

Environmental Product Declaration

According to ISO 14025:2006 and ISO 21930:2017



CHOMARAT

C-GRID® Carbon Fiber Reinforcement for Precast Concrete



Environmental Product Declaration

According to ISO 14025:2006 and ISO 21930:2017



EPD Owner
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CHOMARAT

Product Group Textile reinforcement

Product Applicability Precast concrete products

Production Location
2901 New Pond Road
Anderson, SC 29624

Markets of Applicability Global

Period of reported foreground data 2022

Program Operator
ASTM International
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For any explanatory material regarding this EPD, please contact the program operator.
Note: The Project Report is not part of public communication).

General Program Instructions ASTM Program Operator Rules. Version: 8.0, Revised 04/29/20 [3]

Product Category Rules (PCR) ISO 21930:2017 Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services [1]

Declaration Type Company- and facility-specific “cradle-to-gate” Type III environmental declaration (modules A1 to A3); reference service life n/a.

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Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:2006 [4]

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X

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About Chomarat

Founded in 1898, Chomarat is an independent industrial group that has become a benchmark in the world of composite materials and technical textiles. It has three businesses that function in synergy – Composites Reinforcements, Construction Reinforcements, and Coatings & Films – Textiles – and it draws on an international organizational structure with four industrial sites in France, Tunisia, the United States and China.

The Group has a strong innovation strategy: it invests in new technologies and carries out research through academic and technical partnerships on all continents. Chomarat offers a high level of technical expertise in the most innovative sectors, including the automotive, aeronautics, sports, energy, marine and construction industries, and also in markets demanding high standards, know-how and creativity, such as the luxury goods market.

Product Identification

C-GRID® is a unique carbon and epoxy grid product to reinforce concrete structures which can be used instead of, or in addition to, welded wire meshes. C-GRID® can be placed just underneath the finished surface, which gives it a significant advantage over steel where several centimeters of concrete are needed to protect the steel from corrosion and prevent rust stains. The C-GRID® carbon structure has been designed to improve the durability and reduce the weight of concrete structures in various applications such as pillars, parks, swimming pools, pavements, parking lots and constructions. See Figure 1 for a visual representation of C-GRID and Table 1 for details on each product assessed.



Figure 1: C-GRID Sheet

Environmental Product Declaration

According to ISO 14025:2006 and ISO 21930:2017



Table 1: C-GRID product details

Product	Description	Strand Spacing (mm)	Grid Strength (kN/m)	Weight (g/m ²)
C50 1.80 x 1.60	Strand spacing optimizes strength; designed to be a shear truss in precast insulated wall panels.	46 x 41	97 x 109	230
C50 2.36 x 2.36	Used to reinforce concrete structures; larger apertures ease concrete aggregate pouring during overlays.	60 x 60	74 x 74	162
C50 2.95 x 2.95	Suitable for cladding panels; designed for reinforcing the face of architectural cladding panels.	75 x 75	59 x 59	130

Declared Unit

The declared unit is defined as the quantity of a construction product for use as a reference unit in an EPD based on LCA for the expression of environmental information in information modules [1].

The declared unit used in this EPD is 1 m² of textile reinforcement product.

Material Composition

The material content of the three C-GRID products is presented in Table 2. The primary materials used are epoxy resin and carbon fibers, with other plastic ingredients making up the balance of the total product mass.

Table 2: Material composition of the declared products, mass basis

Flow	C50 – 1.8 X 1.6	C50 – 2.36 X 2.36	C50 – 2.95 X 2.95
Epoxy resin adhesive	32.0%	32.0%	32.0%
60K carbon fiber	16.0%	17.0%	17.0%
48K carbon fiber	16.0%	17.0%	17.0%
24K carbon fiber	36.0%	34.0%	34.0%
Total	100.0%	100.0%	100.0%

System Boundary

The system boundary of this EPD is the Production Stage per ISO 21930 [1], i.e., “cradle-to-gate”, which includes the modules *A1 Extraction and upstream production*, *A2 Transport to factory*, and *A3 Manufacturing*. Construction, Use, and End-of-Life stages, and optional supplementary module D are excluded from the system boundary.

