scope**

In addition, as according to the relevant PCR, the following requirements are excluded from this study:

- Production, manufacture and construction of A3 building/capital goods and infrastructure;
- Production and manufacture of steel production equipment, steel delivery vehicles, earth-moving equipment, and laboratory equipment;
- Personnel-related activities (travel, furniture, office supplies);
- Energy use related to company management and sales activities.

For this LCA the manufacturing plant, owned and operated by REGEN Fiber LLC, is located at their Fiber Recycling Services Des Moines facility in Des Moines, IA. All operating data is formulated using the actual data from REGEN Fiber LLC's plant at the above location, including water, energy consumption and waste generation. All inputs for this system boundary are calculated for the plant.

This life cycle inventory was organized in a spreadsheet and was then input into an RStudio environment where pre-calculated LCIA results for relevant products/activies stemming from the ecoinvent ecoinvent v3.8 database and a local EPD database in combination with primary data from REGEN Fiber LLC were utilized. Explanations of the contribution of each data source to this study are outlined in the section 'Data Sources and Quality'. Further LCI details for each declared product are provided in the sections 'Detailed LCI tables' and 'Transport tables' of the detailed LCA report. A parameter uncertainty analysis was also performed where key statistical results (e.g. min/mean/max etc.) are provided in the detailed LCA report.

No known flows are deliberately excluded from this EPD.

CUT-OFF CRITERIA

ISO 14044:2006 and the focus PCR requires the LCA model to contain a minimum of 95% of the total inflows (mass and energy) to the upstream and core modules be included in this study. The cut-off criteria were applied to all other processes unless otherwise noted above as follows. A 1% cut-off is considered for all renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process where the total of the neglected inputs does not exceed 5%.

DATA SOURCES AND DATA QUALITY ASSESSMENT

No recovered on-site energy occurs at this facility.

No re-used or recycled material for utilization on-site or off-site was reported at this facility.

The following statements explain how the above facility requirements/generation were derived:

Raw material transport: REGEN Fibers are recycled decommissioned or new wind turbine blades manufacturing scrap materials. Those materials are purchased from various suppliers and trucked to the REGEN processing facility in Des Moines, Iowa. The fibers have no other ingredients; therefore, the recycled materials are modeled as "waste materials produced offsite" and goverened by the Polluter Pays Principle.

Electricity: All electricity reported is based on REGEN primary information from utility bills for the reporting period.

Process/space heating: No energy process for space heating required.

Fuel required for machinery: No on-site machinery fuel used.

Waste generation: All waste values reported is based on REGEN primary information from utility bills for the reporting period.

Recovered energy: No recovered energy on site.

Recycled/reused material/components: No materials for re-**use.**

Module A1 material losses: Default, 2% material loss factor used.

Direct A3 emissions accounting: No direct emissions on site.

The following tables depict a list of assumed life cycle inventory utilized in the LCA modeling to generate the impact results across the life cycle modules in scope. An assessment of the quality of each LCI activities utilized from various sources is also provided.

Table 4: **LCI inputs assumed for module A1 (i.e. raw material supply)**

Input	LCI Activity	Data Source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Fiber glass	waste produced off-site	See A3 inputs	Iowa	See A3 inputs	2	A3	2	A3	A3

Table 5: **LCI inputs assumed for module A2 (i.e. transport of A1 inputs)**

Input	LCI Activity	Data Source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Bulk-Waste-freight transport via Truck	market for transport, freight, lorry 16-32 metric ton, EURO6/transport, freight, lorry 16-32 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	RoW	v3.8 in 2021	2	3	1	3	3
Fiber glass-freight transport via Truck	market for transport, freight, lorry 16-32 metric ton, EURO6/transport, freight, lorry 16-32 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	RoW	v3.8 in 2021	2	3	1	3	3
Plastic bags-freight transport via Truck	market for transport, freight, lorry 16-32 metric ton, EURO6/transport, freight, lorry 16-32 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	RoW	v3.8 in 2021	2	3	1	3	3
Plastic warp-freight transport via Truck	market for transport, freight, lorry 16-32 metric ton, EURO6/transport, freight, lorry 16-32 metric ton, EURO6/RoW/tkm	ecoinvent v3.8	RoW	v3.8 in 2021	2	3	1	3	3
Supersacks-freight transport via Truck	market for transport, freight, lorry 16-32 metric ton, EURO6/transport, freight, lorry 16-32	ecoinvent v3.8	RoW	v3.8 in 2021	2	3	1	3	3

