SRM CONCRETE

Ready Mixed Concrete

GTN – Facebook Mobile

Environmental Product Declaration

Date of Issue: 09/26/2022
Date of Revision: 06/23/2023
Date of Expiration: 09/26/2027

PRODUCT CATEGORY RULE
NSF International. PCR for Concrete, v2.1, August 2021.

DECLARED UNIT
1 m^3 of concrete

NSF®
Certified Environmental Product Declaration
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Program Operator Information

Program Operator	NSF Certification LLC 789 N. Dixboro, Ann Arbor, MI 48105 www.nsf.org
Manufacturer Name and Address	Smyrna Ready Mix 1432 Gateway Drive, Gallatin, TN 37066
Facility Under Study	Facebook Mobile Plant
Declaration Number	EPD10783
Product and Declared Unit	1 m^3 of ready-mixed concrete
Reference PCR and Version Number	Core PCR: ISO 21930:2017 Sustainability in Building Construction – Environmental Declaration of Building Products Sub-category PCR: NSF International. PCR for Concrete, v2.1, August 2021
Product's intended Application and Use	Concrete in residential, commercial, and public works
Product RSL	Not Applicable
Markets of Applicability	United States
Date of Issue	September 26, 2022 Additional mixes added June 8, 2023
Period of Validity	5 years from original date of issue
EPD Type	Product Specific
EPD Scope	Cradle to Gate
Year of reported manufacturer primary data	2020
LCA Software and Version Number	Concrete EPD Calculator, v2022.1
LCI Database and Version Number	Data as specified in PCR
LCIA Methodology and Version Number	TRACI 2.1
The sub-category PCR review was conducted by:	Dr. Thomas P. Gloria, PhD Industrial Ecvology Consultants t.gloria@industrial-ecology.com
Independent verification of the declaration and data, according to ISO 14025: 2006, ISO 21930:2017, and the PCR. ☐ Internal ☒ External	Jack Geibig jgeibig@ecoform.com
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	WAP Sustainability Consulting

Limitations:

- Environmental declarations from different programs (ISO 14025) may not be comparable.
- Only EPDs prepared from cradle-to-grave life-cycle results and based on the same function, reference service life, and quantified by the same functional unit, and meeting all the conditions in ISO 14025, Section 6.7.2, can be used to assist purchasers and users in making informed comparisons between products.
- Full conformance with the PCR for Products 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 results for upstream or downstream of the life cycle stages declared.
- Additional information on the life cycle assessment can be found by contacting the manufacturer directly www.smyrnareadymix.com.

Declaration of General Information

Company Description

SRM Concrete is a family owned and operated ready-mix company founded by Melissa and Mike Hollingshead in 1999.

We started Smyrna Ready Mix to service our own concrete needs, because we were not receiving reliable customer service from the local ready-mix companies.

With very little money and three trucks, we built a concrete plant in our own backyard at 4500 Hickory Grove Road in Murfreesboro, Tenn. Within six months of launching the company, other area concrete finishers began ordering.

Smyrna Ready Mix was founded for the purpose of providing superior customer service. Through hard work and the grace of God, Smyrna Ready Mix grew. Our company continues to expand, but our mission to provide every customer with quality concrete and unmatched service remains the same.

The dedication and determination from an outstanding group of Mixer Operators drives the business growth and has allowed SRM Concrete to add more than 5,400 team members in 16 states.

Product Description and Intended Use

This Environmental Product Declaration (EPD) is for multiple concrete mixes produced at SRM's Facebook Mobile plant. As the precise mix designs are considered proprietary composition is listed in order of greatest mass per mix. UNSPSC Code: 30111500, CSI Code: 03 30 00.

The below table provides select technical details and the unique mix ID for the mixes under study. No regulated substances of very high concern are present in the mixes assessed.

Mix	Bulk Density [kg/m^3]	Comp Strength @ 28 days (MPa)	Fly Ash %	Slag %	Air Entrained (Y/N)	W/C Ratio	Slump flow	Composition (in order of greatest mass)
20000	2429	2000	28%	0%	n	0.6	4+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Fly ash, Plasticizers and superplasticizers
20900	2009	2000	33%	0%	y	0.71	6+/-2	Natural sand, Batch water, Portland cement, Fly ash, Plasticizers and superplasticizers, Air entrainers
30050	2345	3000	20%	0%	y	0.5	5+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Fly ash, Plasticizers and superplasticizers, Air entrainers
30066	2254	3000	0%	0%	n	0.55	4+/-1	Coarse aggregate (natural), Natural sand, Portland cement, Batch water, Plasticizers and superplasticizers

