شركة أسمنت الاتحاد(ش.م.خ.)
UNION CEMENT COMPANY (Pr.J.S.C)

DURABILITY CEMENT

ENVIRONMENTAL PRODUCT DECLARATION

SULPHATE RESISTING CEMENT (CEM I 42.5 N - SR 5, LA)

In accordance with ISO 14025 & EN 15804:2012+A2:2019/AC:2021

EPD Program	Title	Details
International Climate Intelligence System 71-75 Shelton Street Covent Garden, London, WC2H 9JQ United Kingdom office@climateintell.com	Registration Number	ICIS-202603-127
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Union Cement Company (Pr.J.S.C)
Khor Khwair Industrial Area,
Ras Al Khaimah, UAE
www.uccrak.com

For the most current version and to confirm the validity of an EPD within International Climate Intelligence System, please refer to www.climateintell.com. EPDs are subject to revision or removal if conditions vary.

With world-leading clinker capacity, Union Cement Company defines strength

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OVERVIEW

This Environmental Product Declaration (EPD) presents verified and transparent environmental performance data for Sulphate Resisting Cement (CEM I 42.5 N - SR 5, LA) manufactured by Union Cement Company at its production facility in Ras Al Khaimah, United Arab Emirates, for the reporting period April 2024 to March 2025. The declared unit for this assessment is 1 metric ton of Sulphate Resisting Cement (CEM I 42.5 N - SR 5, LA).

The Life Cycle Assessment (LCA) has been conducted in accordance with the requirements of ISO 14025 and EN 15804:2012 + A2:2019/AC:2021, covering all relevant life cycle stages within the defined system boundary. This EPD provides consistent, third-party-verified environmental information to support architects, engineers, developers, contractors, and sustainability professionals in embodied carbon assessment, green building certification schemes, and transparent procurement decision-making.

PRODUCT INFORMATION

Product Name

Sulphate Resisting Cement
(CEM I 42.5 N - SR 5, LA)

Product Type

Hydraulic binder for
sulphate-resistant concrete

Declared Unit

1 metric ton

PCR & Version

ICIS PCR 2026:18 v1.2.6
(EN 15804 + A2 aligned)

Scope

Cradle-to-Gate with
options (A1-A4, C1-D)

Production Route

Dry process with
preheater–precalciner kiln

Recycled Content

Not intentionally added
(inherent recycled content only)

Electricity Mix

UAE grid mix from Ecoinvent 3.11 (cut-off). Natural Gas (89.42%), Nuclear (7.06%), Oil (0.60%), Solar (0.18%) and others.

LCA Tool and Database

Air.e.LCA v3.20.1.0 and
Ecoinvent v3.11 (Cut-Off)

Geographical Scope

United Arab Emirates

PRODUCT INFORMATION

Verification

International Climate Intelligence System
71-75 Shelton Street, Covent Garden
London, WC2H 9JQ
United Kingdom
office@climateintell.com
www.climateintell.com

Product Group Classification

UN CPC 37440
(Portland Cement)

Environmental Performance Summary (A1-A3)

Indicator	Result	Unit
Climate change (GWP) - total	7.86E+02	Kg CO_2e
Climate change (GWP) - fossil	7.86E+02	Kg CO_2e
Ozone Depletion (ODP)	1.47E-05	Kg CFC-11e
Abiotic depletion of fossil resources	8.39E+03	MJ

Hotspot Summary

Process	Share of Total GWP (%)
Raw Material Supply (A1)	1.04
Raw Material Transportation (A2)	0.07
Manufacturing (A3)	93.63
Remaining Modules (A4, C1-C4)	5.26

PRODUCT INFORMATION

Where This Adds Value

Scheme / Area	Relevance to SRC (CEM I 42.5 N - SR 5, LA)
LEED v4.1 (USGBC) – Material Disclosure & Whole-Building LCA	LEED projects in the UAE and Oman prioritise product-specific EPDs to achieve MR credits and improve whole-building embodied carbon performance. As sulphate-resistant concrete is specified for foundations and aggressive soil conditions, this verified Type III EPD enables accurate modelling and strengthens sustainability submissions.
Estidama Pearl Rating System (Abu Dhabi)	Pearl-rated government and infrastructure projects require transparent environmental documentation for material approval. The availability of a verified EPD for SRC enhances specification confidence and supports embodied carbon and responsible material selection criteria.
Oman Green Building Guidelines (OGBG)	Sustainability-driven developments in Northern Oman increasingly adopt material transparency practices. This EPD provides quantifiable environmental data that supports consultant benchmarking and acceptance in projects requiring sulphate-resistant concrete.
BREEAM International (UAE & GCC Projects)	BREEAM-aligned developments reward the use of products with verified environmental declarations. This EPD contributes to LCA-based credits, enabling project teams to optimise structural carbon performance while demonstrating responsible sourcing transparency.
Whole-Building Embodied Carbon Assessment	Cement is a major embodied carbon contributor in foundations and marine structures. Providing product-specific LCA data allows designers to refine modelling, support carbon reduction strategies, and differentiate bids in durability-critical projects.

PRODUCT INFORMATION

Government & Giga-Project Procurement	Major infrastructure and mega-developments increasingly request product-specific EPDs during material prequalification. Availability of this EPD strengthens Union Cement Company's positioning in durability-driven and sustainability-focused tenders.
Ready-Mix, Precast & Contractor Supply Chains	As embodied carbon reporting becomes standard practice across the GCC, ready-mix producers and contractors benefit from access to verified SRC GWP values, supporting sustainability reporting and project competitiveness.

ABOUT UNION CEMENT

Founded in 1972, Union Cement Company (UCC) is a pioneering cement manufacturer headquartered in Ras Al Khaimah. Operating one of the world's highest-capacity single clinker production lines, UCC produces over 13,500 tonnes per day. The company manufactures OPC, SRC, PLC, GGBFS, DrillWell cement, and clinker, supporting large-scale infrastructure, energy, transport, and industrial development projects with reliable, performance-driven manufacturing excellence.

UCC operates a fully integrated cement manufacturing facility in Ras Al Khaimah, covering:

- High-capacity dry-process clinker production with preheater–precalciner kiln technology.
- Large-scale cement grinding and dispatch operations serving UAE and Oman.
- Bulk and bagged cement supply to ready-mix, precast, and infrastructure sectors.
- Advanced laboratory testing and continuous process monitoring.
- Optimised fuel and raw material management systems.

UCC's production infrastructure is engineered for efficiency, consistency, and reliability — ensuring uninterrupted supply for major construction and infrastructure projects.

UCC maintains internationally recognised management systems and product compliance standards, including:

- ISO 9001 – Quality Management System.
- ISO 14001 – Environmental Management System.
- ISO 45001 – Occupational Health & Safety Management System.
- Compliance with EN standards and relevant GCC regulatory requirements.
- Product conformity aligned with regional construction specifications.

UCC continues to invest in operational excellence, sustainability performance, and technological optimisation to meet the evolving demands of large-scale construction and infrastructure development across the UAE and Northern Oman.

Through world-leading clinker capacity, disciplined quality control, and responsible manufacturing practices, UCC remains a cornerstone supplier to the region's structural growth.

PRODUCT DESCRIPTION

Sulphate Resisting Cement (CEM I 42.5 N – SR 5, LA) is a high-durability hydraulic binder manufactured through the controlled grinding of specially formulated Portland cement clinker with a regulated addition of gypsum to achieve required setting characteristics and strength development. Supplied as a fine grey powder, it reacts with water to form a dense and stable cementitious matrix that enhances resistance to sulphate attack in aggressive environments. Its composition is characterised by a low tricalcium aluminate (C_3A) content, together with calcium silicates formed during high-temperature clinker production, ensuring improved durability under sulphate exposure.

The product is designed for structural and infrastructure applications where resistance to sulphate-bearing soils, groundwater, or marine conditions is essential. SRC (CEM I 42.5 N – SR 5, LA) supports reliable long-term strength development, dimensional stability, and enhanced durability in chemically aggressive environments. Typical uses include foundations, marine structures, sewerage systems, retaining walls, canal linings, culverts, and underground concrete works. The cement is supplied in bulk and bagged formats, enabling efficient handling for large-scale infrastructure projects and specialised construction applications.