See Figure 2 for a schematic of the product system and the key input and output flows considered in analysis. Cut-off criteria as per ISO 21930, 7.1.8 were followed for this LCA – all input/output data collected at the Anderson, SC was included in the life cycle inventory (LCI) modelling. The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the LCI. None of the inputs/outputs was knowingly excluded from the system boundary.

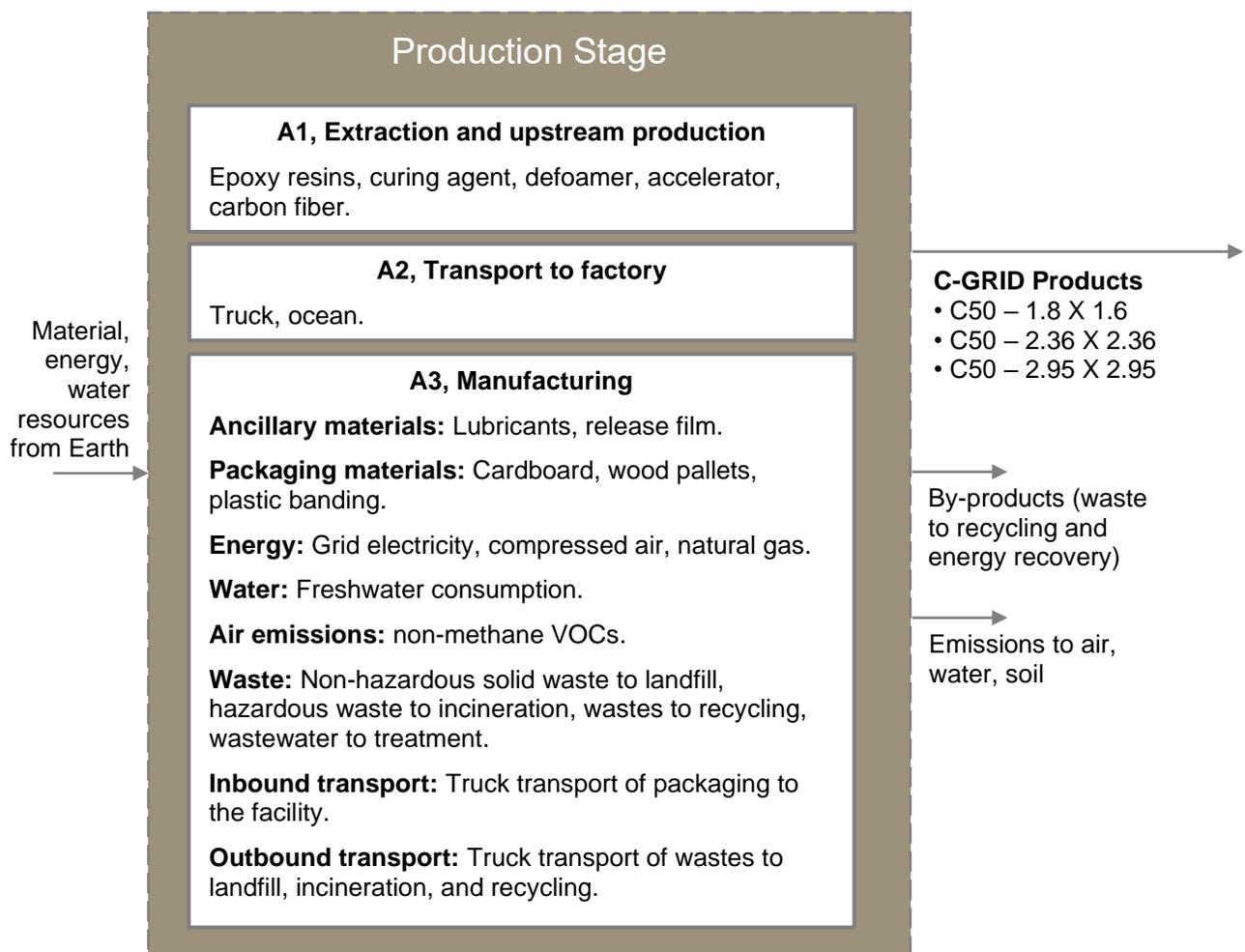


Figure 2: System boundary of C-GRID production, with key inputs and outputs



Life Cycle Assessment Model

LCI data collection was based on a customized survey which covered foreground data of the Anderson, SC facility for the 2022 reference period – see Table 3 for a summary of data sources. Data calculation procedures follow ISO 14044 [2] and ISO 21930 [1].