	metric ton, EURO6/RoW/tkm								

Table 6: **LCI inputs assumed for module A3**

Input	LCI Activity	Data Source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Bulk-Waste	process-specific burdens, residual material landfill/process-specific burdens, residual material landfill/RoW/kg	ecoinvent v3.8	Iowa	v3.8 in 2021	2	3	2	3	3
Electricity	market for electricity, medium voltage/electricity, medium voltage/US-MRO/kWh	ecoinvent v3.8	Iowa	v3.8 in 2021	2	3	2	3	3
Pallets	EUR-flat pallet production/EUR-flat pallet/RoW/unit	ecoinvent v3.8	Iowa	v3.8 in 2021	2	3	2	3	3
Plastic bags	polyethylene production, high density, granulate/polyethylene, high density, granulate/RoW/kg	ecoinvent v3.8	Multiple Regions	v3.8 in 2021	2	3	2	3	3
Plastic warp	packaging film production, low density polyethylene/packaging film, low density polyethylene/RoW/kg	ecoinvent v3.8	Iowa	v3.8 in 2021	2	3	2	3	3
Supersacks	textile production, nonwoven polypropylene, spunbond/textile, nonwoven polypropylene/RoW/kg	ecoinvent v3.8	Iowa	v3.8 in 2021	2	3	2	3	3

DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged based on its precision (measured, calculated or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

Precision: Through measurement and calculation, the manufacturers collected and provided primary data on their annual production. For accuracy, the LCA practitioner and 3rd Party Verifier validated the plant gate-to-gate data.

Completeness: All relevant specific processes, including inputs (raw materials, energy and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. The majority of relevant background materials and processes were taken from ecoinvent ecoinvent v3.8 LCI datasets where relatively recent region-specific electricity inputs were utilized. The most relevant EPDs requiring key A1 inputs were also utilized where readily available.

Consistency: To ensure consistency, the same modeling structure across the respective product systems was utilized for all inputs, which consisted of raw material inputs and ancillary material, energy flows, water resource inputs, product and co-products outputs, returned and recovered Reinforcement Fiber materials, emissions to air, water and soil, and waste recycling and treatment. The same background LCI datasets from the ecoinvent ecoinvent v3.8 database were used across all product systems. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the plant and selected process level to maintain a high level of consistency.

Reproducibility: Internal reproducibility is possible since the data and the models are stored and available in a machine readable project file for all foreground and background processes, and in Labeling Sustainability's proprietary Reinforcement Fiber LCA calculator* for all production facility and product-specific calculations. A considerable level of transparency is provided throughout the detailed LCA report as the specifications and material quantity make-up for the declared products are presented and key primary and secondary LCI data sources are summarized. The provision of more detailed publicly accessible data to allow full external reproducibility was not possible due to reasons of confidentiality.

*Labeling Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for Reinforcement Fiber product designs. The tool auto-calculates results by scaling base-unit technosphere inputs (i.e. 1 kg sand, 1 kWh electricity, etc.) to replicate the reference flow conversions that take place in any typical LCA software like openLCA or SimaPro. The tool was tested against several LCAs performed in openLCA and the tool generated identical results to those realized in openLCA across every impact category and inventory metric (where comparisons could be readily made).

Representativeness: The representativeness of the data is summarized as follows.

- Time related coverage of the manufacturing processes' primary collected data from 2023-01-01 to 2023-07-31.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent ecoinvent v3.8 database.

- Geographical coverage for inputs required by the A3 facility(ies) is representative of its region of focus; other upstream and background processes are based on US, North American, or global average data and adjusted to regional electricity mixes when relevant.
- Technological coverage is typical or average and specific to the participating facilities for all primary

ENVIRONMENTAL INDICATORS AND INVENTORY METRICS

Per the PCR, this EPD supports the life cycle impact assessment indicators and inventory metrics as listed in the tables below. As specified in the PCR, the most recent US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), impact categories were utilized as they provide a North American context for the mandatory category indicators to be included in the EPD. Additionally, the PCR requires a set of inventory metrics to be reported with the LCIA indicators (see tables below).