Mix	Bulk Density [kg/m^3]	Comp Strength @ 28 days (MPa)	Fly Ash %	Slag %	Air Entrained (Y/N)	W/C Ratio	Slump flow	Composition (in order of greatest mass)
30067	2200	3000	0	0	n	0.54	5+/-1	Coarse aggregate (natural), Natural sand, Portland cement, Batch water, Plasticizers and superplasticizers
30670	2248	3000	0	0	y	0.51	5+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Retarders, Retarders, Air entrainers
30901	2265	3000	15	0	n	0.56	6+/-2	Natural sand, Portland cement, Batch water, Fly ash, Plasticizers and superplasticizers
30910	1799	n/a	0		n	0.53	n/a	Portland cement, Batch water
40028	2354	4000	20	0	y	0.42	4+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Fly ash, Plastic fibers, Plasticizers and superplasticizers, Air entrainers
40050	2369	4000	19.3	0	y	0.42	4+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Fly ash, Plasticizers and superplasticizers, Air entrainers
40051	2451	4000	18.1	0	n	0.45	5+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Fly ash, Plasticizers and superplasticizers
40060	2344	4000	25	0	y	0.44	2+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Fly ash, Plasticizers and superplasticizers, Air entrainers
40125	2386	4000	24	0	n	0.4	5+/-1	Natural sand, Coarse aggregate (crushed), Portland cement, Batch water, Fly ash, Plasticizers and superplasticizers
40134	2274	4000	24	0	n	0.4	5+/-1	Natural sand, Coarse aggregate (natural), Portland cement, Batch water, Fly ash, Plasticizers and superplasticizers
40160	2347	4000	21	0	y	0.42	2+/-1	Natural sand, Coarse aggregate (crushed), Portland cement, Batch water, Fly ash, Plasticizers and superplasticizers, Air entrainers
40670	2214	4000	0	0	y	0.46	6+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Plasticizers and superplasticizers, Retarders, Air entrainers

Mix	Bulk Density [kg/m^3]	Comp Strength @ 28 days (MPa)	Fly Ash %	Slag %	Air Entrained (Y/N)	W/C Ratio	Slump flow	Composition (in order of greatest mass)
50307	2343	5000	0	0	y	0.35	4+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Plasticizers and superplasticizers, Air entrainers
901	2106	n/a	71	0	n	1.14	n/a	Natural sand, Batch water, Fly ash, Portland cement
905	1790	1000	57	0	y	0.53	n/a	Natural sand, Fly ash, Batch water, Portland cement, Air entrainers
40305	2447	4000	0	0	n	0.46	4+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Plasticizers and superplasticizers
30385	2373	3000	0	0	n	0.51	5+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Water resisting admixtures
40085	2373	3000	2	0	N	0.51	5+/-1	Coarse aggregate (crushed), Natural sand, Portland cement, Batch water, Fly ash, Water resisting admixtures

Declaration of the Methodological Framework

Type of EPD and Declared Unit

This EPD is a Cradle-to-Gate EPD for business-to-business communication, and includes the sourcing of raw materials, transportation of raw materials to the manufacturing facility, and the manufacturing and packaging of the product.

The declared unit is 1 m^3 of concrete.

System Boundary

Production			Construction		Use							End of Life				Benefits & Loads Beyond System Boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
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
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Construction of the facility, maintenance and construction of operational equipment, and any personnel related activity, such as transport, are excluded.

Background Data

The below table summarizes the material LCI data sources utilized.