Table 3: Foreground data sources summary

Type of Source	Applicability
Direct: Based on measurements or purchasing/selling records of the surveyed facilities.	<ul style="list-style-type: none"> - A1 product material content - A2, A3 inbound transport from domestic manufacturer/vendor to Chomarat facility; outbound transport of waste - A3 energy (compressed air, natural gas) and water use, packaging, ancillary materials (release film), and waste amounts (cardboard to recycling)
Indirect: Based on calculations made by the personnel of the surveyed facilities and/or Athena.	<ul style="list-style-type: none"> - A1/A3 product manufacturing waste - A3 energy (electricity) - A3 non-methane VOC air emissions, waste (non-hazardous waste to landfill, wood to recycling, wastewater, hazardous liquid waste to energy recovery)
Estimated: Based on the industry average data and/or expert judgment.	<ul style="list-style-type: none"> - A2 inbound transport from overseas manufacturer to domestic vendor (where applicable) - A3 ancillary materials (lubricants), waste (packaging to landfill, metal scrap to recycling)

The life cycle modeling was performed using SimaPro v9.5.0.2, 2024 [5]. Background datasets for upstream, core, and downstream material and processes come from the ecoinvent v3.9.1, 2024 database [6], the U.S. LCI Database, 2015 [7], and ELCD database [8] (polyacrylonitrile fiber production only). Input and output quantities for carbon fiber production comes from Karuppanan Gopalraj et al. [9]. Curing agent, defoamer, and accelerator products were modeled with information from product literature, using expert judgement to estimate material composition and select background data.

The allocation rules in general conform to ISO 14044, Clauses 4.3.4.1 and 4.3.4.2, and ISO 21930, 7.2.5 Allocation for co-products. The Anderson, SC manufacturing facility produces various products and as such allocation was necessary. “Energy” was used as the physical parameter for allocating flows between the facility’s product lines, based on the power rating of machinery and their run times. “Mass” was then used as the physical parameter for allocating flows between the products of interest and other co-products to calculate the input energy flows (electricity, and natural gas), ancillary materials used at the facility, total water consumption, process emissions to air and water and waste flows.

Environmental Indicator Results

The environmental indicator results covered by this EPD, and the methods used to calculate them are summarized in Table 4. Tables 5 through 7 then present results for each C-GRID product. The following ISO 14025 [4] and ISO 21930 [1] statements indicate the EPD comparability limitations and intend to avoid any market distortions or misinterpretation of EPDs.

- Environmental declarations from different programs may not be comparable [4].
- Only EPDs prepared from cradle-to-grave life cycle results and based on the same function, Reference Service Life, quantified by the same functional unit, and meeting all the conditions for comparability listed in ISO 14025:2006 and ISO 21930:2017 can be used to comparison between products.

