

Biochar

Verde Resources



Environmental Product Declaration

Declaration Number:	ASTM-EPD 1256
Date of Issue:	2026-09-17
Date of Expiration:	2031-09-17

Product Category Rule

ISO 21930:2017
In accordance with ISO 14025

Declared Unit

1 kg

EPD Information

Program Operator	ASTM International 100 Barr Harbor Dr., West Conshohocken, PA 19428 cert@astm.org
General Program Instructions and Version Number	ASTM Program Operator Rules. Version: 8.0, Revised 04/29/20
Manufacturer Name and Address	Verde Resources 8112 Maryland Avenue, Suite 400 St. Louis, MO 63105 https://www.verderesources.com/
Declaration Number	ASTM-EPD 1256
Declared Product and Declared Unit	1 kg of biochar
Reference PCR and Version Number	ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
Product's Intended Application and Use	Asphalt additive
Product RSL	N/A
Markets of Applicability	Manufactured and sold in North America
Date of Issue	2026-09-17
Period of Validity	5 years from date of issue
EPD Type	Manufacturer Specific, Product Specific, Facility Specific
Intended Audience	Business-to-Business
EPD Scope	Cradle to gate
Year of Reported Manufacturer Primary Data	October 2022 – September 2023
LCA Software and Version Number	openLCA 2.6
LCI Database and Version Number	ecoinvent v3.11
LCIA Methodology and Version Number	IPCC AR6 and TRACI 2.2
Independent verification of the declaration and data, according to ISO 21930:2017 and 14025 ☐ Internal ☒ External	 Thomas Gloria, Ph.D. Industrial Ecology Consultants
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Isabel Oskwarek (info@wapsustainability.com), WAP Sustainability
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	 Thomas Gloria, Ph.D. Industrial Ecology Consultants
Limitations: • Environmental declarations from different programs (ISO 14025) may not be comparable. • Comparison of the environmental performance of construction products using the EPD shall consider all the relevant information modules over the full life cycle of the products within the construction works. Such a comparison requires scenarios in the construction works context. • Full conformance with this 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 in results for upstream or downstream of the life cycle stages declared. • Comparability of EPDs is limited to those applying a functional unit.	

General Information

Company Description

Verde Resources, Inc. is a sustainable infrastructure materials company focused on developing performance-driven, cost-effective, carbon-sequestering solutions for the road construction and infrastructure sectors.

Verde is advancing the integration of engineered biochar and carbon-sequestration technologies into road construction materials and other infrastructure applications. Its platform is designed to combine materials innovation, practical construction performance, measurable carbon benefits, and scalable commercialization to support the transition toward Net Zero infrastructure.

Product Description

The product is engineered biochar supplied by Oregon Biochar Solutions ("OBS") from their facility in White City, OR for use in sustainable infrastructure and road construction materials.

Product Composition

The product is 100% biochar and 80% carbon by mass.

No substances required to be reported per relevant regulations as hazardous are associated with the production or composition of this product. No release testing for dangerous substances is required for the intended application of the product.

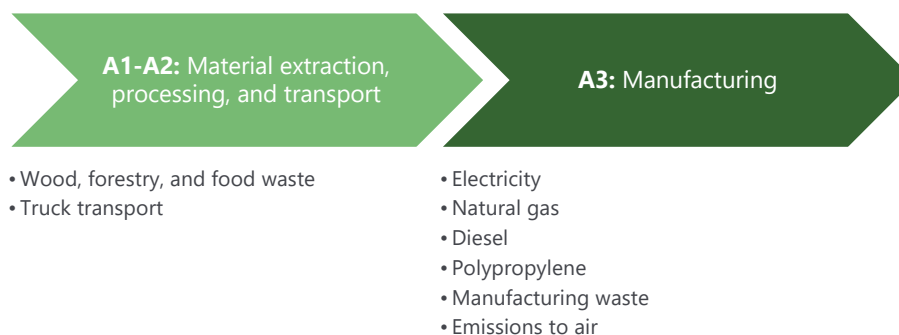
LCA Methodology

Declared Unit

The declared unit is 1 kg of product.

System Boundary

The scope of the EPD is cradle to gate. Production of capital goods, and personnel-related activities are excluded, as are long-term emissions (>100 years). Impacts from waste treatment are accounted for in the module where generated.