Sectors & Corresponding Uses

Sector	Application / Use Case
Coastal & Marine Construction	Reinforced concrete for marine foundations, quay walls, jetties, breakwaters, and substructures exposed to seawater requiring sulphate resistance and long-term durability
Foundations & Substructure Engineering	Concrete for raft foundations, basements, retaining walls, and underground structures in sulphate-bearing soils and aggressive groundwater conditions
Precast & Underground Concrete Manufacturing	Precast pipes, segments, manholes, and boundary elements requiring resistance to chemical exposure and durable performance
Infrastructure & Transport Engineering	Concrete for bridge substructures, tunnels, culverts, drainage systems, and mass works exposed to sulphate-rich environments
Industrial & Utility Facilities	Concrete for desalination plants, sewerage systems, storage tanks, and industrial foundations requiring strength and chemical resistance

PRODUCT DESCRIPTION

Technical Specifications

Parameter	Details / Specification
Product Type	Hydraulic Binder (Sulphate Resisting Portland Cement)
Strength Class	42.5 N (Normal early strength)
Form	Fine grey powder
Main Constituent	Low C_3A Portland clinker with controlled gypsum addition
28-Day Compressive Strength	≥ 42.5 MPa
Early Strength	Normal early strength development
Initial Setting Time	Conforming to EN 197-1 requirements
Soundness	Within EN 197-1 specified limits
Density (True)	Approx. 3.10–3.15 g/cm³
Supply Format	Bulk tanker, 50 kg paper bags or Jumbo Bags

MANUFACTURING DETAILS

The production of Sulphate Resisting Cement (CEM I 42.5 N – SR 5, LA) begins with the inspection and preparation of the principal raw material, limestone, together with carefully proportioned clay and minor corrective materials to achieve the required low C_3A clinker chemistry. All incoming materials undergo quality verification to ensure conformity with defined chemical and physical specifications before being conveyed to storage areas or silos. The limestone and associated raw materials are subjected to raw grinding, where they are finely milled to produce a homogenised raw meal formulated to support sulphate-resistant clinker production.

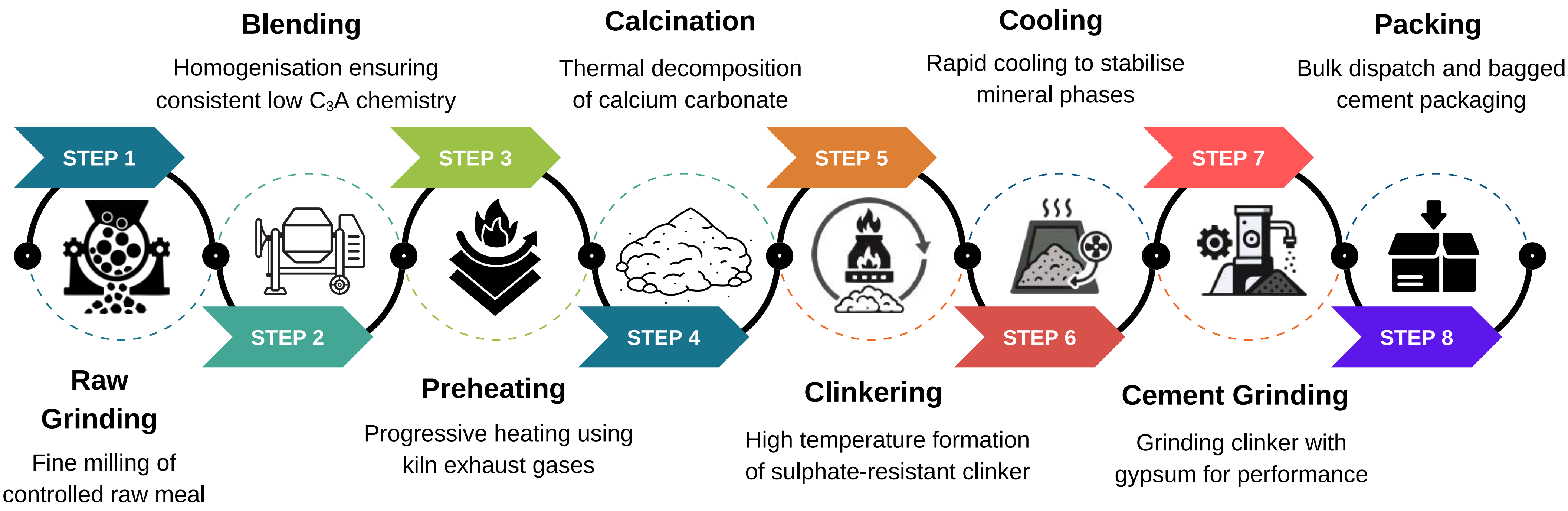
The prepared raw meal is transferred to blending systems to ensure consistent chemical composition prior to entering the preheater. During preheating, the material is progressively heated by counter-current hot gases from the kiln. In the calcination stage, calcium carbonate decomposes into calcium oxide and carbon dioxide. The material then enters the rotary kiln for clinkering, where temperatures approaching 1450°C promote the formation of clinker minerals with controlled tricalcium aluminate content to enhance sulphate resistance. The hot clinker is rapidly cooled to stabilise the desired mineral phases and preserve reactivity.

After cooling, the clinker is stored and subsequently fed into the cement grinding stage, where it is interground with controlled amounts of gypsum to regulate setting time and achieve the specified performance class. The grinding process determines the final fineness and durability characteristics of the cement. Finished cement undergoes quality control testing to verify strength class, sulphate resistance classification, setting behaviour, and physical properties before being transferred to bulk silos for tanker dispatch or packed into 50 kg PP bags and jumbo bags (FIBC), palletised where applicable, and prepared for distribution.

For a visual representation of the full manufacturing workflow, refer to the illustrated flow chart on the next page. A screenshot of the process flow as modeled in the LCA software is provided on the page that follows.

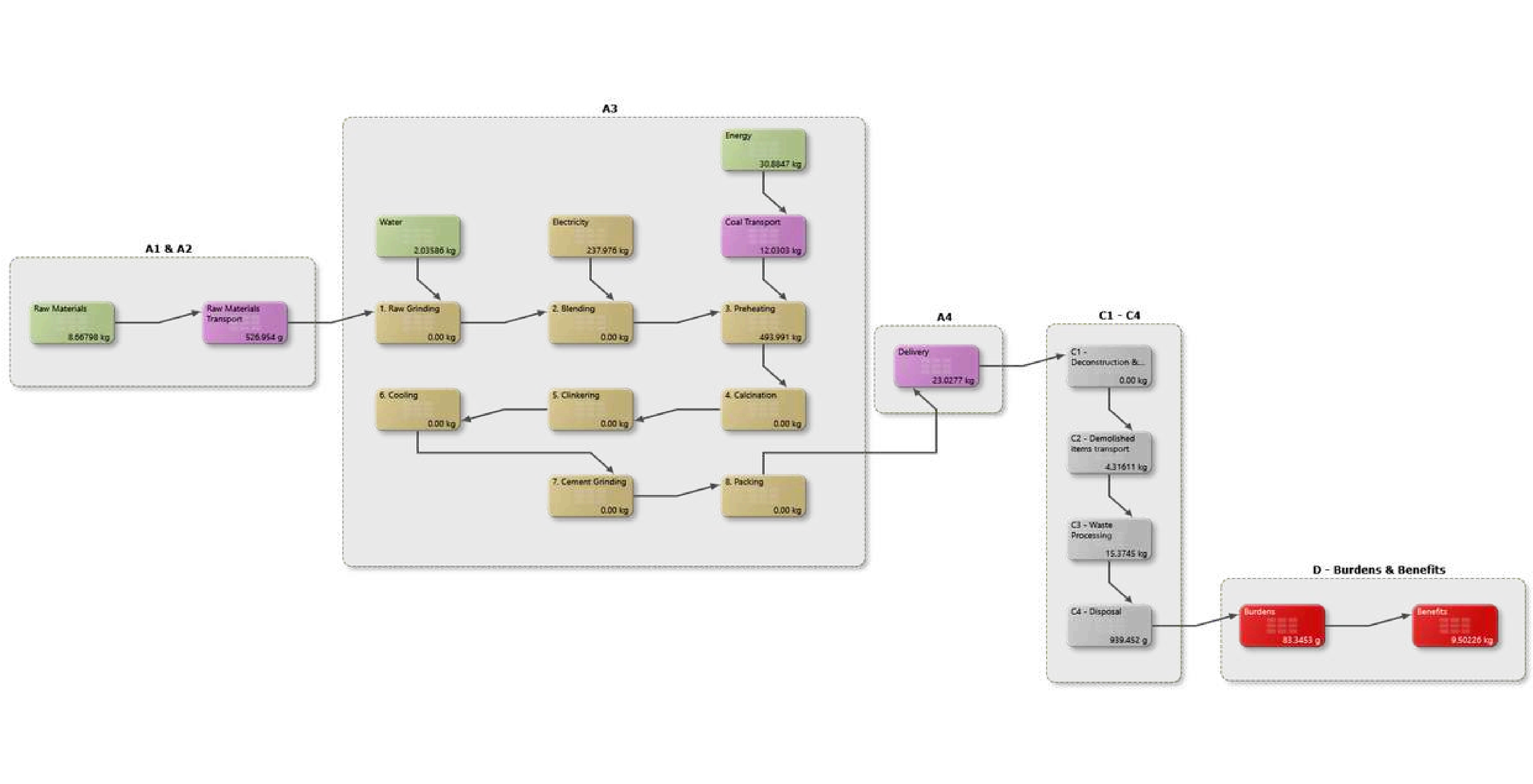
MANUFACTURING DETAILS

Schematic overview of SRC (CEM I 42.5N - SR 5, LA) manufacturing process



MANUFACTURING DETAILS

Screenshot of SRC (CEM I 42.5 N - SR 5, LA) LCA model from LCA software



CONTENT DECLARATION

The content declaration provides a transparent breakdown of the constituent materials present in Sulphate Resisting Cement (CEM I 42.5 N – SR 5, LA), expressed per 1 metric ton of product. The cement is predominantly composed of specially formulated Portland clinker with controlled low C_3A content, interground with regulated quantities of gypsum to achieve specified setting characteristics and durability performance. The total of all listed constituents equals 1 metric ton, matching the declared unit and ensuring complete material accounting in accordance with EN 15804 and ISO 14025 requirements.

Component	Weight (kg/Declared unit)	Post-consumer recycled (%)	Pre-consumer recycled (%)	Biogenic Content (%)	Biogenic Carbon (kg C/DU)
Portland Clinker	948	0	0	0	0
Gypsum	50	0	0	0	0
Additives & Fillers	2	0	0	0	0
Total	**1000**	**0**	**0**	**0**	**0**

Substances of Very High Concern (SVHC)

According to the requirements of the ECHA Candidate List of Substances of Very High Concern (SVHC), SRC (CEM I 42.5 N – SR 5, LA) contains no substances listed above the 0.1% (w/w) threshold in the final product.

All principal constituents of the cement—low C_3A Portland clinker, gypsum, and minor constituents where applicable—were reviewed against the latest published SVHC list at the time of reporting. Based on supplier declarations and available safety data sheets, no SVHCs are present in concentrations exceeding regulatory reporting thresholds.

Packaging Material Declaration

Packaging materials used for SRC (CEM I 42.5 N - SR 5, LA) include 50 kg multi-wall cement bags (85 GSM kraft paper), wooden pallets, jumbo bags (FIBCs), pull tie cords, sling bag caps, PVC binding straps, and LDPE protective sheets. Each component performs a defined function within the supply chain—cement bags and jumbo bags contain and protect the powder product, pallets enable stable stacking and mechanical handling, binding straps and LDPE sheets secure palletised loads during transport, and auxiliary components such as pull ties and caps ensure closure and lifting integrity.

All packaging materials are included in the life cycle assessment, as they contribute to upstream

CONTENT DECLARATION

manufacturing impacts and form recoverable or disposable material streams at end-of-life in accordance with EN 15804 requirements.

Packaging Material	Biogenic Content (%)	Biogenic Carbon Fraction (kg C/kg material)	Notes & References
Wooden Pallet	~100% (solid wood)	0.50 kg C/kg	IPCC (2006) Guidelines — wood contains ~50% carbon by dry mass.
50 kg Cement Bags (85 GSM Kraft paper)	~100% (paper fibre basis)	0.44 kg C/kg	Based on IPCC (2006) default carbon content for lignocellulosic biomass and pulp/paper industry data. Conservative value used for kraft paper.
Jumbo Bags (PP - FIBC)	0%	0 kg C/kg	Polypropylene is petroleum-based; contains no biogenic carbon.
Pull Tie Cord (PP)	0%	0 kg C/kg	Polypropylene accessory component; fossil-based polymer.
Sling Bag Caps (PP)	0%	0 kg C/kg	Injection-moulded polypropylene; fossil-based carbon.
Binding Strap (PVC)	0%	0 kg C/kg	PVC is petroleum-based; no biogenic carbon content.
LDPE Sheet	0%	0 kg C/kg	Low-density polyethylene is fossil-based; contains no biogenic carbon.

Wooden pallets and multi-wall kraft cement bags contain significant biogenic carbon, as both originate from lignocellulosic biomass (solid wood and paper fibre). In contrast, jumbo bags (polypropylene), pull tie cords, sling bag caps, binding straps (PVC), and LDPE sheets are fossil-based polymers and contain no biogenic carbon.

These biogenic fractions are reported transparently to reflect the temporary storage of renewable carbon within the packaging system. Their modelling and reporting in the LCA follow EN 15804+A2 requirements, with biogenic carbon flows presented in the Packaging Composition and Biogenic Carbon table below.

CONTENT DECLARATION

Packaging Material	Weight (kg/Declared Unit)	Share of Packaging (%)	Biogenic Carbon (kg C/DU)	End-of-Life Handling
Wooden Pallet	5.93E-04	48.45	2.97E-04	Reuse / Recycle / Energy Recovery
50 kg Cement Bags (85 GSM Kraft paper)	5.91E-04	48.24	2.60E-04	Recycle / Energy Recovery
Jumbo Bags (PP - FIBC)	2.93E-05	2.39	0.00E+00	Reuse / Recycle / Energy recovery
Pull Tie Cord (PP)	5.53E-07	0.05	0.00E+00	Energy recovery / Landfill
Sling Bag Caps (PP)	3.98E-07	0.03	0.00E+00	Energy recovery / Landfill
Binding Strap (PVC)	5.97E-07	0.05	0.00E+00	Recycle (limited) / Energy recovery
LDPE Sheet	9.69E-06	0.79	0.00E+00	Recycle / Energy recovery
Total	**1.22E-03**	**100**	**5.57E-04**	**-**

Note - Biogenic content in packaging materials **exceed the 5% threshold** of the total packaging weight as stated in **ICIS PCR 2026:18**. Hence, these biogenic emissions are added in **module A3 and balanced out in module A5**.

LCA KNOWLEDGE

Declared Unit

The declared unit for this EPD is 1 metric ton of SRC (CEM I 42.5 N - SR 5, LA) at the factory gate. All material inputs, energy use, emissions, transportation, packaging, and end-of-life modelling are quantified relative to this unit. This ensures consistent comparison across life cycle stages and aligns with EN 15804+A2 requirements for construction products. No functional performance is assigned to the product in this declaration, as the EPD is based on a declared unit rather than a functional unit.

Temporal, Geographical and Technological Representativeness

Temporal Representativeness: Primary data for SRC (CEM I 42.5 N - SR 5, LA) reflects the reporting period April 2024 to March 2025, in line with EN 15804+A2 requirements that primary manufacturing data must be no older than five years. All on-site information—including raw material consumption, energy use, water use, and waste generation—represents current operational conditions at the Ras Al Khaimah plant during the defined reporting year. Background data used in the study are consistent with the temporal validity provided in their respective datasets to ensure alignment with the modelling year.

Geographical Representativeness: The LCA model for SRC (CEM I 42.5 N - SR 5, LA) reflects the actual manufacturing and supply conditions of Union Cement Company's Ras Al Khaimah facility in the United Arab Emirates, where all primary data was collected. The study represents production and operations within UAE, with UAE-specific or GCC-specific conditions applied wherever available — particularly for raw material sourcing patterns, electricity grid characteristics, water production, and end-of-life treatment routes.

Where UAE-specific datasets or regional factors were not available, GCC-appropriate or globally representative datasets were used. All transport distances, energy consumption figures, and end-of-life scenarios are based on realistic practices in the UAE, ensuring geographical relevance of the final results.

Technological Representativeness: The manufacturing process modelled for SRC (CEM I 42.5 N - SR 5, LA) accurately reflects the integrated dry-process production technology used at Union Cement Company's facility. Production includes raw material preparation (crushing, raw grinding, and blending), preheating and calcination in a rotary kiln system, clinker formation at high temperature with controlled low C_3A chemistry, rapid clinker cooling, followed by finish grinding with gypsum and minor additions, and final packing. The process involves high-temperature thermochemical reactions during calcination and clinkering, supported by controlled fuel combustion and kiln operation.

LCA KNOWLEDGE

The technological assumptions applied in the LCA represent a modern dry-process kiln with preheater and precalciner configuration, consistent with large-scale clinker manufacturing operations. Energy inputs, process emissions from calcination, fuel combustion, internal material handling, and cement grinding are included to reflect actual plant conditions. The modelling approach therefore represents real industrial sulphate-resisting cement production technology and ensures that the results are aligned with site-representative manufacturing practice.

LCA Software and Database

The life cycle model for SRC (CEM I 42.5 N - SR 5, LA) was developed using Air.e.LCA v3.20.1.0, with all background inventory data sourced from Ecoinvent v3.11 (Allocation, cut-off by classification). The software was used to structure process flows, assign datasets, calculate environmental indicators, and perform all module-by-module inventory tracking. The database provides consistent, peer-reviewed life cycle inventories for raw materials, energy supply, transportation, and waste management processes. All datasets selected reflect technologies and supply chains relevant to the product and regional context, ensuring reliable integration of foreground data with established international life cycle inventories.

System Boundary

This EPD covers all product stages from “cradle to gate with options”, i.e. this LCA covers Production stage A1-A3, Transportation A4, End-of-life stages C1-C4 and Resource recovery stage D according to EN 15804:2012 + A2:2019 / AC:2021.

The procedures that are not controlled by the company, but are included in this environmental study, are:

- The extraction and production of fuels and electricity.

All related direct and indirect environmental impacts related to these elements have been calculated and were included in the LCA and this EPD. Personnel-related processes, such as transportation of employees to and from work is excluded. Also, the production and end-of-life processes of infrastructure or capital goods used in the product system are excluded.

Module A1 - Raw Material Supply

Module A1 encompasses all upstream processes associated with the extraction, processing, and supply of raw materials used in the manufacture of SRC (CEM I 42.5 N – SR 5, LA). The principal constituents—limestone, gypsum, and minor constituents where applicable—are sourced from suppliers within the United Arab Emirates, ensuring traceability and alignment with plant quality specifications. Upstream activities including quarrying, raw material processing, fuel production, electricity generation, and the manufacture of auxiliary materials are included within this module.

LCA KNOWLEDGE

Packaging materials are sourced from a combination of suppliers located in the UAE, Oman, and India. These include woven polypropylene cement bags, wooden pallets, jumbo bags (FIBC), pull tie cords, sling bag caps, binding straps, and LDPE sheets. The upstream production and processing of these packaging materials, including raw material extraction and polymer or paper manufacturing, are accounted for within Module A1.

Module A2 - Raw Material Transportation

Module A2 covers the transportation of all raw and packaging materials to the Union Cement Company facility in Ras Al Khaimah, United Arab Emirates. The primary raw materials—limestone, gypsum, and minor constituents where applicable—are sourced within the UAE and transported to the Ras Al Khaimah plant using >32-ton Euro 6 lorry, representative of bulk mineral transport within the country. Packaging materials are sourced from a combination of the UAE, Oman, and India. Materials from the UAE and Oman are transported by >32-ton Euro 6 lorry, while packaging materials imported from India are transported via sea freight container ship to Mina Saqr port and subsequently delivered by >32-ton Euro 6 lorry to the Ras Al Khaimah facility.

Environmental impacts in this module arise from diesel combustion in heavy-duty road transport and marine fuel combustion in container shipping. Transport distances, load factors, and logistics modelling reflect realistic GCC supply chain conditions, ensuring representative accounting of both domestic and international inbound transport to the Ras Al Khaimah cement plant.

Module A3 - Manufacturing

Manufacturing impacts cover all processes required to convert raw materials into finished SRC (CEM I 42.5 N – SR 5, LA) at the Union Cement Company production facility in Ras Al Khaimah. Production follows a continuous, integrated process comprising eight sequential stages: Raw Grinding, Blending, Preheating, Calcination, Clinkering, Cooling, Cement Grinding, and Packing. These stages ensure controlled raw meal preparation, stable kiln operation at high temperatures, formation of clinker minerals with low C_3A content, and final grinding to achieve the specified cement fineness and durability performance characteristics.

Environmental loads in this module include electricity consumption for raw milling, kiln auxiliaries, clinker cooling, and cement grinding; thermal energy from fuel combustion in the preheater and rotary kiln; internal material transport via conveyors and mobile equipment; and process-related CO_2 emissions from limestone calcination. Additional impacts include minor solid waste generation from dust collection systems and routine maintenance activities. All direct emissions from fuel combustion, calcination, on-site equipment operation, and process-related releases are included within the A3 system boundary.

LCA KNOWLEDGE

Module A4 - Delivery

Module A4 accounts for the transportation of finished SRC (CEM I 42.5 N - SR 5, LA) from the Union Cement Company manufacturing facility in Ras Al Khaimah, United Arab Emirates, to customer locations. The product is supplied to construction and infrastructure projects across the UAE and Northern Oman, including Dubai, Abu Dhabi, Sharjah, Ajman, Fujairah, Umm Al Quwain, Al Ain, Sohar, and Musandam. Outbound transport is modelled using >32-ton Euro 6 lorry, representing typical bulk cement and palletised bag transport within the GCC regional road network.

SRC is delivered either in bulk form (for ready-mix and batching plants) or as bagged cement on pallets and jumbo bags. Transport modelling assumes high load utilisation consistent with cement distribution practices in the region. Environmental impacts in this module include diesel consumption, tailpipe emissions, and distance-based fuel use associated with road transport from the Ras Al Khaimah facility to customer sites across the UAE and Northern Oman corridor.

Scenario details	Description
Vehicle used for transport	Euro 6, >32 ton truck
Vehicle capacity	>32 tons
Fuel type and consumption	Diesel, 0.38 liters per km
Capacity utilization	100% as assumed in Ecoinvent v3.11
Bulk transportation	Mass of the transported product

Module C1 - Deconstruction and Demolition

Module C1 covers impacts from activities required to deconstruct or demolish the product at end-of-life. Sulphate Resisting Cement (SRC CEM I 42.5 N – SR 5, LA) is used as a hydraulic binder and, after hydration, becomes chemically bound within the hardened cement paste and fully integrated into the concrete or mortar matrix. In service, SRC does not remain a separable component that can be dismantled, removed, or targeted independently.

At end-of-life, demolition is performed at the level of the building element (e.g., reinforced concrete slabs, beams, columns, foundations) using standard mechanical demolition equipment such as hydraulic breakers, crushers, or shears. These demolition activities are driven by the structural form and reinforcement layout of the concrete element and are not influenced by the presence of SRC as a material constituent. The cement fraction does not require additional tools, energy, or handling beyond what is already required to demolish the concrete element as a whole.

Accordingly, no distinct demolition operations can be attributed specifically to SRC (CEM I 42.5 N – SR 5, LA) as a standalone product. Therefore, environmental burdens in Module C1 are set to zero, with the understanding that demolition impacts occur at the concrete or structural system level rather than being attributable to cement itself.

Module C2 - Transport to Waste Processing

Module C2 accounts for the transport of demolition waste from the demolition site to waste processing or disposal facilities.

At end-of-life, Sulphate Resisting Cement (SRC CEM I 42.5 N – SR 5, LA) is fully integrated within the hardened concrete matrix. Following demolition, the cement fraction forms part of mixed mineral construction and demolition (C&D) rubble. Based on regional waste management practices across the United Arab Emirates and Northern Oman (Sohar and Musandam), 85% of the concrete demolition waste is assumed to be transported to authorised C&D recycling facilities, while the remaining 15% is transported to inert landfill sites.

The selected recovery rate reflects established C&D recycling systems in the UAE. Construction and demolition waste constitutes one of the largest waste streams in the country, and government authorities have implemented dedicated recycling facilities and diversion policies. Dubai Municipality operates specialised C&D recycling facilities, while Abu Dhabi's Tadweer (Abu Dhabi Waste Management Center) and BEEAH in Sharjah manage large-scale material recovery operations for mineral waste (Dubai Municipality, 2022; Tadweer, 2023; BEEAH Group, 2023). The UAE Ministry of Climate Change and Environment has also issued regulatory guidance supporting the use of recycled aggregates in infrastructure projects (MOCCAE, 2019).

For benchmarking, advanced economies report mineral C&D waste recovery rates typically ranging between 70% and 90%, with some countries exceeding 90% under strong regulatory enforcement (European Commission, 2018; European Environment Agency, 2020). The adopted 85% recycling assumption therefore represents a regionally realistic and internationally consistent value, accounting for high diversion performance in Dubai and Abu Dhabi and comparatively lower recovery in smaller emirates and Northern Oman.

A one-way transport distance of 50 km is assumed from demolition site to recycling facility and landfill. This represents typical intra-emirate and regional transport distances for C&D waste within the UAE and Northern Oman industrial corridors. Transport is modelled using a >32-ton EURO 6 heavy-duty lorry, representative of bulk mineral waste transport vehicles operating in the region.

Module C2 therefore includes only the environmental burdens associated with transporting mixed mineral demolition waste containing SRC (CEM I 42.5 N – SR 5, LA) to recycling and landfill facilities.

Type	Capacity utilization	Type of vehicle	Average distance
Truck	92%	Euro 6, >32 ton truck	50 kms

Module C3 - Waste Processing

Module C3 includes the processing of mineral construction and demolition (C&D) waste directed to recycling facilities. Upon arrival at an authorised C&D recycling plant, the concrete rubble containing SRC (CEM I 42.5 N – SR 5, LA) undergoes a sequence of mechanical treatment operations designed to recover usable mineral fractions. The material is first subjected to inspection and coarse sorting to remove oversized contaminants. It then passes through primary crushing equipment (e.g., jaw or impact crushers) to reduce fragment size.

Following primary size reduction, magnetic separation systems remove embedded ferrous metals such as reinforcing steel. The mineral fraction is subsequently processed through secondary crushing and multi-stage screening to produce graded recycled aggregate fractions and fines suitable for use in road base, sub-base, backfilling, and other infrastructure applications. All treatment operations are mechanical; no thermal or chemical processing occurs. The cement paste remains bound within the crushed concrete and behaves as part of the inert mineral matrix throughout processing.

Module C3 therefore accounts for the environmental burdens associated with these mechanical crushing, separation, and screening operations required to produce recycled aggregate from the recovered mineral demolition waste.

Module C4 - Disposal

Module C4 covers the final disposal of the 15% fraction of mineral construction and demolition (C&D) waste that is not directed to recycling. This fraction of concrete rubble containing SRC (CEM I 42.5 N – SR 5, LA) is assumed to be disposed of in authorised inert construction and demolition landfill facilities within the United Arab Emirates and Northern Oman.

LCA KNOWLEDGE

The disposed material consists entirely of inert mineral waste derived from crushed concrete. These materials are non-biodegradable, do not generate landfill gas, and do not undergo further chemical degradation under landfill conditions. Disposal operations typically involve unloading, placement, compaction, and periodic covering of the inert mineral waste in engineered landfill cells designed specifically for construction and demolition materials.

Module C4 therefore includes the operational burdens associated with inert landfill activities for the non-recycled mineral fraction, while no additional emissions are attributed to the cement component due to its chemically stable and inert nature after hydration.

Module D - Reuse, Recovery and Recycling Potential

Module D reports the net environmental benefits and burdens resulting from material recovery processes that substitute primary production outside the system boundary, in accordance with EN 15804+A2.

Mineral Fraction (Concrete Containing SRC CEM I 42.5 N – SR 5, LA)

At end-of-life, SRC (CEM I 42.5 N – SR 5, LA) remains chemically bound within the hardened concrete matrix and cannot be recovered as cement. Based on regional construction and demolition (C&D) waste management practices across the United Arab Emirates and Northern Oman, 85% of the mineral demolition waste is assumed to be directed to authorised recycling facilities. The processed concrete rubble is mechanically crushed and screened to produce recycled aggregate fractions used in infrastructure applications such as road base, sub-base, and backfilling.

Recycled aggregate is modelled as substituting virgin crushed aggregate on a 1:1 mass basis. This substitution approach is consistent with regional regulatory frameworks supporting the use of recycled aggregates in construction projects (MOCCAE, 2019; Dubai Municipality, 2022) and aligns with international C&D waste recovery protocols that recognise mineral aggregate substitution as the primary recovery pathway (European Commission, 2018). Module D therefore includes the avoided burdens associated with primary aggregate extraction and processing.

Packaging Materials

Packaging materials are modelled with recovery rates reflecting industrial source-segregated collection practices within the UAE and Northern Oman, supported by regional waste management frameworks and international recycling benchmarks.

Wooden Pallets – 95% Recovery

LCA KNOWLEDGE

Wooden pallets are assumed to be reused or recycled at a rate of 95%, reflecting established industrial reuse markets and high recovery rates reported by pallet industry studies (National Wooden Pallet & Container Association, 2016). Regional segregation frameworks in the UAE support recyclable wood recovery through licensed waste operators (Dubai Municipality, 2022).

Multi-Wall Kraft Cement Bags (80 GSM) – 95% Recovery
Kraft paper cement bags are assumed to be recovered at 95%, consistent with industrial source-separated paper collection streams and aligned with precedent assumptions applied in regional cement EPDs. Paper and cardboard packaging exhibit high recycling rates internationally (Eurostat, 2023), and UAE waste segregation policies support recyclable material recovery when properly segregated (Dubai Municipality, 2022).

Jumbo Bags (FIBC – Polypropylene) – 75% Recovery
Flexible Intermediate Bulk Containers (FIBCs) are reusable industrial packaging products made of polypropylene fabric. A 75% recovery rate is assumed, reflecting industrial reuse practices and the recyclability of polypropylene materials (PlasticsEurope, 2023). Regional waste operators in the UAE and Oman maintain plastic recycling capacity for segregated industrial streams (BEEAH Group, 2023).

Pull Tie Cord (Polypropylene) – 10% Recovery
Small plastic accessory components such as pull tie cords are assigned a 10% recovery rate due to limited segregation in construction waste streams. International plastic packaging recycling statistics indicate lower capture rates for small plastic components compared to bulk packaging (Eurostat, 2023).

Sling Bag Caps (Polypropylene) – 5% Recovery
Detached plastic caps are assumed to have minimal recovery (5%) due to their small size and low likelihood of source separation within C&D waste management systems.

Binding Strap (PVC) – 15% Recovery
PVC binding straps are assigned a 15% recovery rate, reflecting limited recycling capture for flexible PVC packaging materials. International plastic recovery data indicate moderate-to-low recycling rates for such materials without dedicated take-back schemes (PlasticsEurope, 2023).

LDPE Sheet – 95% Recovery
LDPE sheets are assumed to be recovered at 95% under an industrial source-segregated collection scenario. The UAE maintains plastic recycling infrastructure capable of processing

LCA KNOWLEDGE

LDPE materials (BEEAH Group, 2023), and LDPE film exhibits high recycling potential when clean and segregated (PlasticsEurope, 2023).

Process	Unit (metric ton)
Collection process specified by type	
SRC (CEM I 42.5 N - SR 5, LA) in concrete collected as mixed mineral C&D waste	1
Recovery system specified by type	
Mineral demolition rubble sent for reuse / recycling as aggregate	0.85 (85%)
Mineral demolition rubble sent for energy recovery	Not applicable
Disposal specified by type	
Mineral demolition rubble sent to inert landfill	0.15 (15%)
Transportation assumptions	
Transport to recycling and landfill sites	50 km transport by Euro 6, >32 ton truck

LCA KNOWLEDGE

System Boundaries Illustration

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction / installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction & Demolition	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	X	X	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
Geography	UAE	UAE	UAE	GLO	-	-	-	-	-	-	-	-	GLO	GLO	GLO	GLO	GLO
Share of specific data	GWP > 90%			-		-	-	-	-	-	-	-	-	-	-	-	-
Variation - products	0%			-		-	-	-	-	-	-	-	-	-	-	-	-
Variation - sites	0%			-		-	-	-	-	-	-	-	-	-	-	-	-

X - Included, ND - Modules not declared.
**Module A5 is included to balance out biogenic emissions from packaging.*

LCA KNOWLEDGE

Cut-Off Rules

All relevant material and energy flows contributing to the manufacture of SRC (CEM I 42.5 N - SR 5, LA) have been included in the LCA model. More than 99% of the total mass, energy use, and environmental relevance is captured. Negligible flows—those that do not influence the overall results—are excluded.

The Polluter Pays Principle and the Modularity Principle are applied to ensure that impacts are assigned to the processes where they occur and that each life cycle stage is reported independently. No known data gaps or exclusions are expected to influence the robustness of the results.

Allocation

Allocation was applied only where shared energy inputs were used across multiple cement product lines. Coal consumption, natural gas use, electricity consumption, water use, and diesel for internal handling were allocated using a mass-based approach, reflecting each product's proportional share of total annual production at the Ras Al Khaimah facility.

Raw materials—including low C_3A Portland clinker, gypsum, and minor constituents—and all associated transport flows were modelled using product-specific primary data, as these inputs are directly dosed for SRC (CEM I 42.5 N – SR 5, LA) and do not require allocation. No economic allocation was applied, as the plant does not generate co-products within the cement manufacturing process.

Electricity

Electricity consumption in the LCA model is based on the UAE grid mix as represented in Ecoinvent v3.11 (Allocation, cut-off by classification). The UAE electricity supply is predominantly generated from natural gas, supplemented by nuclear power, oil, solar energy, and minor imports from neighbouring GCC countries. The modelled grid composition is as follows:

Energy Source	Share (%)
Natural Gas - Combined Cycle Power Plant	51.31%
Natural Gas - Conventional Power Plant	38.11%
Nuclear - Pressure Water Reactor	7.06%
Hard Coal	2.09%

Oil	0.60%
Import from Saudi Arabia	0.44%
Import from Oman	0.20%
Solar Thermal (Parabolic Trough)	0.18%
Wind (<1 MW, Onshore)	0.00003%

The climate impact associated with this electricity mix is 5.81E-01 kg CO_2e per kWh, and this factor is applied consistently to all electricity use across modules A1–A3 and relevant downstream stages. This approach ensures that electricity-related impacts accurately reflect UAE operational conditions and the energy landscape relevant to Union Cement Company's Ras Al Khaimah facility.

Calculation Rules

The LCA model for SRC (CEM I 42.5 N – SR 5, LA) uses foreground data collected directly from Union Cement Company's Ras Al Khaimah manufacturing facility, combined with background datasets sourced from Ecoinvent v3.11 (Allocation, cut-off by classification). These datasets provide emission factors for key inputs, including low C_3A Portland clinker, gypsum, minor constituents, fuel combustion (coal and natural gas), electricity generation, packaging materials, and transportation. Regionally representative conditions—such as UAE electricity mixes, supplier distances, and GCC end-of-life practices—were incorporated where relevant to ensure representativeness.

Transport activities for raw material supply, packaging procurement, and finished product delivery are included based on actual supplier-to-plant and plant-to-customer road distances. Road distances were measured using Google Maps, while sea freight distances for packaging imported from India were determined using portdistance.com. Exclusions are limited to items of negligible relevance (<1%), such as administrative activities, office utilities, and capital equipment maintenance. Transport flows are therefore fully represented within the defined geographical scope.

Byproducts Assignment

No by-products are generated during SRC (CEM I 42.5 N – SR 5, LA) manufacturing. The only outputs are finished cement and process emissions from fuel combustion and calcination. Therefore, no allocation is required.

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ENVIRONMENTAL PERFORMANCE

In the following tables, the environmental performance of the declared unit “1 metric ton of Sulphate Resisting Cement (CEM I 42.5 N - SR 5, LA)” is presented for the Union Cement Company. Environmental impacts are calculated using EF-3.1, (ILCD).

ENVIRONMENTAL PERFORMANCE

Core Environmental impact indicators

The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding thresholds values, safety margins or risks.

Impact Category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Climate change (GWP) - fossil	Kg CO_2e	8.61E+00	5.27E-01	7.77E+02	7.86E+02	2.30E+01	0.00E+00	0.00E+00	4.31E+00	1.53E+01	9.39E-01	-9.36E+00
Climate change (GWP) - biogenic	Kg CO_2e	0.00E+00	0.00E+00	2.04E-03	2.04E-03	0.00E+00	-2.04E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Climate change (GWP) - LULUC	Kg CO_2e	1.82E-02	2.53E-04	3.52E-02	5.37E-02	1.11E-02	0.00E+00	0.00E+00	2.07E-03	2.18E-02	5.34E-04	-1.91E-02
Climate change (GWP) - total	Kg CO_2e	8.67E+00	5.27E-01	7.77E+02	7.86E+02	2.30E+01	0.00E+00	0.00E+00	4.32E+00	1.54E+01	9.39E-01	-9.42E+00
Ozone depletion	Kg CFC-11e	1.13E-07	7.03E-09	1.45E-05	1.47E-05	3.07E-07	0.00E+00	0.00E+00	5.76E-08	2.44E-07	2.61E-08	-1.08E-07
Acidification	mol H+e	9.29E-02	1.27E-03	5.23E+00	5.32E+00	5.46E-02	0.00E+00	0.00E+00	1.02E-02	1.18E-01	6.57E-03	-6.39E-02
Eutrophication, aquatic freshwater	kg PO_4^{3-} eq	6.51E-03	1.23E-04	4.93E-01	4.99E-01	5.38E-03	0.00E+00	0.00E+00	1.01E-03	2.27E-02	2.52E-04	-1.03E-02
Eutrophication, aquatic freshwater	Kg P eq	2.12E-03	4.01E-05	1.61E-01	1.63E-01	1.75E-03	0.00E+00	0.00E+00	3.29E-04	7.41E-03	8.22E-05	-3.36E-03
Eutrophication, aquatic marine	Kg N eq	3.13E-02	3.38E-04	6.48E-01	6.80E-01	1.46E-02	0.00E+00	0.00E+00	2.73E-03	4.17E-02	2.53E-03	-1.77E-02
Eutrophication, terrestrial	mol N eq	3.94E-01	3.64E-03	6.81E+00	7.21E+00	1.57E-01	0.00E+00	0.00E+00	2.94E-02	4.52E-01	2.76E-02	-2.04E-01
Photochemical ozone formation	Kg NMVOC eq	1.04E-01	2.00E-03	2.37E+00	2.48E+00	8.68E-02	0.00E+00	0.00E+00	1.63E-02	1.44E-01	9.95E-03	-6.29E-02
Abiotic depletion, minerals & metals	Kg Sb eq	3.00E-05	1.57E-06	1.56E-04	1.87E-04	6.88E-05	0.00E+00	0.00E+00	1.29E-05	3.48E-05	1.37E-06	-6.54E-05
Abiotic depletion of fossil resources	MJ	1.20E+02	7.18E+00	8.27E+03	8.39E+03	3.14E+02	0.00E+00	0.00E+00	5.88E+01	2.37E+02	2.30E+01	-1.23E+02
Water use	m^3 depr.	6.25E+00	4.25E-02	2.31E+01	2.94E+01	1.86E+00	0.00E+00	0.00E+00	3.48E-01	5.14E+01	1.02E+00	-1.42E+01

The results of the environmental impact indicators — Abiotic depletion, Water use, and all optional indicators except Particulate matter and Ionizing radiation, human health — shall be used with care, as the uncertainties on these results are high or there is limited experience with the indicator. Reading example: 1.57E-03 = 1.57×10^{-3} = 0.00157.

ENVIRONMENTAL PERFORMANCE

Additional environmental impact indicators

Impact Category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Particulate matter	Incidence	1.76E-06	5.37E-08	6.00E-05	6.18E-05	2.35E-06	0.00E+00	0.00E+00	4.40E-07	8.81E-06	1.51E-07	-1.29E-06
Ionizing radiation, human health	Kbq U-235 eq	2.34E-01	6.88E-03	2.27E+01	2.29E+01	3.01E-01	0.00E+00	0.00E+00	5.64E-02	3.73E-04	1.38E-02	-4.04E-01
Ecotoxicity (freshwater)	CTUe	5.77E+01	9.83E-01	1.06E+03	1.12E+03	4.30E+01	0.00E+00	0.00E+00	8.06E+00	7.71E+01	1.66E+00	-4.30E+01
Human toxicity, cancer effects	CTUh	2.94E-08	8.80E-11	7.21E-08	1.02E-07	3.85E-09	0.00E+00	0.00E+00	7.21E-10	3.37E-09	1.70E-10	-2.92E-08
Human toxicity, non-cancer effects	CTUh	6.55E-08	5.23E-09	3.53E-06	3.60E-06	2.29E-07	0.00E+00	0.00E+00	4.29E-08	1.32E-07	3.83E-09	-9.18E-08
Land use related impacts/soil quality	Dimensionless	2.78E+03	8.25E+00	6.68E+02	3.46E+03	3.61E+02	0.00E+00	0.00E+00	6.76E+01	2.57E+02	4.52E+01	-2.70E+03

This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure, or radioactive waste disposal in underground facilities. Potential ionizing radiation from soil, radon, and some construction materials is also not measured by this indicator.

GWP-GHG Indicators

Impact Category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-GHG	Kg CO_2e	8.67E+00	5.27E-01	7.77E+02	7.86E+02	2.30E+01	2.04E-03	0.00E+00	4.32E+00	1.54E+01	9.39E-01	-9.42E+00

This indicator includes all greenhouse gases, excluding biogenic carbon dioxide uptake and emissions, as well as biogenic carbon stored in the product, as defined by IPCC AR6 (2021). The indicator aligns closely with the Global Warming Potential (GWP) outlined in EN 15804:2012+A2:2019, incorporating updated characterization factors and environmental impact indicators.

Resource Use Indicators

Impact Category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Renewable PER used as energy	MJ	3.86E+02	1.11E-01	6.02E+01	4.46E+02	4.84E+00	0.00E+00	0.00E+00	9.07E-01	6.74E+00	2.17E-01	-3.69E+02
Renewable PER used as materials	MJ	3.04E-02	0.00E+00	2.82E-01	3.12E-01	0.00E+00	-3.12E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-3.55E-02

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Total use of renewable PER	MJ	3.86E+02	1.11E-01	6.05E+01	4.47E+02	4.84E+00	-3.12E-01	0.00E+00	9.07E-01	6.74E+00	2.17E-01	-3.69E+02
Non-renewable PER used as energy	MJ	1.20E+02	7.18E+00	8.27E+03	8.40E+03	3.14E+02	0.00E+00	0.00E+00	5.93E+01	2.37E+02	2.30E+01	-1.24E+02
Non-renewable PER used as materials	MJ	1.03E-03	0.00E+00	3.09E-05	1.06E-03	0.00E+00	-1.06E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-8.93E-04
Total use of non-renewable PER	MJ	1.20E+02	7.18E+00	8.27E+03	8.40E+03	3.14E+02	-1.06E-03	0.00E+00	5.93E+01	2.37E+02	2.30E+01	-1.24E+02
Use of secondary materials	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	m^3	0.00E+00	0.00E+00	4.53E-01	4.53E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Waste Indicators

Impact Category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Hazardous waste	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-hazardous waste	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E+02	0.00E+00
Radioactive waste	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Output Flow Indicators

Impact Category	Unit	A1	A2	A3	A1-A3	A4	A5	C1	C2	C3	C4	D
Components for reuse	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.52E+02
Materials for recycling	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.50E+02	0.00E+00	8.52E+02

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Materials for energy recovery	Kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy - electricity	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy - thermal	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Biogenic carbon content

Details	Unit	A1-A3
Biogenic carbon content in product	Kg C	0.00E+00
Biogenic carbon content in accompanying packaging	Kg C	5.57E-04

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO_2. "Reading example: 1.57E-03 = $1.57*10^{-3}$ = 0.00157"

Disclaimer: "According to the **EN 15804:2012+A2:2019** standard, the LCIA results are relative expressions translating impacts into environmental themes such as climate change, ozone depletion, etc. (midpoint impact categories). Thus, the LCIA results do not predict impacts on category endpoints such as impact on the extinction of species or human health. In addition, the results do not provide information about exceeding thresholds, safety margins or risks".

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Interpretation

The life cycle results for SRC (CEM I 42.5 N – SR 5, LA) demonstrate a production-stage–dominated environmental profile, with Module A3 accounting for 93.63% of total GWP. This distribution is technically consistent with sulphate-resisting cement manufacturing in the UAE and wider GCC region, where emissions are primarily driven by high-temperature kiln operations and calcination of limestone during clinker production. The thermal energy demand of the rotary kiln (typically 3.0–3.6 GJ per ton of clinker in modern dry-process systems) and the release of process CO_2 from calcium carbonate decomposition inherently concentrate impacts within A3. Given that SRC in the GCC maintains a high clinker factor (≈94–96%) with controlled low C_3A mineralogy rather than clinker substitution, the dominance of A3 reflects expected regional production realities and chemistry-driven clinker intensity.

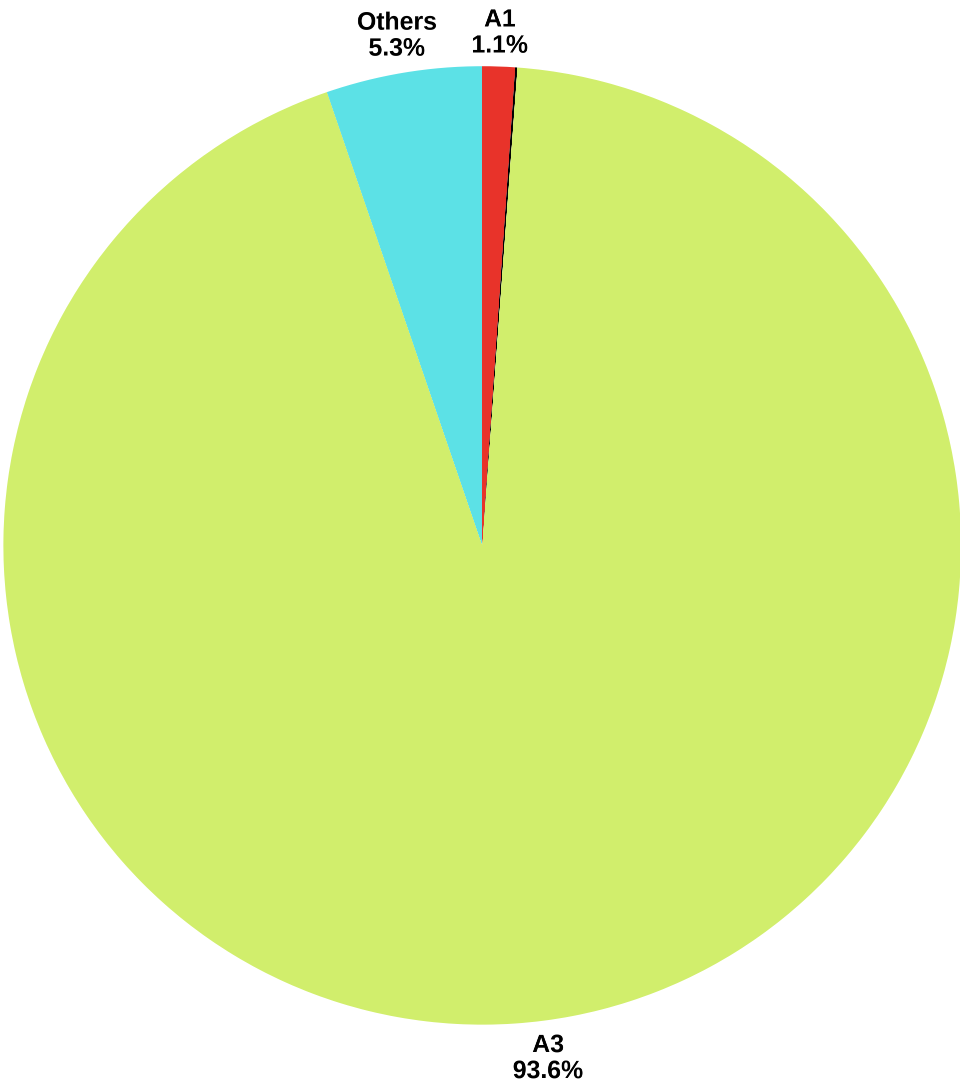
Module A1 (1.04%) and A2 (0.07%) remain comparatively low due to the localized sourcing structure typical of integrated UAE cement plants. Limestone extraction and gypsum procurement are sourced within the UAE, minimizing upstream transport and processing burdens. The very small A2 contribution confirms that inbound logistics distances are short and efficiently managed using heavy-duty road transport within national industrial corridors. This aligns with the vertically integrated quarry-to-kiln model commonly observed in Ras Al Khaimah and other GCC cement hubs, where raw material proximity significantly reduces upstream transportation emissions. The slightly lower A1 share compared to OPC reflects the absence of grinding aids and minimal auxiliary material inputs in SRC production.

Module A4 (2.78%) reflects outbound transport of finished cement to construction markets across the UAE and Northern Oman. The higher relative contribution compared to OPC is attributable to the wider distribution of sulphate-resistant cement to infrastructure, marine, and substructure projects, which may involve longer transport corridors within the UAE–Oman network. Nevertheless, the contribution remains modest when compared to clinker-related emissions. Distribution typically occurs via bulk delivery to ready-mix plants and large infrastructure contractors using high-capacity road freight (>32-ton Euro 6 lorries), ensuring efficient load utilization. The share of A4 confirms that while regional transport influences the total footprint, it does not materially alter the clinker-dominated carbon profile of SRC.

End-of-life modules show limited overall impact, consistent with GCC construction waste management practices. C1 is zero because SRC, like all hydraulic binders, becomes chemically bound within hardened concrete and does not generate standalone demolition burdens. C2 (0.52%) reflects transport of demolition waste to recycling and landfill facilities within the UAE and Northern Oman and remains minor relative to production-stage impacts. C3 (1.85%)

represents mechanical crushing and screening of concrete rubble at authorized C&D recycling facilities operating in Dubai, Abu Dhabi, Sharjah, and Northern Oman, where mineral recovery rates are high under municipal diversion policies. C4 (0.11%) remains low because inert concrete waste does not biodegrade or generate landfill gas. Overall, the distribution of impacts aligns with established GCC cement production, durability-driven infrastructure demand, and regional waste management systems, reinforcing the technical robustness and representativeness of the SRC LCA model.

Life Cycle Stage Contribution to GWP (kg CO_2e per 1 metric ton of SRC CEM I 42.5 N - SR 5, LA)



ENVIRONMENTAL PERFORMANCE

Mandatory Statements

Explanatory materials are available from the EPD Owner and/or LCA Author. The verifier and Program Operator make no claims and bear no responsibility regarding the legality of the study. Sole ownership, liability, and responsibility for the EPD lie with the EPD Owner. The LCA Author is not liable for manufacturer-provided information, life cycle data, or supporting evidence.

EPDs within the same product category, but issued by different EPD programs, may not be comparable. For valid comparison, both EPDs must be based on the same PCR (including version number), or on fully-aligned PCRs. Products must have identical function, technical performance, and use cases (e.g. the same declared or functional unit); share equivalent system boundaries, data descriptions, and data quality standards; use comparable collection methods and allocation rules; include matching content declarations; and be valid at the time of comparison.

Information related to EPD of multiple products

This is not an EPD of multiple products.

Information related to Sector EPD

This is not a sector EPD.

Differences vs previous versions

This is the first version of the EPD.

REVIEW AND VERIFICATION

Program Operator	International Climate Intelligence System 71-75 Shelton Street Covent Garden London, WC2H 9JQ United Kingdom
Registration Number	ICIS-202603-127
Publication Date	26-03-2026
Valid Until	25-03-2031
Geographical Scope	United Arab Emirates (UAE)
Product category rules (PCR): PCR 2026:18 Construction products (EN15804:2012+A2:2019/AC:2021) Version 1.2.6 dated 21-Jan-2026	
PCR review was conducted by: International Climate Intelligence System	
Independent verification of the declaration and data, according to ISO 14025:2006 and ISO 14040: EPD Process Certification (internal) ☑ EPD Verification (external)	
Third party verifier: Constantine Stephen, International Climate Intelligence System (ICIS)	

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ACRONYMS

Acronym	Meaning
kg CO_2e	Kilograms of carbon-dioxide equivalent
kg CFC-11e	Kilograms of Chlorofluorocarbon-11 equivalent
mol H+e	Moles of hydrogen ion equivalent
kg PO_4^{3-} eq	Kilograms of phosphate equivalent
kg P eq	Kilograms of phosphorus equivalent
kg N eq	Kilograms of nitrogen equivalent
mol N eq	Moles of nitrogen equivalent
kg NMVOC eq	Kilograms of non-methane volatile organic compound equivalent
kg Sb eq	Kilograms of antimony equivalent
MJ	Megajoules
m^3 depr.	Cubic meters of water deprived
incidence	Unit representing human health impact related to particulate matter exposure
Kbq U-235 eq	Kilo-becquerels of Uranium-235 equivalent
CTUe	Comparative Toxic Unit for ecosystems
CTUh	Comparative Toxic Unit for humans
dimensionless	Unitless characterization factor — used for land-use/soil quality impacts
kg C	Kilograms of biogenic carbon contained in product or packaging

STANDARDS AND REFERENCES

Standards & Methodological Frameworks

- EN 15804:2012 + A2:2019 / AC:2021 – Sustainability of construction works – Core rules for environmental product declarations of construction products.
- ISO 14025:2006 – Environmental labels and declarations – Type III environmental declarations – Principles and procedures.
- ISO 14040:2006 – Life cycle assessment – Principles and framework.
- ISO 14044:2006 – Life cycle assessment – Requirements and guidelines.

PCR & Program Documents

- PCR 2026:18 Construction Products, Version 1.2.6 – International Climate Intelligence System (EN 15804+A2 aligned).
- EPD General Program Instructions (GPI) of International Climate Intelligence System, v2.0, 2023.

Databases, Tools & Modelling Sources

- Ecoinvent v3.11, system model: Allocation, cut-off by classification.
- Air.e.LCA Software v3.20.1.0 by Solid Forest – Used for LCA modelling and impact calculations.
- IPCC AR6 (2021) Characterization Factors – Applied for GWP indicators (where relevant).
- EF 3.1 (Environmental Footprint 3.1 method) – Used for all midpoint impact indicators.

Transport Calculation Tools

- Google Maps – Road transport distance calculations.
- PortDistance.com – Maritime transport distance calculations.

End-of-Life & Recycling

- BEEAH Group (2023). Waste Recycling and Processing Operations in the UAE. BEEAH Group, Sharjah, United Arab Emirates.
- Dubai Municipality (2022). Waste Segregation and Construction & Demolition Waste Recycling Guidelines. Government of Dubai, United Arab Emirates.
- European Commission (2018). EU Construction and Demolition Waste Management Protocol. Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, Brussels, Belgium.
- European Environment Agency (2020). Construction and Demolition Waste Statistics and Recycling Performance in Europe. EEA, Copenhagen, Denmark.
- Eurostat (2023). Packaging Waste Statistics – Recycling Rates in the European Union. Statistical Office of the European Union, Luxembourg.

STANDARDS AND REFERENCES

- Ministry of Climate Change and Environment (MOCCAE), UAE (2019). Resolution on the Use of Recycled Aggregates from Construction and Demolition Waste in Infrastructure Projects. Government of the United Arab Emirates.
- National Wooden Pallet & Container Association (2016). U.S. Pallet Recycling Study. NWPCA / Virginia Tech Study, United States.
- PlasticsEurope (2023). Plastics – The Facts 2023: An Analysis of European Plastics Production, Demand and Waste Data. PlasticsEurope, Brussels.
- Tadweer (Abu Dhabi Waste Management Center) (2023). Construction and Demolition Waste Recycling Operations and Diversion Practices. Abu Dhabi, United Arab Emirates.


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