EPD™

Environmental Product Declaration

ISO 14025, ISO 21930 & EN15804+A2 2019 Compliant

Global GreenTag EPD Program

EcoPlatform Compliant

KEMBLA

MM Kembla Pty Ltd

Kembla Seamless Copper Plumbing Tube

Hard Drawn and Annealed Unwashed Tube

Company Adress	30 Gloucester Boulevarde Port Kembla NSW 2505Australia
EPD No	MMAP01 EP2024 & MMAP02 EP2024
Issue date	29 Sept 2024
Valid To	29 Sept 2029
Version	5
Revision date	15th Oct 2024

ECO PLATFORM

ECO PLATFORM EPD VERIFIED

Kembla Seamless Copper Plumbing Gas and Drainage Tube

Mandatory Disclosures

EPD type	Cradle to grave A1 to C4 + D	Issue Date	29 September 2024
Product Range	Kembla Seamless Copper Tube [1]	Valid Until	29 September 2029
Brand Name	Kembla Plumbing Gas and Drainage Tube		
Product Code	Kembla Hard Drawn Plumbing Tube	Kembla Annealed Plumbing Tube	
EPD Number	MMAP01 EP2024	MMAP02 EP2024	
Communication	This Environmental Product Declaration (EPD) discloses potential environmental outcomes compliant with EN 15804 for business-to-business communication. Independent external verification of the declaration and data, mandatory for business-to-consumer communication according to ISO		
Comparability	Construction product EPDs may not be comparable if not EN15804 compliant. Different program EPDs may not be comparable. Comparability is further dependent on the product category rules and data source used.		
Reliability	Life Cycle Impact Assessment (LCIA) results are relative expressions that do not predict impact on category endpoints, threshold exceedance, safety		

EPD Program Operator	**LCA and EPD Producer**	**Declaration Owner**
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PCR	Standard EN 15804+A2 2019 serves as core Product Category Rules (PCR) [2]. Sub-PCR PDP:2023 Plumbing and Drainage Piping also applies [3].
EPD Owner	This EPD is the property of the declared manufacturer tabled above.

Signed and Dated Demonstration of Internal and External Verification

Internal	Delwyn Jones 15 Oct 2024 — Life Cycle Assessment (LCA) developed by Delwyn Jones, The Evah Institute 29Aug2024 — LCA peer reviewed by Dr Sharmina Begum, Ecquate Pty Ltd 15/10/2024 — EPD Platform Operator review by David Baggs, Global GreenTag International Pty Ltd
External Verifier Statement	I, the undersigned, verifier, hereby confirm my examination did not find any relevant deviations by the EDP owner, LCA report or PCRs based on EN 15804 2012+A2:2019 and ECO Platform agreed interpretations by CEN TR 16970. Company-specific, upstream and downstream data in the LCA & environmental features report files held at The Evah Institute were plausible and consistent. This verification applied Global GreenTag International adopted ECO Platform checklists and this EPD states where to find PCRs and programme rules. 15/10/2024 — Verified by Murray Jones Ecquate Pty Ltd
Explanations	Further explanatory information is available at info@globalgreentag.com or by contacting certification1@globalgreentag.com [3].

KEMBLA

Kembla Seamless Copper Plumbing Gas and Drainage Tube

Program Description

EPD type	Cradle to grave A1 to C4 + D as defined by EN 15804 [1]
System boundary	The system boundary with nature includes material and energy acquisition, processing, manufacture, transport, installation, use plus waste arising to end of life.
Stages included	Stages A1-3 A4-5, B1-4, C1 to C2 and C4 D1 to D3
Stages excluded	Stages B5 to B7 were excluded and all B1 and C3 flows and results were zero.
Scope Depiction	Figure 1 depicts ticks in all modules being declared including with zero results. Any module not declared (MND) does not indicate a zero result.

Model	Actual			Scenarios											Potential		
Information	Building Life Cycle Assessment														Supplementary		
Stages	Product			Construct		Building Use							End-of-Life				Benefit & load beyond system		
Data Modules						Fabric					Operate								
Unit Operations	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D1	D2	D3
Phases	√	√	√	√	√	0	√	√	√		MND		√	√	0	√	√	√	√
Cradle to Gate+ Options & Grave	Resources	Transport	Manufacture	Transport	Construct	Use	Maintain	Repair	Replace	Refurbish	Energy use	Water use	Demolish	Transport	Process Waste	Disposal	Reuse	Recovery	Recycling

Figure 1 EPD Life Cycle Modules Cradle to Grave

Data Sources

Primary Data	Data was collected from primary sources 2019 to 2022 including the manufacturer and suppliers' standards, locations, logistics, technology, market share, management system in accordance with EN ISO 14044:2006, 4.3.2, [4]. All are biochemical-physical allocated none are economically allocated.
A1-A3 Stage inclusions	Operations include all known raw material acquisition, refining, processing plus scrap or material reuse from prior systems; electricity generated from all sources with extraction, refining & transport plus secondary fuel energy and recovery processes. Also, transport to factory gate; manufacture of inputs, ancillary material, product, packaging, maintenance, replacement plus flows leaving at end-of-waste boundary and fate of all flows at end of life.
Variability	Significant differences of average LCIA results are declared.
Chemicals of Concern	Contains no substances in the European Chemicals Agency "Authorised or Candidate Lists of Substances of Very High Concern (SVHCs)".

Data Quality

Data cut-off & quality criteria complies with EN 15804 [1] The LCA used background data aged <10 years and quality parameters tabled below.

Background	**Data Quality**	**Parameters and Uncertainty (U)**			
Correlation	**Metric σg**	U ±0.01	U ±0.05	U ±0.10	U ±0.20
Reliability	**Reporting**	Site Audit	Expert verify	Region	Sector
	Sample	>66% trend	>25% trend	>10% batch	>5% batch
Completion	**Including**	>50%	>25%	>10%	>5%
	Cut-off	0.01%w/w	0.05%w/w	0.1%w/w	0.5%w/w
Temporal	**Data Age**	<3 years	≤5 years	<7.5 years	<10 years
	Duration	>3 years	<3 years	<2 years	≥1 year
Technology	**Typology**	Actual	Comparable	In Class	Convention
Geography	**Focus**	Process	Line	Plant	Corporate
	Range	Continent	Nation	Plant	Line
	Jurisdiction	Representation is Global: Africa, North America, Europe, Pacific Rim			

Kembla Seamless Copper Plumbing Gas and Drainage Tube

Details of Manufacturer

MM Kembla manufactures and supplies seamless copper plumbing tube across Australia and South East Asia. Kembla's plumbing and drainage range also includes copper tube fittings not declared herein.