Category	Material	Dataset	Database	Notes
Aggregates	Coarse aggregate (natural)	Gravel, round {RoW}| gravel and sand quarry operation | Alloc Rec	Ecoinvent 3.7	Foreground process replaced with US electricity
	Coarse aggregate (crushed)	Gravel, crushed {RoW}| production | Alloc Rec	Ecoinvent 3.7	Foreground process replaced with US electricity
	Natural sand	Gravel, round {RoW}| gravel and sand quarry operation | Alloc Rec	Ecoinvent 3.7	Foreground process replaced with US electricity
	Manufactured/crushed sand	Gravel, crushed {RoW}| production | Alloc Rec	Ecoinvent 3.7	Foreground process replaced with US electricity
	Recycled concrete aggregate	Diesel, combusted in industrial equipment/US	USLCI	Estimated as 0.4 MMBTU/short ton (0.047 MJ/kg), sourced from diesel (US EPA, 2020)
	Lightweight aggregates	Expanded clay {RoW}| production | Alloc Rec	Ecoinvent 3.7	Foreground process replaced with US electricity
Cementitious Materials	Portland cement	EPD, Portland Cement Association (2016)		
	Blended hydraulic cement	EPD, Portland Cement Association (2016)		
	Portland-limestone cement	EPD, Portland Cement Association (2016)		
	Fly ash[1]	n/a		Recovered Material per PCR
	Slag cement	EPD, Slag Cement Association (2015)		
	Silica fume[1]	n/a		Recovered Material per PCR
	Slag[1]	n/a		Recovered Material per PCR
Water	Batch water	Tap water {RoW}| market for | Cut-off		Replaced with US electricity
Admixtures	Air entrainers	EPD, EFCA (2015)		
	Retarders	EPD, EFCA (2015)		
	Plasticizers and superplasticizers	EPD, EFCA (2015)		
	Hardening accelerators	EPD, EFCA (2015)		
	Set accelerators	EPD, EFCA (2015)		
	Coloring admixtures	Used water reducing admixture EPD as proxy		
	Corrosion inhibitors	Used water reducing admixture EPD as proxy		
	Water resisting admixtures	EPD, EFCA (2015)		
	Carbon cure	Electricity, medium voltage {US}| market group for | Cut-off, U	Ecoinvent 3.7	Estimated as 200 kWh electricity per metric ton

Category	Material	Dataset	Database	Notes
				carbon dioxide processed (Haring, 2008)
Fibers	Plastic fibers	Fibre, polyester {RoW}| polyester fibre production, finished | Cut-off, U	Ecoinvent 3.7	Foreground process replaced with US electricity
	Glass fibers	Glass fibre {RoW}| production | Cut-off, U	Ecoinvent 3.7	Foreground process replaced with US electricity

[1] The product category rules for this EPD recognize fly ash, silica fume and slag as recovered materials and thus the environmental impacts allocated to these materials are limited to the treatment and transportation required to use as a concrete material input.

Allocation Procedure and Cut-off Procedure

General principles of allocation for the LCA were based on ISO 14040/44. There are no products other than the synthetic granulates produced as part of the manufacturing processes studied in the LCA. Since there are no co-products, no allocation based on co-products is required.

Of relevancy 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 the raw materials from recycled stock are excluded from the system boundary. Hence no impacts arise from secondary materials used as raw materials for the manufacture of synthetic gravel. The study does include the impacts associated with reprocessing and preparation of the recycled materials that are used as raw materials.

Material inputs greater than 1% (based on total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion and/or the material input was thought to have significant environmental impact. Cumulative excluded material inputs and environmental impacts are less than 5% based on total weight of the functional unit.

Results - Declaration of Environmental Indicators Derived from LCA

The environmental indicators required by the PCR are specified by the table below.

Abbreviation	Indicator	Unit
Impact		
GWP	Global warming potential, 100 years, excluding biogenic carbon	kg CO_2 eq
ODP	Ozone depletion potential	kg CFC 11 eq
EP	Eutrophication potential	kg N eq
AP	Acidification potential	kg SO_2 eq
SFP	Smog formation potential	kg O_3 eq
ADP-elements[1]	Abiotic depletion potential for non-fossil resources	kg Sb eq
ADP-fossil	Abiotic depletion potential for fossil resources	MJ, net calorific value
Carbon Emissions		
CCE	Calcination and carbonation emissions	kg CO_2
Resource Use		
RPR_E[1]	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value
RPR_M	Use of renewable primary energy resources used as raw materials	MJ, net calorific value

Abbreviation	Indicator	Unit
$NRPR_E$[1]	Use of non-renewable primary energy excluding 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[1]	Use of secondary materials	kg
RSF[1]	Use of renewable secondary fuels	MJ, net calorific value
NRSF[1]	Use of non-renewable secondary fuels	MJ, net calorific value
RE[1,3]	Recovered energy	MJ, net calorific value
FW	Net use of fresh water	m^3
Waste Categories		
HWD[1]	Hazardous waste disposed	kg
NHWD	Non-hazardous waste disposed	kg
RWD[1,2]	Radioactive waste disposed	kg
HLRW[1,2]	*High-level radioactive waste, conditioned, to final repository*	*kg*
ILLRW[1,2]	*Intermediate- and low-level radioactive waste, conditioned, to final repository*	*kg*
Output Flows		
CRU[1]	Components for reuse	kg
MR	Materials for recycling	kg
MER[1]	Materials for energy recovery	kg
EE	Exported energy	MJ

[1] 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 these categories.
[2] As many of the specified data sources do not differentiate between high-level and intermediate- and low-level radioactive waste, the two metrics have been summed into a single indicator.
[3] Not all LCA datasets for upstream materials include these impact categories and thus results may be incomplete. Use caution when interpreting data in these categories. Noted as "X" in results.