Environmental Product Declaration

According to ISO 14025:2006 and ISO 21930:2017



Table 4: Environmental indicators reported in the EPD

Environmental Indicator	Unit	Method
Core mandatory impact indicators		
GWP: Global warming potential	kg CO ₂ eq.	TRACI 2.1 v1.05 [5], updated with IPCC 2013 AR5 [11]
ODP: Depletion potential of the stratospheric ozone layer	kg CFC-11 eq.	
AP: Acidification potential	kg SO ₂ eq.	TRACI 2.1 v1.05
EP: Eutrophication potential	kg N eq.	
SFP: Smog formation potential	kg O ₃ eq.	
Indicators describing use of primary resources		
RPRE: Renewable primary resources used as energy carrier (fuel)	MJ, LHV	Cumulative Energy Demand, LHV (NCV) v1.0 [5]
RPRM: Renewable primary resources with energy content used as material	MJ, LHV	ACLCA ISO 21930 Guidance [10]; packaging not considered
NRPRE: Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	Cumulative Energy Demand, LHV (NCV) v1.0
NRPRM: Non-renewable primary resources with energy content used as material	MJ, LHV	ACLCA ISO 21930 Guidance (plastic components only); net calorific values (MJ/kg) come from [6]
Indicators describing use of secondary resources		
SM: Secondary materials	kg	ACLCA ISO 21930 Guidance; packaging not considered
RSF: Renewable secondary fuels	MJ, LHV	
NRSF: Non-renewable secondary fuels	MJ, LHV	ACLCA ISO 21930 Guidance
RE: Recovered energy	MJ, LHV	
Mandatory inventory parameters		
FW: Consumption of freshwater	m ³	RECIPE H v1.08 [5]
ADP: Abiotic depletion potential, fossil	MJ, LHV	CML-IA Baseline v3.09 [5]
Indicators describing waste		
HWD: Hazardous waste disposed	kg	
NHWD: Non-hazardous waste disposed	kg	
HLRW: High level radioactive waste, conditioned, to final repository	m ³	Calculated as the sum of relevant LCI flows
ILLRW: Intermediate and low level radioactive waste, conditioned, to final repository	m ³	
Output Flows		
CRU: Components for re-use	kg	
MR: Materials for recycling	kg	ACLCA ISO 21930 Guidance
MER: Materials for energy recovery	kg	
EE: Exported energy	MJ, LHV	
Additional inventory parameters for transparency		
CO ₂ ^{biop} : Removals and emissions associated with biogenic carbon content of the bio-based packaging	kg CO ₂ eq.	Only upfront removals of finished product packaging are included. Cardboard and pallet wood are assumed to be 50% carbon.

Environmental Product Declaration

According to ISO 14025:2006 and ISO 21930:2017



Table 5: Production Stage results – 1 m² C50 – 1.8 X 1.6

Environmental Indicator	Unit	A1	A2	A3	Total
Core mandatory impact indicators					
GWP	kg CO ₂ eq.	4.92E+00	7.23E-02	1.11E+00	6.10E+00
ODP	kg CFC-11 eq.	2.39E-05	2.95E-12	8.68E-07	2.47E-05
AP	kg SO ₂ eq.	1.39E-01	1.08E-03	7.35E-03	1.47E-01
EP	kg N eq.	1.05E-02	6.28E-05	6.66E-04	1.13E-02
SFP	kg O ₃ eq.	3.19E+00	2.92E-02	5.50E-02	3.27E+00
Indicators describing use of primary resources					
RPR _E	MJ, LHV	4.46E+00	0.00E+00	3.64E+00	8.10E+00
RPR _M	MJ, LHV	0.00E+00	n/a	n/a	0.00E+00
NRPR _E	MJ, LHV	8.54E+01	1.01E+00	2.34E+01	1.10E+02
NRPR _M	MJ, LHV	9.68E-01	n/a	n/a	9.68E-01
Indicators describing use of secondary resources					
SM	kg	0.00E+00	n/a	0.00E+00	0.00E+00
RSF	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
NRSF	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
RE	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
Mandatory inventory parameters					
FW	m ³	1.60E-02	0.00E+00	7.59E-03	2.36E-02
ADP _f	MJ, LHV	7.40E+01	1.00E+00	2.05E+01	9.55E+01
Indicators describing waste					
HWD	kg	9.76E-04	0.00E+00	4.48E-02	4.58E-02
NHWD	kg	1.25E-01	1.12E-03	7.07E-02	1.96E-01
HLRW	m ³	6.10E-09	0.00E+00	1.57E-09	7.68E-09
ILLRW	m ³	3.56E-08	0.00E+00	1.30E-08	4.86E-08
Output flows					
CRU	kg	n/a	n/a	n/a	n/a
MR	kg	n/a	n/a	6.72E-03	6.72E-03
MER	kg	n/a	n/a	4.63E-02	4.63E-02
EE	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
Additional inventory parameters for transparency					
CO ₂ _{biop}	kg CO ₂ eq.	n/a	n/a	-3.41E-01	-3.41E-01