Product Information

Brand Name	Kembla Plumbing and Gas Copper Tube
Manufacturer address	30 Gloucester Boulevarde, Port Kembla NSW 2505, Australia
Site representation	Australasia
Factory warranty	25 years
Geographical Area	Use and disposal as for Australasia
Application	Pressure and non-pressure plumbing, gas fittings and drainage
Function in Building	Plumbing, gas fittings and drainage tube and pipe
Lifetime [5,6]	60 years Reference Service Life (RSL) [ISO 15686]
Declared unit	Hard drawn and annealed copper tube of kg/m as tabled for construction
Functional unit	60 years in/external use of declared product/kg cradle to grave and beyond

Product Functional, Technical & Dimensional Information

Manufactured to Australian Standard AS1432 Kembla hard drawn and annealed seamless copper plumbing gas & drainage tube is suitable for use in pressure and non-pressure plumbing, gas fitting and drainage applications. Tube length, outer diameter and mass per lineal metre is table below.

Hard Drawn						Annealed		
Length (m)	**OD**	**kg/m**	**Length (m)**	**OD**	**kg/m**	**Length (m)**	**OD**	**kg/m**
6.0	19.05	1.62	5.8	42.00	4.32	1.5, 3.0, 5.8 & 6.0	12.70	0.95
6.0	19.05	2.21	6.0	31.75	4.33	6.0	12.70	1.05
3.0, 5.8 & 6.0	25.40	2.60	5.8	35.00	4.44	6.0	15.88	1.20
3.0, 5.8 & 6.0	31.75	3.29	5.8 & 6.0	38.10	5.25	6.0	15.88	1.34
6.0	25.40	3.42	3.0, 5.8 & 6	50.80	5.34	6.0	19.05	1.46
5.8	35.00	3.58	5.8	54.00	5.59	6.0	15.88	1.58
3.0, 5.8 & 6.0	38.10	3.97	6.0	50.80	7.08	1.5, 3.0, 5.8 & 6.0	19.05	1.62
						6.0	19.05	2.21

Product Components

This section summarises factory components, functions, source nation and % mass share.

Product %w/w	Component	Cradle	Hard drawn	Annealed
Substrate	Copper	Australia	>99<100	>99<100
Deoxidant	Phosphorus copper	USA	<0.004	<0.004
Packaging				
Wrap & slings	Polyester	global	>0.3 <0.4	>0.3 <0.4
Lashing	Polypropylene	global	>0.05 <0.1	>0.05 <0.1
HDPE[1]	Caps		<0.0004	<0.0004

[1] High Density Polyethylene

System Analysis Scope and Boundaries

Stages A1 to 3 model actual operations. Stage A4 to C4 are model scenarios.

Typical scenarios are assumed to forecast unit operations as described in the next section.

Figure 2. shows included processes in a cradle to grave system boundary to end of life fates to unshown beyond the boundary reuse, recycling or landfill grave.

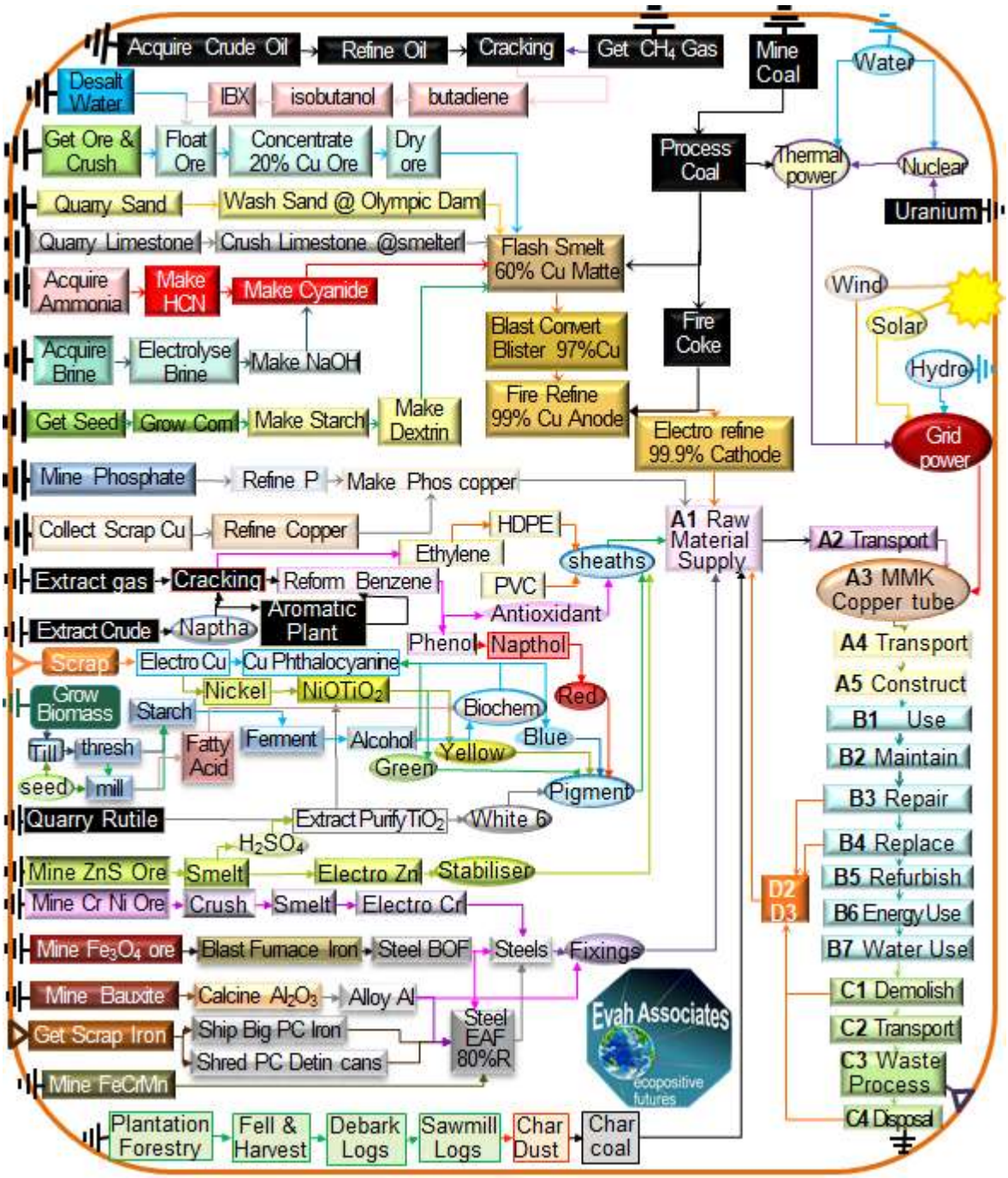


Figure 2. Product Process Flow Chart

Scenarios for Modules/Functional Unit

Stages A1 to A3 model actual operations for existing market demand or purposes deemed compliant with technical requirements and legal guidelines. This section defines scenarios A4 to D3. C3 Waste Treatment has no flows. There is no flow for B6 but if there were it must reflect gE0graphical scope.