	Production			Construction		Use							End of Life				Benefits & Loads Beyond System Boundary
	Raw Material Supply	Transport	Manufacturing	Transport to Site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste Processing	Disposal	Reuse, Recovery, Recycling Potential
Module	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Modules declared	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

X = Module included in LCA, ND = Module not declared

Allocation

General principles of allocation were based on ISO 14040/44. The reactor that produces the biochar product also produces a synthesis gas (syngas) co-product which is used to generate electricity. To derive a per-unit value for manufacturing inputs such as electricity, thermal energy and water, allocation based on total production by energy was adopted. As the two co-products from the facility are biochar and electricity, allocation based on energy content of the products was necessary because electricity as a product does not carry a mass or any other physical properties. Biogenic carbon is treated as an inherent property of the materials and products in scope and reflects the actual flow quantities. As a default, secondary ecoinvent datasets use a physical basis for allocation.

Of relevance to the defined system boundary is the method in which recycled materials were handled. Throughout the study recycled materials were accounted for via the cut-off method. Under this method, impacts and benefits associated with the previous life of a raw material from recycled stock are excluded from the system boundary. The study does include the impacts associated with reprocessing and preparation of feedstock secondary materials.

Cut-off rules

Cumulative excluded material inputs, energy inputs, and environmental impacts must not exceed 5% based on total weight, energy use, or environmental impact of the declared unit. No flows were intentionally omitted from the scope of the study.

Period Under Review

Data were collected for October 2022 through September 2023.

Manufacturing Description

OBS biochar is produced from biomass feedstock through a controlled conversion process, resulting in a stable, carbon-rich material. The biochar is then post-processed into pellets to support consistency and incorporation into downstream road construction applications.

The pelletized biochar is intended to serve as an input material for Verde's road materials, including asphalt-related mixes, pavement products, and other infrastructure applications. Its use is intended to contribute to carbon sequestration, improved material performance, broader sustainability initiatives, and the development of scalable Net Zero construction material solutions.

Packaging

The product is packaged in bulk polypropylene tote bags. 7.01E-03 kg of bag is required per kg of product. There is no biogenic carbon in the packaging.

Environmental Performance

Results presented in this report are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins, or risks. No delayed emissions or temporary storage credits are applied to the LCA results. Net storage of carbon in the product is dependent on its downstream use and application.

Abbreviation		Unit
IPCC AR6		
GWPI	Global warming potential (100 years, including biogenic CO ₂)	kg CO ₂ eq
GWPe	Global warming potential (100 years, excluding biogenic CO ₂)	kg CO ₂ eq
TRACI 2.2		
AP	Acidification potential of soil and water	kg SO ₂ eq
EP-freshwater	Eutrophication potential, freshwater	kg P eq
EP-marine	Eutrophication potential, marine	kg N eq
ODP	Depletion of stratospheric ozone layer	kg CFC 11 eq
SFP	Smog formation potential	kg O ₃ eq
CML-2001		
ADP-fossil	Abiotic depletion potential, fossil resources	MJ
Resource Use Parameters		
RPR _E	Use of renewable primary energy excl. renewable primary energy resources used as raw materials	MJ, net calorific value (LHV)
RPR _M	Use of renewable primary energy resources used as raw materials	MJ, net calorific value
NRPR _E	Use of non-renewable primary energy excl. non-renewable primary energy resources used as raw materials	MJ, net calorific value
NRPR _M	Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value
SM	Use of secondary materials	kg
RSF	Use of renewable secondary fuels	MJ, net calorific value
NRSF	Use of non-renewable secondary fuels	MJ, net calorific value
RE	Recovered energy	MJ, net calorific value
FW	Net use of fresh water	m ³
Waste Parameters and Output Flows		
HWD	Disposed-of-hazardous waste	kg
NHWD	Disposed-of non-hazardous waste	kg
HLRW	High-level radioactive waste, conditioned, to final repository	kg
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	kg
CRU	Components for reuse	kg
MR	Materials for recycling	kg
MER	Materials for energy recovery	kg
EEE	Exported electrical energy	MJ
EET	Exported thermal energy	MJ
Carbon Emissions and Removals		
BCRP	Biogenic Carbon Removal from Product	kg CO ₂
BCEP	Biogenic Carbon Emission from Product	kg CO ₂
BCRK	Biogenic Carbon Removal from Packaging	kg CO ₂
BCEK	Biogenic Carbon Emission from Packaging	kg CO ₂
BCEW	Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes	kg CO ₂
CCE	Calcination Carbon Emissions	kg CO ₂
CCR	Carbonation Carbon Removals	kg CO ₂
CWNR	Carbon Emissions from Combustion of Waste from Non- Renewable Sources used in Production Processes	kg CO ₂

Impact	Unit	A1	A2	A3	Total
GWPI	kg CO ₂ eq	-3.85E+00	1.62E-01	2.05E+00	-1.63E+00
GWPe	kg CO ₂ eq	0.00E+00	1.62E-01	1.44E-01	3.06E-01
AP	kg SO ₂ eq	0.00E+00	3.80E-04	2.58E-03	2.96E-03
EP-freshwater	kg P eq	0.00E+00	1.70E-05	1.92E-05	3.62E-05
EP-marine	kg N eq	0.00E+00	2.70E-04	3.34E-03	3.61E-03
ODP	kg CFC 11 eq	0.00E+00	2.52E-09	2.12E-09	4.64E-09
SFP	kg O ₃ eq	0.00E+00	6.59E-03	8.21E-02	8.87E-02
ADP-fossil	MJ	0.00E+00	2.37E+00	1.79E+00	4.16E+00
Carbon Emissions and Removals					
BCRP	kg CO ₂	3.85E+00	0.00E+00	0.00E+00	3.85E+00
BCEP	kg CO ₂	0.00E+00	0.00E+00	9.32E-01	9.32E-01
BCRK	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEK	kg CO ₂	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BCEW	kg CO ₂	0.00E+00	0.00E+00	9.78E-01	9.78E-01
CCE	kg CO ₂	-3.85E+00	1.62E-01	2.05E+00	-1.63E+00
CCR	kg CO ₂	0.00E+00	1.62E-01	1.44E-01	3.06E-01
CWNR	kg CO ₂	0.00E+00	3.80E-04	2.58E-03	2.96E-03
Resource Use					
RPR _E	MJ	0.00E+00	3.32E-02	2.75E-02	6.07E-02
RPR _M	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPR _E	MJ	0.00E+00	2.40E+00	1.51E+00	3.91E+00
NRPR _M	MJ	0.00E+00	0.00E+00	3.10E-01	3.10E-01
SM	kg	1.00E+01	0.00E+00	-3.61E-16	1.00E+01
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	0.00E+00	3.60E-04	0.00E+00	3.60E-04
Output Flows and Waste					
HWD	kg	0.00E+00	3.86E-03	2.11E-03	5.97E-03
NHWD	kg	0.00E+00	2.14E-02	2.15E+00	2.18E+00
HLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ILLRW	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Interpretation

Over the cradle-to-gate scope the greatest contributor to LCIA results is A3 manufacturing, driven by fuel use and reactor emissions. A2 feedstock transport is also a significant contributor to GWPe and EP-freshwater. The results for GWPI demonstrate the carbon storage in the product based on the carbon content of the feedstocks (A1), less the emissions from the pyrolysis reactor (A3).

Additional Environmental Information

1. Low-Carbon Infrastructure Innovation

Verde Resources is advancing the development and commercialization of engineered biochar technologies designed to support lower-carbon infrastructure solutions. These efforts focus on integrating [carbon-sequestering materials](#) into durable infrastructure applications while reducing life-cycle greenhouse gas emissions and maintaining or enhancing engineering performance.

2. Carbon Management

Verde is advancing carbon accounting methodologies and environmental reporting frameworks to quantify and transparently communicate the [long-term carbon sequestration benefits](#) associated with engineered biochar incorporated into durable infrastructure materials.

3. Performance Validation

Verde collaborates with the National Center for Asphalt Technology (NCAT) and industry partners to evaluate the performance, durability, and suitability of engineered biochar in road construction and infrastructure applications. These validation efforts support the successful integration of carbon-sequestering materials into practical, long-life infrastructure systems.

References

1. European Biochar Certification. (2021, February). Guidelines for the Certification of Biochar Based Carbon Sinks version 2.1. Retrieved from https://www.european-biochar.org/media/doc/2/c_en_sink-value_2-1.pdf.
2. IPCC. (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.
3. ISO. (2006). ISO 14025: Environmental labels and declarations - Type III environmental declarations - Principles and procedures. Geneva: International Organization for Standardization.
4. ISO. (2006). ISO 14040/Amd 1:2020: Environmental management - Life cycle assessment - Principles and framework. Geneva: International Organization for Standardization.
5. ISO. (2006). ISO 14044/Amd 1:2017/Amd 2:2020: Environmental Management - Life cycle assessment - Requirements and Guidelines. Geneva: International Organization for Standardization.
6. ISO. (2017). ISO 21930: Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services. Geneva: International Organization for Standardization.
7. Puro.earth. (2025). *Puro.earth Certification Framework Biochar*. Puro.earth.
8. U.S. EPA. (2022). 1.6 Wood Residue Combustion in Boilers. AP 42, Fifth Edition, Volume I Chapter 1: External Combustion Sources.
9. US EPA. (2012). Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI) . Retrieved from <https://www.epa.gov/chemical-research/tool-reduction-and-assessment-chemicals-and-other-environmental-impacts-traci>.
10. WAP Sustainability. (2026). Life Cycle Assessment of Verde Resources Biochar.