Environmental Product Declaration

According to ISO 14025:2006 and ISO 21930:2017



Table 6: Production Stage results – 1 m² C50 – 2.36 X 2.36

Environmental Indicator	Unit	A1	A2	A3	Total
Core mandatory impact indicators					
GWP	kg CO ₂ eq.	3.46E+00	5.07E-02	9.16E-01	4.42E+00
ODP	kg CFC-11 eq.	1.68E-05	2.07E-12	8.60E-07	1.77E-05
AP	kg SO ₂ eq.	9.78E-02	7.55E-04	5.32E-03	1.04E-01
EP	kg N eq.	7.41E-03	4.39E-05	4.08E-04	7.86E-03
SFP	kg O ₃ eq.	2.25E+00	2.04E-02	4.05E-02	2.31E+00
Indicators describing use of primary resources					
RPR _E	MJ, LHV	3.19E+00	0.00E+00	1.75E+00	4.94E+00
RPR _M	MJ, LHV	0.00E+00	n/a	n/a	0.00E+00
NRPR _E	MJ, LHV	6.00E+01	7.09E-01	1.75E+01	7.82E+01
NRPR _M	MJ, LHV	6.82E-01	n/a	n/a	6.82E-01
Indicators describing use of secondary resources					
SM	kg	0.00E+00	n/a	0.00E+00	0.00E+00
RSF	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
NRSF	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
RE	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
Mandatory inventory parameters					
FW	m ³	1.13E-02	0.00E+00	6.04E-03	1.73E-02
ADP _f	MJ, LHV	5.20E+01	7.02E-01	1.54E+01	6.81E+01
Indicators describing waste					
HWD	kg	6.87E-04	0.00E+00	3.17E-02	3.24E-02
NHWD	kg	8.71E-02	7.83E-04	5.43E-02	1.42E-01
HLRW	m ³	4.20E-09	0.00E+00	1.13E-09	5.33E-09
ILLRW	m ³	2.48E-08	0.00E+00	9.26E-09	3.41E-08
Output flows					
CRU	kg	n/a	n/a	n/a	n/a
MR	kg	n/a	n/a	4.73E-03	4.73E-03
MER	kg	n/a	n/a	3.26E-02	3.26E-02
EE	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
Additional inventory parameters for transparency					
CO ₂ _{biop}	kg CO ₂ eq.	n/a	n/a	-1.37E-01	-1.37E-01

Environmental Product Declaration

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Table 7: Production Stage results – 1 m² C50 – 2.95 X 2.95

Environmental Indicator	Unit	A1	A2	A3	Total
Core mandatory impact indicators					
GWP	kg CO ₂ eq.	2.76E+00	4.05E-02	7.75E-01	3.58E+00
ODP	kg CFC-11 eq.	1.34E-05	1.65E-12	8.58E-07	1.43E-05
AP	kg SO ₂ eq.	7.82E-02	6.04E-04	4.56E-03	8.34E-02
EP	kg N eq.	5.93E-03	3.51E-05	3.77E-04	6.34E-03
SFP	kg O ₃ eq.	1.80E+00	1.63E-02	3.72E-02	1.85E+00
Indicators describing use of primary resources					
RPR _E	MJ, LHV	2.55E+00	0.00E+00	1.69E+00	4.24E+00
RPR _M	MJ, LHV	0.00E+00	n/a	n/a	0.00E+00
NRPR _E	MJ, LHV	4.80E+01	5.67E-01	1.53E+01	6.38E+01
NRPR _M	MJ, LHV	5.45E-01	n/a	n/a	5.45E-01
Indicators describing use of secondary resources					
SM	kg	0.00E+00	n/a	0.00E+00	0.00E+00
RSF	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
NRSF	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
RE	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
Mandatory inventory parameters					
FW	m ³	9.02E-03	0.00E+00	5.78E-03	1.48E-02
ADP _f	MJ, LHV	4.16E+01	5.61E-01	1.35E+01	5.57E+01
Indicators describing waste					
HWD	kg	5.49E-04	0.00E+00	2.54E-02	2.59E-02
NHWD	kg	6.96E-02	6.26E-04	4.99E-02	1.20E-01
HLRW	m ³	3.36E-09	0.00E+00	9.54E-10	4.31E-09
ILLRW	m ³	1.98E-08	0.00E+00	7.67E-09	2.75E-08
Output flows					
CRU	kg	n/a	n/a	n/a	n/a
MR	kg	n/a	n/a	3.79E-03	3.79E-03
MER	kg	n/a	n/a	2.61E-02	2.61E-02
EE	MJ, LHV	n/a	n/a	0.00E+00	0.00E+00
Additional inventory parameters for transparency					
CO ₂ _{biop}	kg CO ₂ eq.	n/a	n/a	-1.37E-01	-1.37E-01



References

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