Phase	Operation	Type specified	Amount	Type specified	Amount
A4 Transport	Transport to Site	25t semi-trailer	60 km	85% Capacity	Full back load
	Long distance road	25t semi-trailer	600km	85% Capacity	Full back load
	Continental freight rail	Diesel train	600km	85% Capacity	Full back load
	Container shipping	Factory to CBD	1,200km	85% Capacity	Full back load
	Volume capacity (<1 ≥1)	Utilisation factor	1	Uncompressed	Un-nested
A5 Construct	Ancillaries	Adhesive	0.025kg	Edge trim	0.0001kg
	Packing	Cardboard	0.005kg	Polymer	0.00001kg
	Water & Energy	Town water	0.5litre	Grid power	0.0002 MJ
	Waste on site	Trims	0.05kg	All packaging	As shown kg
	Scrap collection & route	25t semi-trailer	60 km	to landfill	In LCA report
	Emissions	Nil to air & water	0.0kg	All from landfill	In LCA report
B2 Maintain	Maker's specification	URL Declared	Specified	Clean cycle	Weekly
	Ancillaries	Wipes	Negligible	Detergent	0.007kgpa
	Surface Washdown	Town water	1.95kgpa	Net to drain	1.90kgpa
B3 Repair	Typical practice	Damaged parts	0.05kg	Damaged part	Same 5%
	Maker's specification	As per website	Specified	Freight to site	As A5
	Energy input & source	No excess	0.0MJpa	Packaging	As A5
C1 Demolish	Typical practice	Remove worn	0.05kg	Collect Separate	0.05kg
	Collection process	In site waste	0.40kg	Separate to reuse	0.0kg
C2 Transport	Typical practice	25t truck road	50km	85% capacity	No back load
C3 Waste Treatment	Typical practice	No waste treated	0.0kg	Not for energy	0.0kg
C4 Dispose	Typical practice	Product specific	0.05kg	Collect separately	0.05kg
	Typical practice	None to landfill	0%	All reused, recovered or recycled	
	Recovery system	No recycling	0.0kg	Not for energy	0.0kg
D1 Reuse	Typical practice	Reuse as is	75%	Patch 5%	0.05kg
D2 Recover	Typical practice	Recover unworn	22.5%	None	sweep
D3 Recycle	Typical practice	To recycling	2.5%	None	0%

Environmental Impact Terminology

The United Nations reports only a few decades are left to resolve accelerating climate emergency and extinction crises. It is a call to action to all people to reverse the loss of climate and biodiversity security from all human development activity [16]. Key environmental damages contributing to risks of ecological and community loss and collapse are tabled below with common names and remedies for each indicator.

Climate change from anthropo-genic infrared forced global warming	Greenhouse gases absorb infra-red radiation. This heat reduces thermal energy differentials, from equator to poles, forcing ocean current and wind circulation to blend and regulate climate. Weakly blended "lumpier" weather has more frequent, extreme heat wave, fire-storm, cyclone, rain-storm, flood and blizzard events. Accumulation of carbon dioxide, natural gas methane, nitrous oxides and volatile organic compounds from burning fossil fuels causes global warming. Forest and wilderness growth absorbing air-borne carbon in biomass can drawdown such accumulation. Urgent renewable energy reliance is vital in time to avoid imminent tipping points and the worsening "***climate emergency***".
Ozone layer depletion	Stratospheric ozone loss weakens the planet's solar shield so more shorter wavelength ultraviolet (UVB) light reaching earth damages plants and increases malignant melanoma and skin cancer in humans and animals. Chlorofluorocarbons, hydrochlorofluorocarbons (HCFC), hydrobromofluorocarbons, carbon tetrachloride, chlorobromomethane, methyl chloroform, methyl bromide and halon gas cause ozone layer loss. To repair the "***ozone hole***" reliance on ozone-safe refrigerants, aerosols and solvents is essential to avoid further its depletion and enable accumulation of naturally-formed ozone.
Acidification of air, land and waters	Acidification in the atmosphere reduces soil and waterway pH, impedes nitrogen fixation vital for plant growth and inhibits natural decomposition. It increases rates and incidence of fish kills, forest loss and deterioration of buildings and materials. Chief synthetic causes of "***acid rain***" are emissions of sulphur and nitrogen oxides, hydrochloric and hydrofluoric acids and ammonia from burning fossil fuels polluting precipitation of rain and snow world-wide.
Eutrophication of terrestrial, freshwater and marine life	Eutrophication from excessively high macronutrient levels added to natural waters promotes excessive plant growth that severely reduces oxygen, water and habitat security for aquatic and terrestrial organisms across related ecosystems. Chief synthetic cause of "***algal blooms***" is nitrogen (N, NOx, NH_4) and phosphorus (P, PO_4^{3-}) in rain run-off over-fertilised land catchments.
Photochemical ozone creation	Tropospheric photochemical ozone, called "***summer smog***" near ground level, is created from natural and synthetic compounds in UV sunlight. Low concentration smog damages vegetation and crops. High concentration smog is hazardous to human health. Chief synthetic causes are nitrogen oxides, carbon monoxide and volatile organic compounds (VOC) pollutants. Avoiding reliance on dirtiest coal fuel and volatile chemicals has reduced smog incidence in many areas globally.
Depletion of minerals, metals & water	Abiotic depletion of finite mineral resources increases time, effort and money required to obtain more resources to the point of extinction of naturally viable reserves. This can limit access to available, valuable and scarce elements vital for human-life. The youth movement "***extinction rebellion***" calls on adults to secure climate, material reserves and biodiversity for current and future generations.
Depletion of fossil fuel reserves	Abiotic depletion of resources by consuming finite oil, natural gas, coal and yellowcake fossil fuel reserves leaves current and future generations suffering limited available, accessible, plentiful, essential valuable as well as scarce raw material, medicinal, chemical, feedstock and fuel stock. Approaching "***peak oil***" acknowledged fossil fuel reserves are finite and the need for decision-makers to act to avoid market instability, insecurity and or oil and gas wars.

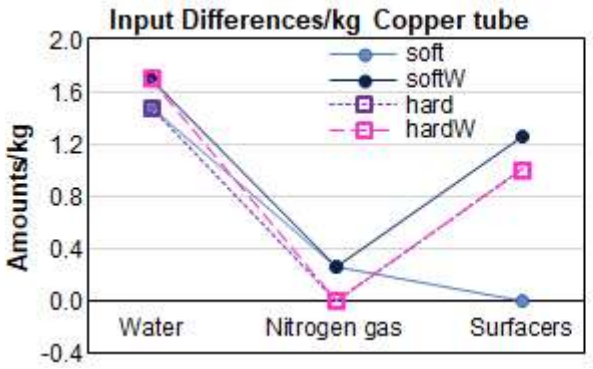
Glossary of Impact Assessment Terms, Methods and Units

Acronyms, methods and units of impact potentials plus inventory inputs and outputs, are defined below