Table 7: **Life cycle impact categories and life cycle inventory metrics**

ID	LCIA.indicators	Abbreviations	Units
1	Environmental impact: acidification	AP	moles of H+-Eq
2	Environmental impact: eutrophication	EP	kg N
3	Environmental impact: global warming	GWP	kg CO2-Eq
4	Environmental impact: ozone depletion	ODP	kg CFC-11-Eq
5	Environmental impact: photochemical oxidation	PCOP	kg NOx-Eq
6	Material resources: metals/minerals: abiotic depletion potential (ADP): elements (ultimate reserves)	ADPe	kg Sb-Eq
7	Energy resources: non-renewable: abiotic depletion potential (ADP): fossil fuels	ADPf	MJ, net calorific value
Inventory metrics			
8	Total primary energy	TPE	MJ-Eq
9	Renewable energy	RE	MJ-Eq
10	Non-renewable energy	NRE	MJ-Eq
11	Non-Renewable Resources	NRR	kg
12	Renewable Resources	RR	m3
13	Water depletion: WDP	WDP	m3
14	Land filling: bulk waste	LFW	kg waste
15	Land filling: hazardous waste	LFHW	kg waste

It should be noted that emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in any of the following categories.

- Renewable primary energy resources as energy (fuel);
- Renewable primary resources as material;
- Non-renewable primary resources as energy (fuel);
- Non-renewable primary resources as material;
- Secondary Materials;
- Renewable secondary fuels;
- Non-renewable secondary fuels;

- Recovered energy;
- Abiotic depletion potential for non-fossil mineral resources.
- Land use related impacts, for example on biodiversity and/or soil fertility;
- Toxicological aspects;
- Emissions from land use change [GWP 100 (land-use change)];
- Hazardous waste disposed;
- Non-hazardous waste disposed;
- High-level radioactive waste;
- Intermediate and low-level radioactive waste;
- Components for reuse;
- Materials for recycling;
- Materials for energy recovery;
- Recovered energy exported from the product system

TOTAL IMPACT SUMMARY

The analysis of the environmental impact of REGEN-R8 reinforcement fibers in various packaging formats revealed specific recurring themes or "hotspots" that contribute significantly to the overall environmental footprint. These should be central to any mitigation strategies aimed at minimizing the environmental burden of these products.

1. **REGEN-R8 1/4" Chopped Glass Fiber 50# Bag:**

   - **Transport Impact:** Freight transport of fiber via truck is the most prominent contributor, accounting for 84% (73% + 11%) of the environmental impact.
   - **Packaging Impact:** The plastic bags used for packaging contribute 5.65%.

2. **REGEN-R8 1/4" Chopped Glass Fiber 2,000# Supersack:**

   - **Transport Impact:** Similarly, truck transport of fiber dominates with 84% (73% + 11%).
   - **Packaging Impact:** The impact of plastic bags remains consistent at 5.65%.

3. **REGEN-R8 1/4" Asphalt Fiber 1# Dose Bag:**

   - **Transport Impact:** Truck transport's contribution rises slightly to 80.7% for this variant.

4. **REGEN-R8 1/4" Asphalt Fiber 50# Bag:**

   - **Transport Impact:** Trucking of fiber again is the primary culprit with 84% (73% + 11%).
   - **Packaging Impact:** Plastic bags used in packaging still account for 5.65%.

5. **REGEN-R8 1/4" Asphalt Fiber 2,000# Supersack:**

   - **Transport Impact:** Here, the combined contribution of truck transport slightly changes, accounting for 88.9% (77.3% + 11.6%).

Key Takeaways and Mitigation Strategies: Transport, mainly via trucks, emerges as the significant environmental hotspot across all product variants. The consistent impact of plastic bags also underscores the need for exploring sustainable packaging alternatives.