Production A1-A3

Production results are presented in the following tables for the mix designs under study.

Product ID:		20000	20900	30050	30066	30067	30670	30901	30910	40028	40050
Impacts	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP	kg CO_2 eq	219	339	274	311	259	244	405	1150	321	319
ODP	kg CFC-11 eq	5.82E-06	7.63E-06	6.99E-06	7.43E-06	6.29E-06	6.34E-06	9.10E-06	2.58E-05	8.39E-06	7.98E-06
AP	kg SO_2 eq	0.73	0.961	0.831	0.885	0.777	0.769	1.13	2.49	0.939	0.924
EP	kg N- eq	0.277	0.369	0.335	0.35	0.294	0.303	0.44	1.26	0.401	0.384
SFP	kg O_3 eq	17.2	22	19	20.2	18.1	17.7	25.9	51.1	21	20.9
ADP_E	kg Sb eq	5.66E-05	8.09E-05	6.82E-05	7.72E-05	6.64E-05	6.53E-05	9.40E-05	2.53E-04	1.89E-04	7.77E-05
ADP_F	MJ_{NCV}	164	214	184	194	171	171	253	511	220	204
CCE	kg CO_2 eq	81.3	145	110	134	107	95.9	174	576	131	134

Product ID:		40051	40060	40125	40134	40160	40670	50307	901	905	40305
Impacts	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
GWP	kg CO_2 eq	315	272	381	374	299	275	483	119	166	362
ODP	kg CFC-11 eq	7.93E-06	6.88E-06	9.10E-06	8.68E-06	7.36E-06	6.96E-06	1.16E-05	2.77E-06	3.81E-06	8.96E-06
AP	kg SO_2 eq	0.922	0.832	1.06	1.03	0.897	0.829	1.25	0.55	0.606	1.02
EP	kg N- eq	0.381	0.33	0.44	0.415	0.353	0.334	0.562	0.127	0.18	0.433
SFP	kg O_3 eq	20.9	19.2	23.9	23.3	20.6	18.9	27.1	14.4	15	22.7
ADP_E	kg Sb eq	7.70E-05	6.72E-05	9.02E-05	8.95E-05	7.26E-05	7.23E-05	1.12E-04	3.36E-05	4.26E-05	8.77E-05
ADP_F	MJ_{NCV}	204	185	234	226	199	184	269	131	139	226
CCE	kg CO_2 eq	131	109	164	164	122	112	218	29	58.1	154

Product ID:		30385	40085
Impacts	Unit	A1-A3	A1-A3
GWP	kg CO_2 eq	352	295
ODP	kg CFC-11 eq	8.77E-06	7.50E-06
AP	kg SO_2 eq	0.985	0.872
EP	kg N- eq	0.422	0.359
SFP	kg O_3 eq	22.1	19.9
ADP_E	kg Sb eq	9.57E-05	8.09E-05
ADP_F	MJ_{NCV}	215	192
CCE	kg CO_2 eq	151	122

This EPD was calculated using industry average cement data. Cement LCA impacts can vary depending upon manufacturing process, efficiency and fuel source by as much as 50% for some environmental impact categories. Cement accounts for as much as 98% of the impacts of the concrete mixes included in this EPD and thus manufacturer specific cement impacts could result in variation of as much as 49%.

Product ID:		20000	20900	30050	30066	30067	30670	30901	30910	40028	40050
Indicator	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
RPR_E	MJ_{NCV}	623	691	618	599	573	591	816	678	638	637
RPR_M	MJ_{NCV}	0.602	1.07	0.816	0.988	0.795	0.709	1.29	4.26	0.969	0.988
$NRPR_E$	MJ_{NCV}	1540	2040	1780	1870	1630	1640	2420	5480	2120	1990
$NRPR_M$	MJ_{NCV}	1.77	5.72	3.83	3.95	3.72	3.63	5.78	5.7	4.51	4.57
SM	kg	82.8	180	82.5	26.7	21.4	19.1	101	115	94.5	93.2

Product ID:		20000	20900	30050	30066	30067	30670	30901	30910	40028	40050
RSF	MJ_{NCV}	9.2	16.4	12.5	15.1	12.2	10.8	19.7	65.1	14.8	15.1
NRSF	MJ_{NCV}	88.6	158	120	146	117	104	190	627	143	146
RE	MJ_{NCV}	x	x	x	x	x	x	x	x	x	x
FW	m^3	2.15	2.57	2.08	3.21	3.15	2.05	3.07	2.03	2.18	2.11
HWD	kg	2.59E-03	4.09E-03	3.35E-03	3.83E-03	3.12E-03	2.96E-03	4.91E-03	1.56E-02	1.32E-02	3.98E-03
NHWD	kg	110	140	127	138	120	116	164	413	141	142
RWD	kg	1.47E-03	1.39E-03	1.70E-03	1.28E-03	1.28E-03	2.26E-03	1.41E-03	4.02E-04	2.00E-03	1.77E-03
CRU	kg	0	0	0	0	0	0	0	0	0	0
MR	kg	0.0881	0.157	0.12	0.145	0.116	0.104	0.189	0.624	0.142	0.145
MER	kg	0	0	0	0	0	0	0	0	0	0
EE	MJ	0.329	0.587	0.446	0.54	0.434	0.387	0.704	2.33	0.529	0.54

Product ID:		40051	40060	40125	40134	40160	40670	50307	901	905	40305
Indicator	Unit	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3
RPR_E	MJ_{NCV}	649	637	709	673	679	597	668	708	625	662
RPR_M	MJ_{NCV}	0.967	0.806	1.21	1.21	0.902	0.827	1.62	0.215	0.43	1.14
$NRPR_E$	MJ_{NCV}	1980	1770	2290	2190	1910	1780	2710	1100	1230	2210
$NRPR_M$	MJ_{NCV}	4.43	2.98	5.85	5.85	3.3	4.77	7.16	0.287	0.575	9.59
SM	kg	86.6	97.4	139	139	90.9	22.3	43.6	157	254	30.7
RSF	MJ_{NCV}	14.8	12.3	18.6	18.6	13.8	12.7	24.7	3.29	6.57	17.4
NRSF	MJ_{NCV}	142	119	179	179	133	122	238	31.6	63.3	168
RE	MJ_{NCV}	x	x	x	x	x	x	x	x	x	x
FW	m^3	2.17	2.15	2.4	3.06	2.35	2.06	2.15	2.83	2.24	2.23
HWD	kg	3.92E-03	3.30E-03	4.75E-03	4.64E-03	3.63E-03	3.38E-03	6.25E-03	9.78E-04	1.72E-03	4.55E-03
NHWD	kg	142	126	162	158	134	126	196	67.8	79.9	157
RWD	kg	1.77E-03	1.55E-03	1.75E-03	1.47E-03	1.51E-03	2.46E-03	1.99E-03	8.17E-04	7.63E-04	2.52E-03
CRU	kg	0	0	0	0	0	0	0	0	0	0
MR	kg	0.142	0.118	0.178	0.178	0.132	0.121	0.237	0.0315	0.0629	0.167
MER	kg	0	0	0	0	0	0	0	0	0	0
EE	MJ	0.528	0.44	0.663	0.663	0.493	0.452	0.883	0.117	0.235	0.622

Product ID:		30385	40085
Indicator	Unit	A1-A3	A1-A3
RPR_E	MJ_{NCV}	635	621
RPR_M	MJ_{NCV}	1.12	0.902
$NRPR_E$	MJ_{NCV}	2120	1870
$NRPR_M$	MJ_{NCV}	1.49	1.21
SM	kg	30.1	84.9
RSF	MJ_{NCV}	17.1	13.8
NRSF	MJ_{NCV}	165	133
RE	MJ_{NCV}	x	x
FW	m^3	2.14	2.08
HWD	kg	4.45E-03	3.67E-03
NHWD	kg	153	135
RWD	kg	1.47E-03	1.42E-03
CRU	kg	x	x
MR	kg	0.164	0.132
MER	kg	0	0
EE	MJ	0.61	0.493

References

Haring, H.-W. (Ed.), 2008. Industrial Gases Processing. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. Population Reference Bureau (PRB), 2016. 2016 World Population Data Sheet. ISSN: 0085-8315.

ISO 14040: 2006/Amd 1:2020 Environmental Management - Life cycle assessment – Principles and framework.

ISO 14044: 2006/Amd 2:2020 Environmental Management - Life cycle assessment - Requirements and Guidelines

ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.

ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services.

NSF International. Product Category Rule for Environmental Product Declarations: PCR for Concrete. Valid through February 22, 2024.

TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts. Version 2.1 – User Guide - https://nepis.epa.gov/Adobe/PDF/P100HN53.pdf.

US EPA, November 2020. Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM): Construction Materials Chapters, v15. https://www.epa.gov/sites/default/files/2020-12/documents/warm_construction_materials_v15_10-29-2020.pdf