Impact Potentials	Acronym	Description of Methods	Units
Climate Change biogenic	GWP_{bio}	GWP biogenic [7]	kg CO_{2eq}
Climate Change luluc	GWP_{luluc}	GWP land use & change [7]	kg CO_{2eq}
Climate Change fossil	GWP_{ff}	GWP fossil fuels [7]	kg CO_{2eq}
Climate Change total	GWP_{t}	Global Warming Potential [7]	kg CO_{2eq}
Stratospheric Ozone Depletion	ODP	Stratospheric Ozone Loss [8]	kg CFC_{11eq}
Photochemical Ozone Creation	POCP	Summer Smog [9]	kg NMOC $_{eq}$
Acidification Potential	AP	Accumulated Exceedance [10]	mol H^{+} $_{eq}$
Eutrophication Freshwater	EP_{fresh}	Excess nutrients freshwater [11]	kg P $_{eq}$
Eutrophication Marine	EP_{marine}	Excess marine nutrients [11]	kg N $_{eq}$
Eutrophication Terrestrial	EP_{land}	Excess Terrestrial nutrients [11]	mol N $_{eq}$
Mineral & Metal Depletion	ADP_{min}	Abiotic Depletion minerals [12]	kg Sb $_{eq}$
Fossil Fuel Depletion	ADP_{ff}	Abiotic Depletion fossil fuel [13]	MJ $_{ncv}$
Water Depletion	WDP	Water Deprivation Scarcity [14,15]	m^3 $_{WDP\ eq}$
Fresh Water Net	FW	Lake, river, well & town water	m^3
Secondary Material	SM	Post-consumer recycled (PCR)	kg
Secondary Renewable Fuel	RSF	PCR biomass burnt	MJ $_{ncv}$
Primary Energy Renewable Material	PERM	Biomass retained material	MJ $_{ncv}$
Primary Energy Renewable Not Feedstock	PERE	biomass fuels burnt	MJ $_{ncv}$
Primary Energy Renewable Total	PERT	Biomass burnt + retained	MJ $_{ncv}$
Secondary Non-renewable Fuel	NRSF	PCR fossil-fuels burnt	MJ $_{ncv}$
Primary Energy Non-renewable Material	PENRM	Fossil feedstock retained	MJ $_{ncv}$
Primary Energy Non-renewable Not Feedstock	PENRE	fossil-fuel used or burnt	MJ $_{ncv}$
Primary Energy Non-renewable Total	PENRT	Fossil feedstock & fuel use	MJ $_{ncv}$
Hazardous Waste Disposed	HWD	Reprocessed to contain risks	kg
Non-hazardous Waste Disposed	NHWD	Municipal landfill facility waste	kg
Radioactive Waste Disposed	RWD	Mostly ex nuclear power stations	kg
Components For Reuse	CRU	Product scrap for reuse as is	kg
Material For Recycling	MFR	Factory scrap to remanufacture	kg
Material For Energy Recovery	MER	Factory scrap use as fuel	kg
Exported Energy Electrical	EEE	Uncommon for building products	MJ $_{ncv}$
Exported Energy Thermal	EET	Uncommon for building products	MJ $_{ncv}$

Interpretation of Results LCA Cradle to Gate A1 to A3

The first interpretation section discusses product results cradle to gate A1 to A3 for the Kembla hard drawn (Hard) and annealed (Soft) prewashed (W) and unwashed tube for plumbing gas and drainage applications. Figure 3 charts only most significant differences in input of total coolant and wash water, Nitrogen inert annealing atmosphere and process agents including lubricant, solvent, surface and passivation actors (kg)/kg product for annealed versus hard drawn washed and unwashed tube. Figure 4 charts Global Warming Potential (GWP) (kg) versus Fossil Fuel Depletion (ADPff) (MJ)/kg products.



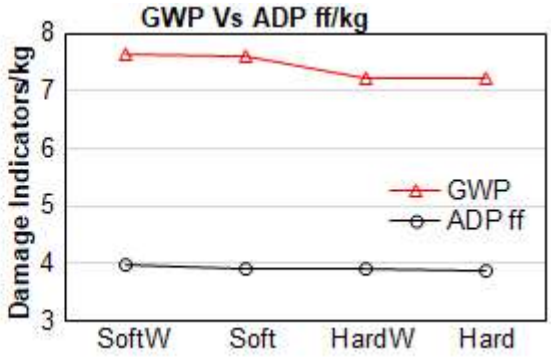
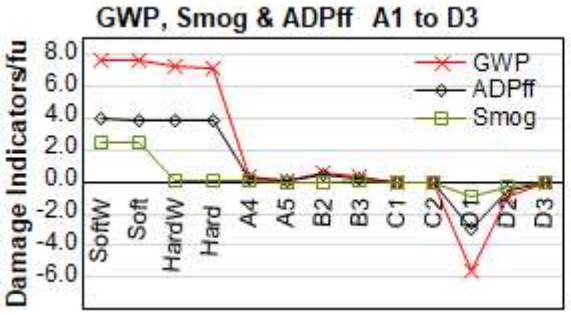


Figure 3 Input Share (MJ & kg) Vs CO_{2e} kg/kg **Figure 4 GWP kg Vs ADP MJncv /kg**

Figure 3 shows least difference in coolant water and nitrogen gas use and highest difference in surface process agents. Figure 4 shows GWP and fossil fuel depletion are directly related. Hard drawn tube had 10% lower GWP but only 2% less Fossil Fuel Depletion than annealed tube. This was because up to 8% of GWP impact was attributable to Nitrogen Oxides from hot annealing gas oxidisation as emitted to air.

Interpretation of Results Cradle to Grave and Beyond A1 to D3

The next section discusses product results cradle to fate A1 to C4 and beyond the system boundary to D1, D2 and D3. Figure 5 charts ADPff versus emission of GWP and Photochemical Smog. Figure 6 charts Freshwater (Fwater) use versus Acidification (Acid) and Terrestrial Eutrophication (EP_{land}). Impact/ functional unit (FU) of the four production processes.



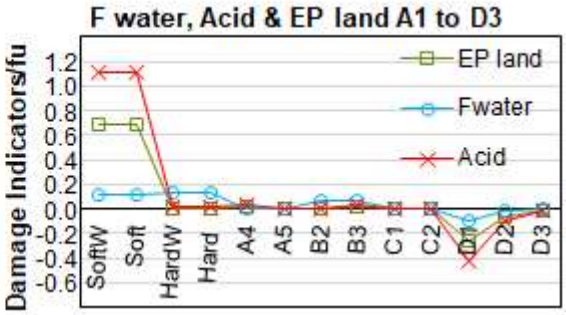


Figure 4 **GWP**, **A**DP ff**,** Acid **&** Smog**/kg** FU **Figure** 5 Freshwater, EP Land & Acid**/kg** FU

Chart 5 shows washed annealed products with highest water use Acidity and Eutrophication compared to both hard drawn tubes' insignificant impact. These impacts arise from Nitrogen Oxides emitted to air from annealing and lubricants, solvents, surface and passivation agents released to water from washing tubes.

All products have highest GWP, ADP ff cradle to gate and insignificant impacts A4 to C2. Also annealed tube both had highest smog impacts A1 to A3. Annealed washed tube A1 to A3 uses most Freshwater and emitted highest Acidity and Eutrophication impact compared to insignificant hard drawn tube impact. Both A1 to D3 charts show minor impact credits beyond 60-years in reuse and recycling.

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Results for Module A1 to A5 Cradle to Site

Table 1 shows A1 Resource Acquisition, A2 Transport, A3 Manufacture, A4 Delivery, A5 Construct results.

Table 1 A1 to A5 Impact & Inventory Results/Functional Unit

Result	A1-3	A4	A5
Climate Change biogenic	-3.7E-02	-1.6E-03	1.9E-02
Climate Change luluc	0.23	1.2E-02	1.0E-09
Climate Change fossil	7.0	0.36	1.9E-02
Climate Change total	7.2	0.37	3.8E-02
Stratospheric Ozone Depletion	1.6E-09	8.7E-11	1.7E-13
Photochemical Ozone Creation	0.10	6.5E-02	1.2E-04
Acidification Potential	1.5E-02	2.8E-02	1.2E-05
Eutrophication Freshwater	7.5E-06	3.7E-07	5.6E-10
Eutrophication Marine	3.9E-03	5.3E-03	2.3E-06
Eutrophication Terrestrial	1.1E-02	1.7E-02	7.7E-06
Mineral and Metal Depletion	0.10	4.8E-03	2.2E-06
Fossil Depletion	3.9	0.20	7.2E-02
Water Scarcity Depletion	2.1E-02	1.0E-03	2.9 E-06
Net Fresh Water Use	0.13	6.4E-03	1.8E-05
Secondary Material	7.8E-02	3.7E-03	2.3E-06
Secondary Renewable Fuel	0.55	2.7E-02	6.8E-06
Primary Renewable Material	0.35	2.0E-02	3.0E-04
Primary Energy Renewable Not Feedstock	5.4	0.30	2.4E-03
Primary Energy Renewable Total	5.8	0.32	2.7E-03
Secondary Non-renewable Fuel	3.2E-02	1.7E-03	7.4E-04
Primary Energy Non-renewable Material	8.1	0.41	0.11
Primary Non-renewable Energy Not Feedstock	62	3.1	0.19
Primary Energy Non-renewable Total	70	3.5	0.3
Hazardous Waste Disposed	3.2E-03	1.6E-04	3.7E-05
Non-hazardous Waste Disposed	4.3E-02	2.3E-03	3.1E-04
Radioactive Waste Disposed	1.4E-17	7.3E-19	1.1E-31
Components For Reuse	2.6E-04	1.3E-05	4.4E-03
Material For Recycling	3.34	0.17	5.7E-06
Material For Energy Recovery	2.6E-05	1.3E-06	2.3E-07
Exported Energy Electrical	0	0	0
Exported Energy Thermal	0	0	0

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Results for Module B: Building Fabric and Operations

Table 2 shows B1 Use, B2 Maintain, B3 Repair, B4 Replace, B5 Refurbish, B6 Energy Use, B7 Water Use results.

Table 2 B1 to B7 Impact & Inventory Results/Functional Unit

Result	B1	B2	B3	B4	B5	B6	B7
Climate Change biogenic	0	-0.10	-1.7E-02	0	0	0	0
Climate Change luluc	0	6.5E-06	-5.0E-06	0	0	0	0
Climate Change fossil	0	0.72	0.37	0	0	0	0
Climate Change total	0	0.62	0.35	0	0	0	0
Stratospheric Ozone Depletion	0	3.2E-09	9.1E-11	0	0	0	0
Photochemical Ozone Creation	0	3.0E-03	6.7E-02	0	0	0	0
Acidification Potential	0	1.3E-03	2.9E-02	0	0	0	0
Eutrophication Freshwater	0	6.5E-07	3.9E-07	0	0	0	0
Eutrophication Marine	0	2.1E-04	5.5E-03	0	0	0	0
Eutrophication Terrestrial	0	1.5E-03	1.8E-02	0	0	0	0
Mineral and Metal Depletion	0	3.2E-04	5.0E-03	0	0	0	0
Fossil Depletion	0	0.52	0.20	0	0	0	0
Water Scarcity Depletion	0	1.1E-02	1.1E-03	0	0	0	0
Net Fresh Water Use	0	0.07	6.5E-02	0	0	0	0
Secondary Material	0	2.7E-03	3.9E-03	0	0	0	0
Secondary Renewable Fuel	0	0.16	2.8E-02	0	0	0	0
Primary Renewable Material	0	1.1	2.1E-02	0	0	0	0
Primary Energy Renewable Not Feedstock	0	0.56	0.31	0	0	0	0
Primary Energy Renewable Total	0	1.8	0.33	0	0	0	0
Secondary Non-renewable Fuel	0	4.2E-02	1.7E-03	0	0	0	0
Primary Energy Non-renewable Material	0	1.7	0.43	0	0	0	0
Primary Non-renewable Energy Not Feedstock	0	7.6	3.8	0	0	0	0
Primary Energy Non-renewable Total	0	9.3	3.9	0	0	0	0
Hazardous Waste Disposed	0	9.9E-04	1.7E-04	0	0	0	0
Non-hazardous Waste Disposed	0	0.11	2.4E-03	0	0	0	0
Radioactive Waste Disposed	0	2.7E-17	7.6E-19	0	0	0	0
Components For Reuse	0	0	1.4E-05	0	0	0	0
Material For Recycling	0	7.6E-02	0.17	0	0	0	0
Material For Energy Recovery	0	3.6E-05	1.4E-06	0	0	0	0
Exported Energy Electrical	0	0	0	0	0	0	0
Exported Energy Thermal	0	0	0	0	0	0	0

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Results for Module C: End-of-life

Table 3 shows C1 demolish, C2 Transport C3 Waste Processing and C4 Disposal results.

Table 3 C1 to C4 Impact & Inventory Results/Functional Unit

Result	C1	C2	C3	C4
Climate Change biogenic	-7.0E-06	-5.4E-07	0	0
Climate Change luluc	1.0E-08	7.9E-10	0	0
Climate Change fossil	1.9E-03	6.1E-03	0	0
Climate Change total	1.9E-03	6.1E-03	0	0
Stratospheric Ozone Depletion	2.3E-13	1.1E-13	0	0
Photochemical Ozone Creation	7.6E-06	6.0E-05	0	0
Acidification Potential	3.5E-06	5.0E-06	0	0
Eutrophication Freshwater	7.3E-13	3.1E-10	0	0
Eutrophication Marine	6.4E-07	9.4E-07	0	0
Eutrophication Terrestrial	4.1E-06	3.2E-06	0	0
Mineral and Metal Depletion	3.8E-09	4.0E-06	0	0
Fossil Depletion	9.2E-04	7.5E-03	0	0
Water Scarcity Depletion	2.5E-07	1.4E-06	0	0
Net Fresh Water Use	1.5E-06	8.7E-06	0	0
Secondary Material	1.5E-05	1.7E-06	0	0
Secondary Renewable Fuel	2.9E-04	9.2E-05	0	0
Primary Renewable Material	1.3E-09	1.6E-03	0	0
Primary Energy Renewable Not Feedstock	2.0E-03	2.0E-04	0	0
Primary Energy Renewable Total	2.3E-03	1.9E-03	0	0
Secondary Non-renewable Fuel	3.9E-10	4.8E-04	0	0
Primary Energy Non-renewable Material	2.5E-04	3.7E-02	0	0
Primary Non-renewable Energy Not Feedstock	1.6E-02	6.3E-02	0	0
Primary Energy Non-renewable Total	1.7E-02	0.10	0	0
Hazardous Waste Disposed	7.3E-08	1.2E-05	0	0
Non-hazardous Waste Disposed	5.6E-06	9.6E-05	0	0
Radioactive Waste Disposed	4.4E-21	8.5E-32	0	0
Components For Reuse	0	0	0	0
Material For Recycling	2.2E-05	4.0E-06	0	0
Material For Energy Recovery	2.9E-10	1.5E-07	0	0
Exported Energy Electrical	0	0	0	0
0Exported Energy Thermal	0	0	0	0

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Results for Module D: Beyond System Boundaries

Table 4 has results for benefit and loads in D1 reuse, D2 recovery and D3 recycling.

Table 4 D1 to D3 Impact & Inventory Results/Functional Unit

Result	D1	D2	D3
Climate Change biogenic	2.5E-02	3.9E-03	1.4E-04
Climate Change luluc	-0.18	-0.03	-1.9E-03
Climate Change fossil	-5.4	-0.92	-5.3E-02
Climate Change total	-5.6	-0.95	-5.5E-02
Stratospheric Ozone Depletion	-1.3E-09	-2.3E-10	-1.2E-11
Photochemical Ozone Creation	-0.97	-0.23	-2.4E-02
Acidification Potential	-0.42	-0.10	-1.1E-02
Eutrophication Freshwater	-5.6E-06	-9.4E-07	-5.1E-08
Eutrophication Marine	-7.9E-02	-1.9E-02	-2.0E-03
Eutrophication Terrestrial	-0.26	-6.3E-02	-6.6E-03
Mineral and Metal Depletion	-7.3E-02	-1.2E-02	-6.8E-04
Fossil Depletion	-2.9	-0.50	-2.8E-02
Water Scarcity Depletion	-1.6E-02	-2.6E-03	-1.4E-04
Net Fresh Water Use	-9.7E-02	-1.6E-02	-8.5E-04
Secondary Material	-5.6E-02	-9.2E-03	-5.2E-04
Secondary Renewable Fuel	-0.40	-6.8E-02	-3.6E-03
Primary Renewable Material	-0.30	-5.5E-02	-3.0E-03
Primary Energy Renewable Not Feedstock	-4.5	-0.80	-4.4E-02
Primary Energy Renewable Total	-4.7	-0.83	-4.5E-02
Secondary Non-renewable Fuel	-2.5E-02	-4.3E-03	-2.3E-04
Primary Energy Non-renewable Material	-6.2	-1.0	-5.8E-02
Primary Non-renewable Energy Not Feedstock	-46	-7.8	-0.44
Primary Energy Non-renewable Total	-52	-8.9	-0.50
Hazardous Waste Disposed	-2.5E-03	-4.2E-04	-2.3E-05
Non-hazardous Waste Disposed	-3.4E-02	-5.9E-03	-3.2E-04
Radioactive Waste Disposed	-1.1E-17	-1.9E-18	-1.0E-19
Components For Reuse	-2.0E-04	-3.3E-05	-1.8E-06
Material For Recycling	-2.5	-0.42	-2.3E-02
Material For Energy Recovery	-2.0E-05	-3.4E-06	-1.9E-07
Exported Energy Electrical	0	0	0
Exported Energy Thermal	0	0	0

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Results for Module A1 to A5 Cradle to Site

Table 5 has A1 Resource Supply, A2 Transport, A3 Manufacture, A4 Delivery and A5 Construct results.

Table 5 Impact & Inventory Results/Functional Unit

Result	A1-3	A4	A5
Climate Change biogenic	-2.2E-02	-1.6E-03	1.9E-02
Climate Change luluc	0.26	1.2E-02	1.0E-09
Climate Change fossil	7.4	0.36	1.9E-02
Climate Change total	7.6	0.37	3.8E-02
Stratospheric Ozone Depletion	1.6E-09	8.7E-11	1.7E-13
Photochemical Ozone Creation	2.5	6.5E-02	1.2E-04
Acidification Potential	1.1	2.8E-02	1.2E-05
Eutrophication Freshwater	7.2E-06	3.7E-07	5.6E-10
Eutrophication Marine	2.1E-01	5.3E-03	2.3E-06
Eutrophication Terrestrial	6.9E-01	1.7E-02	7.7E-06
Mineral and Metal Depletion	0.10	4.8E-03	2.2E-06
Fossil Depletion	3.9	0.20	7.2E-02
Water Scarcity Depletion	2.0E-02	1.0E-03	2.9 E-06
Net Fresh Water Use	0.12	6.4E-03	1.8E-05
Secondary Material	7.9E-02	3.7E-03	2.3E-06
Secondary Renewable Fuel	0.51	2.7E-02	6.8E-06
Primary Renewable Material	0.44	2.0E-02	3.0E-04
Primary Energy Renewable Not Feedstock	6.3	0.30	2.4E-03
Primary Energy Renewable Total	6.4	0.32	2.7E-03
Secondary Non-renewable Fuel	3.2E-02	1.7E-03	7.4E-04
Primary Energy Non-renewable Material	8.1	0.41	0.11
Primary Non-renewable Energy Not Feedstock	62	3.1	0.19
Primary Energy Non-renewable Total	70	3.5	0.3
Hazardous Waste Disposed	3.2E-03	1.6E-04	3.7E-05
Non-hazardous Waste Disposed	4.2E-02	2.3E-03	3.1E-04
Radioactive Waste Disposed	1.4E-17	7.3E-19	1.1E-31
Components For Reuse	2.6E-04	1.3E-05	4.4E-03
Material For Recycling	3.34	0.17	5.7E-06
Material For Energy Recovery	2.6E-05	1.3E-06	2.3E-07
Exported Energy Electrical	0	0	0
Exported Energy Thermal	0	0	0

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Results for Module B: Building Fabric and Operations

Table 6 shows B1 Use, B2 Maintain, B3 Repair, B4 Replace, B5 Refurbish, B6 Energy Use, B7 Water Use results.