1. **Transport Mitigation: Efforts could focus on:**

- Opting for fuel-efficient trucks or transitioning to electric or hybrid models.
- Streamlining distribution routes to reduce travel distances.
- Exploring alternative modes of transport that have a lesser environmental footprint.

2. **Packaging Mitigation: Given the consistent impact of plastic bags, strategies could involve:**

- Transitioning to biodegradable or recyclable packaging materials.
- Adopting a returnable packaging system.
- Reducing the amount of plastic used in each bag.

The following table reports the total LCA results for each product produced at the given reinforcement fiber facility on a per 1 lb of reinforcement fiber basis.

Composites Glass Fiber

Table 9: **Total life cycle (across modules in scope) impact results for Composites glass fiber, assuming the geometric mean point values on a per 1 lb of reinforcement fiber basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
REGEN-R8 1/4" Chopped Glass Fiber 50# Bag	0.021	4.37e-05	0.126	2.37e-08	0.000248	6.08e-07	2.04
REGEN-R8 1/4" Chopped Glass Fiber 2,000# Supersack	0.0194	4.26e-05	0.119	2.35e-08	0.000229	5.32e-07	1.81

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**
REGEN-R8 1/4" Chopped	2.52	0.329	2.15	0.0558	2.79e-05	0.000153	0.0877	4.7e-06

Glass Fiber 50# Bag								
REGEN-R8 1/4" Chopped Glass Fiber 2,000# Supersack	2.26	0.31	1.89	0.0498	2.56e-05	0.000139	0.0868	4.65e-06

Asphalt Paving Fiber

Table 10: **Total life cycle (across modules in scope) impact results for Asphalt paving fiber, assuming the geometric mean point values on a per 1 lb of reinforcement fiber basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	**AP**	**EP**	**GWP**	**ODP**	**PCOP**	**ADPe**	**ADPf**
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
REGEN-R8 1/4" Asphalt Fiber 1# Dose Bag	0.0177	3.95e-05	0.114	2.28e-08	0.000202	4.81e-07	1.73
REGEN-R8 1/4" Asphalt Fiber 50# Bag	0.021	4.37e-05	0.126	2.37e-08	0.000248	6.08e-07	2.04
REGEN-R8 1/4" Asphalt Fiber 2,000# Supersack	0.0194	4.26e-05	0.119	2.35e-08	0.000229	5.32e-07	1.81

b) Inventory Metrics:

Indicator/LCI Metric	**TPE**	**RE**	**NRE**	**NRR**	**RR**	**WDP**	**LFW**	**LFHW**
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**
REGEN-R8 1/4" Asphalt Fiber 1# Dose Bag	1.87	0.0392	1.83	0.047	1.85e-06	0.000121	0.0847	4.51e-06
REGEN-R8 1/4" Asphalt Fiber 50# Bag	2.52	0.339	2.15	0.0563	2.76e-05	0.000153	0.0877	4.7e-06
REGEN-R8 1/4" Asphalt Fiber 2,000# Supersack	2.25	0.31	1.89	0.05	2.62e-05	0.000139	0.0868	4.65e-06

ADDITIONAL ENVIRONMENTAL INFO

No regulated substances of very high concern are utilized on site.

REFERENCES

ISO Standards:

- ISO 6707-1: 2014 Buildings and Civil Engineering Works - Vocabulary - Part 1: General Terms
- ISO 14021:1999 Environmental Labels and Declarations - Self-declared Environmental Claims (Type II Environmental Labeling)
- 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 14067:2018 Greenhouse Gases – Carbon Footprint of Products – Requirements and Guidelines for Quantification
- ISO 14050:2009 Environmental Management - Vocabulary
- ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products

EN Standards:

- EN 16757 Sustainability of construction works - Environmental product declarations – Product Category Rules for concrete and concrete elements.
- EN 15804 Sustainability of construction works - Environmental product declarations -Core rules for the product category of construction products.

Other References:

- USGBC LEED v4 for Building Design and Construction, 11 Jan 2019 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b
- USGBC PCR Committee Process & Resources: Part B, USGBC, 7 July 2017 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b.
- US EPA (2020) Advancing Sustainable Materials Management: 2018 Fact Sheet, https://www.epa.gov/sites/production/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf