METHODOLOGICAL FRAMEWORK

DECLARED UNIT

The declared unit is 1 cubic meter (1 cubic yard) of ready mixed concrete product. The defined concrete mix is intended for commercial applications developed and produced by CalPortland. Key product variables include:

- Compressive strength - Compressive strengths are represented in the mix design and include the number of days after pouring as a part of the reference value: e.g., 3,000 psi @ 28 days; 4,000 psi @ 56 days; 6,000 psi @ 90 days; etc.
- Water to cementitious materials ratio (w/cm) – Varies but generally lower for a higher strength non-air entrained mix design (above 5,000 psi (34.5 MPa)) in accordance with ACI 211.1 recommendations.
- SCM use – various mix designs call for Portland cement displacement by incorporating fly ash (FA) and/or slag cement (SL).
- Admixtures use – Admixtures used was specified for the mix design that was modeled. These admixtures can include an air-entraining admixture, water reducing and accelerating admixtures, and high range water reducer admixtures
- No hazardous substances are present in the declared product.
- The ready mixed concrete products represented in this EPD are comprised of :
  Natural Fine Aggregate (ASTM C33), Natural Coarse Aggregate (ASTM C33), Portland Cement (ASTM C150), BatchWater (ASTM C1602)

SYSTEM BOUNDARY

A summary of life cycle stages included in the EPD is identified in the figure below. This EPD covers A1-A3 life cycle stages (Cradle-to-Gate). A summary of activities excluded from the EPD is as follows:

- Production, manufacture, and construction of manufacturing capital goods and infrastructure.
- Production and manufacture of production equipment, delivery vehicles, and laboratory equipment.
- Personnel-related activities (travel, furniture, and office supplies)
- Energy and water se related to company management and sales activities.

CUT-OFF RULES

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO 21930: 2017 Section 7.1.8. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty (e.g., portland cement and admixtures) are included.
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle inventory.
- Proxy data was used for admixtures used that did not align with any of the admixture categories published in the EFCA EPDs. In those cases, the Water Reducing Admixture data was selected as a conservative assumption as per the NSF PCR Appendix A

BUILDING LIFE CYCLE INFORMATION MODULES (X: Included in LCA; MND: Module Not Declared)															
Production Stage			Construction Stage		Use Stage							End-Of-Life Stage			
Extraction and Upstream Production	Transport to Facility	Manufacturing	Transport to Site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction /Demolition	Transport to Waste Process. or Disposal	Waste Processing	Disposal of Waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

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ALLOCATION

The allocation of co-products or secondary flows cross the system boundary conforms with the ISO 21930: 2017 Section 7.2.4. Specifically, the allocation criteria were applied as follows:

- Allocation was not applied to any of the gate-to-gate production facilities. For facilities that manufacture additional products (i.e., aggregate), the LCI flows at the facility specific to the concrete production were reported.
- For Secondary Data sources, the NSF PCR default allocation selection (i.e., “Cut-off” or “Alloc Rec”) was applied.
- 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.
- A portion (30%) of the reported fleet energy use for truck mixing plants was allocated to the mixing facility.

CALCULATED RESULTS A1- A3

CORE MANDATORY IMPACT INDICATOR			PER YD3	PER M3
Global warming potential	GWP	kg CO2e	329.74	431.29
Depletion potential of the stratospheric ozone layer	ODP	kg CFC11e	6.99E-06	9.14E-06
Acidification potential of soil and water sources	AP	kg SO2e	1.45	1.89
Eutrophication potential	EP	kg Ne	0.40	0.52
Formation potential of tropospheric ozone	SFP	kg 03e	35.92	46.98
Abiotic depletion potential for fossil resources	ADPf	MJ, NCV	1987.73	2599.85
Abiotic depletion potential for non-fossil mineral resources	ADPe	kg Sbe	6.91E-05	9.03E-05
Fossil fuel depletion	FFD	MJ Surplus	95.71	125.18
USE OF PRIMARY RESOURCES				
Renewable primary energy carrier used as energy	RPRE	MJ, NCV	58.46	76.47
Renewable primary energy carrier used as material	RPRM	MJ, NCV	0.00	0.00
Non-renewable primary energy carrier used as energy	NRPRE	MJ, NCV	2043.77	2673.15
Non-renewable primary energy carrier used as material	NRPRM	MJ, NCV	0.00	0.00
SECONDARY MATERIAL, SECONDARY FUEL AND RECOVERED ENERGY				
Secondary material	SM	kg	0.00	0.00
Renewable secondary fuel	RSF	MJ, NCV	0.00	0.00
Non-renewable secondary fuel	NRSF	MJ, NCV	157.84	206.45
Recovered energy	RE	MJ, NCV	0.00	0.00
MANDATORY INVENTORY PARAMETERS				
Consumption of freshwater resources	FW	m3	1.56	2.04
Calcination and carbonation emissions	CCE	kg CO2e	144.87	189.48
INDICATORS DESCRIBING WASTE				
Hazardous waste disposed	HWD	kg	3.92E-03	5.13E-03
Non-hazardous waste disposed	NHWD	kg	64.92	84.92
High-level radioactive waste, conditioned, to final repository	HLRW	m3	6.78E-09	8.87E-09
Intermediate- and low-level radioactive waste, to final repository	ILLRW	m3	1.16E-07	1.52E-07
Components for re-use	CRU	kg	0.00	0.00
Materials for recycling	MR	kg	0.00	0.00
Materials for energy recovery	MER	kg	0.00	0.00
Recovered energy exported from the product system	EE	MJ, NCV	0.00	0.00

**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.*

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DATA SOURCES

This EPD is based on foreground LCI data collected from the participating company's production facilities for the calendar year 2020. All upstream material, resource and energy carrier inputs have been sourced from various industry-average datasets and literature. Many of these data sets are defaulted to those specified for use in the NSF PCR 2022. The following Table describes each LCI data source and includes the data quality assessment.

MATERIALS	LCI DATA SOURCE	YEAR	GEOGRAPHY	DATA QUALITY
Portland Cement and Limestone Cement, ASTM C595, AASHTO M240, or CSA A3001	Portland Cement Association EPD of Portland Cement and Portland Limestone Cement (2021)	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Slag Cement, ASTM C989	Slag Cement Association EPD of North America Slag Cement (2021)	2021	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Fly Ash, ASTM C618	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Silica Fume, ASTM C1240	None, no incoming burden, only inbound transport is considered*	N/A	N/A	N/A
Crushed Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, crushed {RoW}| production | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Natural Aggregates, coarse and fine, ASTM C33	ecoinvent 3.4: "Gravel, round {RoW}| gravel and sand quarry operation | Cut-off, U" (2018), modified with US average electricity	2001	World/US	Technology: very good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Manufactured Lightweight Aggre- gates, ASTM C330	ecoinvent 3.4: Expanded clay {RoW}| production | Cut-off, U (2018), modified with US average electricity	2000	World/US	Technology: good, Time: poor, Geography: good, Completeness: very good, Reliability: very good
Admixtures, ASTM C494	EFCA EPDs for Air Entrainers, Plasticizers and superplas- ticisers, Hardening Accelerators, Set Accelerators, Water Resisting Admixtures, and Retarders (2015)	2015	EU	Technology: very good, Time: very good, Geography: fair, Completeness: very good, Reliability: very good
Batch and Wash Water, ASTM C1602	ecoinvent 3.4: Tap water {RoW}| market for | Cut-off, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Road Transport	USLCI 2014: Transport, combination truck, short-haul, diesel powered/tkm/RNA (2014)	2010	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Rail Transport	USLCI 2014: Transport, train, diesel powered /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Ocean Transport	USLCI 2014: Transport, ocean freighter, average fuel mix/US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Electricity	ecoinvent 3.4: Electricity, low voltage {XX}| market for | Cut-off, U (2018)	2015	North America	Technology: very good, Time: very good, Geography: very good, Completeness: very good, Reliability: very good
Diesel	USLCI 2014: Diesel, combusted in industrial boiler / US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Gasoline	USLCI 2014: Gasoline, combusted in equipment /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Liquefied Propane Gas	USLCI 2014: Liquefied petroleum gas, combusted in industrial boiler /US U (2014)	2007	North America	Technology: very good, Time: fair, Geography: very good, Completeness: very good, Reliability: very good
Hazardous Solid Waste	ecoinvent 3.4: Hazardous waste, for incineration {RoW}| treatment of hazardous waste, hazardous waste incineration | Alloc, Rec, U (2018), modified with US electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good
Non-Hazardous Solid Waste	ecoinvent 3.4: Inert waste {RoW}| treatment of, sanitary landfill | Alloc Rec, U (2018), modified with US average electricity	2011	World/US	Technology: very good, Time: good, Geography: good, Completeness: very good, Reliability: very good

** 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.*

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