Table 6 Impact & Inventory Results/Functional Unit

Result	B1	B2	B3	B4	B5	B6	B7
Climate Change biogenic	0	-0.10	-1.7E-02	0	0	0	0
Climate Change luluc	0	6.5E-06	-5.0E-06	0	0	0	0
Climate Change fossil	0	0.72	0.37	0	0	0	0
Climate Change total	0	0.62	0.35	0	0	0	0
Stratospheric Ozone Depletion	0	3.2E-09	9.1E-11	0	0	0	0
Photochemical Ozone Creation	0	3.0E-03	6.7E-02	0	0	0	0
Acidification Potential	0	1.3E-03	2.9E-02	0	0	0	0
Eutrophication Freshwater	0	6.5E-07	3.9E-07	0	0	0	0
Eutrophication Marine	0	2.1E-04	5.5E-03	0	0	0	0
Eutrophication Terrestrial	0	1.5E-03	1.8E-02	0	0	0	0
Mineral and Metal Depletion	0	3.2E-04	5.0E-03	0	0	0	0
Fossil Depletion	0	0.52	0.20	0	0	0	0
Water Scarcity Depletion	0	1.1E-02	1.1E-03	0	0	0	0
Net Fresh Water Use	0	0.07	6.5E-02	0	0	0	0
Secondary Material	0	2.7E-03	3.9E-03	0	0	0	0
Secondary Renewable Fuel	0	0.16	2.8E-02	0	0	0	0
Primary Renewable Material	0	1.1	2.1E-02	0	0	0	0
Primary Energy Renewable Not Feedstock	0	0.56	0.31	0	0	0	0
Primary Energy Renewable Total	0	1.8	0.33	0	0	0	0
Secondary Non-renewable Fuel	0	4.2E-02	1.7E-03	0	0	0	0
Primary Energy Non-renewable Material	0	1.7	0.43	0	0	0	0
Primary Non-renewable Energy Not Feedstock	0	7.6	3.8	0	0	0	0
Primary Energy Non-renewable Total	0	9.3	3.9	0	0	0	0
Hazardous Waste Disposed	0	9.9E-04	1.7E-04	0	0	0	0
Non-hazardous Waste Disposed	0	0.11	2.4E-03	0	0	0	0
Radioactive Waste Disposed	0	2.7E-17	7.6E-19	0	0	0	0
Components For Reuse	0	0	1.4E-05	0	0	0	0
Material For Recycling	0	7.6E-02	0.17	0	0	0	0
Material For Energy Recovery	0	3.6E-05	1.4E-06	0	0	0	0
Exported Energy Electrical	0	0	0	0	0	0	0
Exported Energy Thermal	0	0	0	0	0	0	0

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Results for Module C: End-of-life

Table 7 shows C1 demolish, C2 Transport C3 Waste Processing and C4 Disposal results.

Table 7 Impact & Inventory Results/Functional Unit

Result	C1	C2	C3	C4
Climate Change biogenic	-7.0E-06	-5.4E-07	0	0
Climate Change luluc	1.0E-08	7.9E-10	0	0
Climate Change fossil	1.9E-03	6.1E-03	0	0
Climate Change total	1.9E-03	6.1E-03	0	0
Stratospheric Ozone Depletion	2.3E-13	1.1E-13	0	0
Photochemical Ozone Creation	7.6E-06	6.0E-05	0	0
Acidification Potential	3.5E-06	5.0E-06	0	0
Eutrophication Freshwater	7.3E-13	3.1E-10	0	0
Eutrophication Marine	6.4E-07	9.4E-07	0	0
Eutrophication Terrestrial	4.1E-06	3.2E-06	0	0
Mineral and Metal Depletion	3.8E-09	4.0E-06	0	0
Fossil Depletion	9.2E-04	7.5E-03	0	0
Water Scarcity Depletion	2.5E-07	1.4E-06	0	0
Net Fresh Water Use	1.5E-06	8.7E-06	0	0
Secondary Material	1.5E-05	1.7E-06	0	0
Secondary Renewable Fuel	2.9E-04	9.2E-05	0	0
Primary Renewable Material	1.3E-09	1.6E-03	0	0
Primary Energy Renewable Not Feedstock	2.0E-03	2.0E-04	0	0
Primary Energy Renewable Total	2.3E-03	1.9E-03	0	0
Secondary Non-renewable Fuel	3.9E-10	4.8E-04	0	0
Primary Energy Non-renewable Material	2.5E-04	3.7E-02	0	0
Primary Non-renewable Energy Not Feedstock	1.6E-02	6.3E-02	0	0
Primary Energy Non-renewable Total	1.7E-02	0.10	0	0
Hazardous Waste Disposed	7.3E-08	1.2E-05	0	0
Non-hazardous Waste Disposed	5.6E-06	9.6E-05	0	0
Radioactive Waste Disposed	4.4E-21	8.5E-32	0	0
Components For Reuse	0	0	0	0
Material For Recycling	2.2E-05	4.0E-06	0	0
Material For Energy Recovery	2.9E-10	1.5E-07	0	0
Exported Energy Electrical	0	0	0	0
0Exported Energy Thermal	0	0	0	0

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Results for Module D: Beyond System Boundaries

Table 8 has results for benefit and loads in D1 reuse, D2 recovery and D3 recycling.

Table 8 Impact & Inventory Results/Functional Unit

Result	D1	D2	D3
Climate Change biogenic	2.5E-02	3.9E-03	1.4E-04
Climate Change luluc	-0.18	-0.03	-1.9E-03
Climate Change fossil	-5.4	-0.92	-5.3E-02
Climate Change total	-5.6	-0.95	-5.5E-02
Stratospheric Ozone Depletion	-1.3E-09	-2.3E-10	-1.2E-11
Photochemical Ozone Creation	-0.97	-0.23	-2.4E-02
Acidification Potential	-0.42	-0.10	-1.1E-02
Eutrophication Freshwater	-5.6E-06	-9.4E-07	-5.1E-08
Eutrophication Marine	-7.9E-02	-1.9E-02	-2.0E-03
Eutrophication Terrestrial	-0.26	-6.3E-02	-6.6E-03
Mineral and Metal Depletion	-7.3E-02	-1.2E-02	-6.8E-04
Fossil Depletion	-2.9	-0.50	-2.8E-02
Water Scarcity Depletion	-1.6E-02	-2.6E-03	-1.4E-04
Net Fresh Water Use	-9.7E-02	-1.6E-02	-8.5E-04
Secondary Material	-5.6E-02	-9.2E-03	-5.2E-04
Secondary Renewable Fuel	-0.40	-6.8E-02	-3.6E-03
Primary Renewable Material	-0.30	-5.5E-02	-3.0E-03
Primary Energy Renewable Not Feedstock	-4.5	-0.80	-4.4E-02
Primary Energy Renewable Total	-4.7	-0.83	-4.5E-02
Secondary Non-renewable Fuel	-2.5E-02	-4.3E-03	-2.3E-04
Primary Energy Non-renewable Material	-6.2	-1.0	-5.8E-02
Primary Non-renewable Energy Not Feedstock	-46	-7.8	-0.44
Primary Energy Non-renewable Total	-52	-8.9	-0.50
Hazardous Waste Disposed	-2.5E-03	-4.2E-04	-2.3E-05
Non-hazardous Waste Disposed	-3.4E-02	-5.9E-03	-3.2E-04
Radioactive Waste Disposed	-1.1E-17	-1.9E-18	-1.0E-19
Components For Reuse	-2.0E-04	-3.3E-05	-1.8E-06
Material For Recycling	-2.5	-0.42	-2.3E-02
Material For Energy Recovery	-2.0E-05	-3.4E-06	-1.9E-07
Exported Energy Electrical	0	0	0
Exported Energy Thermal	0	0	0

Life Cycle Assessment Method

LCA Author	The Evah Institute as described at www.evah.institute
Study Period	Factory data was collected over the last 3 years
Study Goal	The attributional LCA was undertaken for ecolabelling
LCA Method	Compliant with ISO 14040 and ISO 14044 Standards
LCIA method	ReCiPe 2016, EcoIndicator 99 and CML as cited
Scope	Cradle to Fate including all supply chain phases and stages
The system	System boundaries are in accordance with EN 15804+A2 modular design
Phases	The LCA covered all known flows in all known stages cradle to end of life fate.
Assumptions	Use is to typical Australian Facility Management professional practice.
Scenarios	Use, cleaning, maintenance plus disposal and re-use were scenario-based using Facility Management Association denoted and published typical operations.
System Boundaries	The LCA covers all operations in the system boundary depicted in Figure 1.
Processes	All known processes are included from resource acquisition, water, fuel & energy use, power generation & distribution, freight, refining, intermediates, manufacture, scrap re-use, packing and dispatch, installation, use, maintenance and landfill. All significant waste and emission flows from all supply chain operations involved to make, pack and install the product are included.
Inclusions	Evah industry databases cover all known domestic and global scope 1 and 2 operations
Exclusions	They exclude scope 3 burdens from capital facilities, equipment churn, noise and dehydration as well as incidental activities and employee commuting
General LCA Report Information	Statement of en15804 +A2:2019 used for the study and EPD Other independent LCI/LCA data verification is documented EPD states compliance with added EEE construction products demands
Power mix	Power Guarantee of Origin was documented for EPD verification

Primary Data Sources Representativeness and Quality

Primary data used for modelling the state of art of each operation includes all known process for:

- Technology sequences;
- Energy and water use;
- Landfill and effluent plus
- Reliance on raw and recycled material;
- High and reduced process emissions;
- Freight and distribution systems.

Electricity supply models in active databases are updated annually. Primary data is sourced from clients, Annual Reports and their publications on corporate locations, logistics, technology use, market share, management systems, standards and commitment to improved environmental performance.

Information on operations is also sourced from client:

- Supply chain mills, their technical manuals, corporate annual reports and sector experts, and
- Manufacturing specifications websites and factory site development license applications.

Background data Sources Representativeness and Quality

Background data is sourced from the IBISWorld, USGS Minerals, Franklin Associates, Plastics Europe, CML2, Simapro 9.5, EcoInvent 3.9 and NREL USLCI model databases.

Background Power and fuel supply models in active databases are updated annually with data sourced from each power supplier and power station as well as the International Energy Agency.

Information on operations is also sourced from:

- Library, document, NPI and web searches, review papers, building manuals and
- Global Industry Association and Government reports on Best Available Technology (BAT).

For benchmarking, comparison and integrity checks inventory data is developed to represent BAT, business as usual and worst practice options with operations covering industry sector supply and infrastructure in Australia and overseas.

Such technology, performance and license conditions were modelled and evaluated across mining, farming, forestry, freight, infrastructure and manufacturing and building industry sectors by Evah Institute Directors and Associates since 1995.

Quality Assurance

As each project is modelled and new data is available the databases are updated and audited by external Type 1 ecolabel certifiers.

The databases exist in top zones of commercial global inventory modelling and calculating engines and LCIA software including OpenLCA, Australian LCADesign™ as well as Simapro models as of 2014.

Quality control methods are applied to ensure:

- Coverage of place in time with all information[2] for each dataset noted, checked and updated;
- Consistency to Evah guidelines[3] for all process technology, transport and energy demand;
- Completeness of modeling based on reports, literature and industry reviews;
- Plausibility in 2 way checks of LCI input and output flows of data checked for validity, plus
- Mathematical correctness of all calculations in mass and energy balance cross checks.

[2] Jones D G (2004) LCI Database for Commercial Building Report 2001-006-B-15 Icon.net, Australia
[3] Evah Tools, Databases and Methodology Queensland, Australia at http://www.evah.com.au/tools.html

Supply Chain Modelling Assumptions

Australian building sector rules and Evah Institute assumptions applied are defined in Table b.

Table b Scope Boundaries Assumptions and Metadata

Quality/Domain	National including Import and Export
Process Model	Typical industry practice with currently most common or best (BAT) technology
Resource flows	Regional data for resource mapping, fuels, energy, electricity and logistics
Temporal	Project data was collated over the last 3 years
Geography	Designated client, site, regional, national, Pacific Rim then European jurisdiction
Representation	Designated client, their suppliers and energy supply chains back to the cradle
Consistency	Model all operations by known given operations with closest proximity
Technology	Pacific Rim Industry Supply Chain Technology typical of the last 3 years
Functional Unit	Typical product usage with cleaning& disposal/m^2 over the set year service life
System Control	
Primary Sources	Clients and suppliers' mills, publications, websites, specifications & manuals
Other Sources	IEA, GGT, Boustead, Simapro, IBIS, EcoInvent
Data mix	Power grid and renewable shares updated to latest IEA reports
Operational	Company data for process performance, product share, waste and emissions
Logistics	Local data is used for power, fuel mix, water supply, logistics share & capacity
New Data Entry	VliegLCA, Evah Institute; Global Green Tag Researchers
Data Generator	Manufacturers, Evah Institute ; GGTI; Meta: IBIS
Data Publisher	The Evah Institute to Global GreenTag and designated client only
Contributors	All pE0ple's contributors cited in Evah & Global GreenTag records or websites
Data Flow & Mix	
System Boundary	Earth's cradle of all resource & emission flows to end of use, fitout or build life
System flows	All known from and to air, land, water and community sources & sinks
Capital inclusions	Natural stocksΔ, industry stockpilesΔ, capital wear Δ, system losses and use
Arid Practice	Dry technology adopted; Water use is factored by 0.1 as for e.g. Mining
Transportation	Distance >20% than EU; >20% fuel efficient larger vehicles, load & distance
Industrial	Company or industry sector data for manufacturing and minerals involved
Mining	All raw material extraction is based on Australian or Pacific Rim technology
Imported fuel	Mix is from nearest sources is e.g. UAE, SE Asia, Canada or New Zealand
Finishes	Processing inputs with finishing burdens are factored in. If not, that is denoted
Validation	
Accuracy	10^{th} generation study is ± 5 to 10% uncertain due to some background data
Completeness	All significant operations are tracked and documented from the cradle to grave
Precision	Tracking of >90% flows applies a 90:10 rule sequentially to 99.9% and beyond
Allocation	100% to co products on reaction stoichiometry by energetic or mass fraction
Burdens	All resource use from & emissions to community air land, water are included
Plausibility	Results are checked and benchmarked against BAT, BAU & worst practice
Sensitivity	Calculated U is reported & compared to libraries of Bath U RICE & EcoInvent 3.9
Validity Checks	Are made versus Plastics Europe, Ecobilan, GaBi & or Industry LCA Literature

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[1] Kembla Copper Plumbing Range Products https://www.kembla.com/product-range/plumbing/kembla-copper-tube/

[2] EN 15804:2012+A2:2019 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.

[3] Sub-PCR PDP:2023 Plumbing and Drainage Piping v1. https://www.globalgreentag.com/get/files/1259

[4] ISO 14025:2010 Environmental labels and declarations – Type III – environmental declarations - Principles and procedures.

[5] ISO14044:2006 Environmental management – Life cycle assessment (LCA) – Requirements and guidelines.

[6] ISO 15686-2:2012 Buildings and constructed assets: Service life planning Part 2: Service life prediction procedures.

[7] ISO 15686-8:2008 Buildings and constructed assets: Service-life planning Part 8: Reference service life and estimation.

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