LIFE CYCLE ASSESSMENT (LCA) OF TOTO FACUETS, FLUSH VALVES, AND RESIDENTIAL TOILETS

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Contents

1 INTRODUCTION

1.1 Opportunity

TOTO USA is committed to innovating products that make people's lives better, protect the environment and keep our water pure. To honor our commitment to sustainability, it is important that we conduct Life Cycle Assessments to evaluate the environmental impacts of our products in all stages of life, from raw materials to manufacturing and even through to the end of life. The goal of conducting a Life Cycle Assessment is to explore the full range of environmental impacts our products have and to identify ways to improve processes and lessen any negative effects. This project is critical to TOTO's PeoplePlanetWater mission of innovating products for the benefit of people, the planet and our water supply.

In order to understand the true impact of products throughout all life cycle stages, TOTO has chosen to conduct the Life Cycle Assessment using a cradle-to-grave approach. By factoring in all stages, it is more informed on how to reduce impacts on a broader scale.

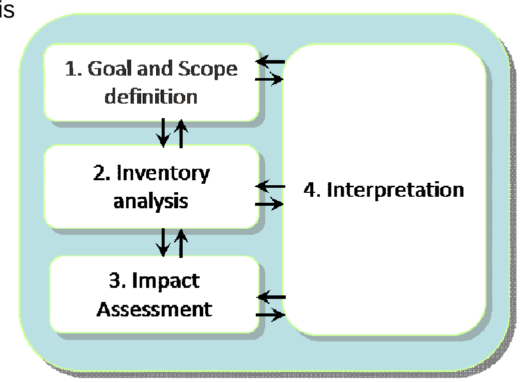
TOTO is continuing to have Life Cycle Assessment (LCA) data available for its most important products to be able to obtain SM Transparency Reports [EPDs]™, type III environmental declarations that can be used for communication with and amongst other companies, architects and consumer communication, and can also be utilized in whole building LCA tools.

1.2 Life Cycle Assessment

Performing a life cycle assessment (LCA) follows the Sustainable Minds Transparency Report [EPD]™ Framework, which is based on ISO 14040-44 & 14025 standards [1, 2]. Such an LCA includes the following phases:

- Goal and Scope
- Inventory Analysis
- Impact Assessment
- Interpretation

This report includes all phases.



Source: ISO 14040

According to the Framework, a stakeholder procedure is required when LCA results are intended to be used for external communication *and* a comparison is made to products that are not produced by the commissioning party. This report concerns products from TOTO only. An ISO 14040-44 third-party review and a third-party report verification for Transparency Reports [EPDs]™ are required in the Framework in order to be able to use Transparency Reports [EPDs]™ as Type III environmental declarations. Both the review and the verifications will be completed in this project.

In order to use LCA to make 'comparative assertions' (asserting that one product is definitively better than another), standards (ISO, CEN) have very prescriptive criteria that must be met. These include (among others):

a. The description (function, performance and use) must be identical.
b. The ISO 14040 goal and scope are equivalent.
c. The data collection methods, calculation procedure and allocation methods are equivalent.
d. The impact categories and calculation methods are identical.

One cannot compare 75 years of use of the studied product to another unless the following conditions, which are unequivocally impossible to meet: materials are functionally equivalent (same strength, durability, thermal properties, etc.), environment it is installed is the same (same usage, maintenance cleaning schedule, etc.) and equivalent installation method with same structural integrity of the wall. And while it is theoretically possible to compare functionally equivalent assemblies, it is quite difficult in practice to design two truly functionally equivalent systems using the multiple criteria by which a performance can be analyzed. Hence, the report is not intended for comparative assertions.

1.3 Status

All information in the report reflects the best possible inventory by TOTO at the time it was collected, and a best practice of TOTO employees to transform this information into this LCA report. The data covers annual manufacturing data during the calendar year 2023. The purpose is to create average LCA models for the studied products. This study includes primary data from the processes at TOTO, secondary data from suppliers that have been contracted and literature data to complete the inventory and fill the gaps. Most data was supplied directly from energy providers or collected by TOTO employees, while the rest of the data was calculated by TOTO specialists via engineering calculations and was validated and quality assured by the LCA manager. TOTO relies on vendors for the components and assembly of some of the products that are sold under its name.

TOTO has chosen to have the LCA data and report go through third-party review against ISO 14040/14044 [1]. A third-party review has been performed by NSF. The review concluded that the LCA report is in conformance with ISO 14040-44.

TOTO has also chosen to have the Transparency Reports [EPDs]™ undergo third-party verification against ISO 14025 [2], SM Part A [3] and the following SM Part Bs:

- Sustainable Minds Transparency Report™ / EPD Framework, Part B: Product group definition | Residential toilets | Part B #23-006, version March 6, 2024 [4]
- Sustainable Minds Transparency Report™ / EPD Framework, Part B: Product group definition |Commercial/public metered and manual lavatory faucets | Part B #23-002, version March 6, 2024 [5]

- Sustainable Minds Transparency Report™ / EPD Framework, Part B: Product group definition | Commercial flushometer valves | Part B #23-001, version March 6, 2024 [6]

A third-party Transparency Report [EPD]™ verification has been performed by NSF. The verification concluded that the Transparency Reports [EPDs]™ are in conformance with the Sustainable Minds Transparency Report™ / EPD Framework Part A and the relevant Part Bs.

1.4 Team

This report is based on the work of the following LCA project leader on behalf of TOTO:

- Gary Soe, Engineering Manager

He has been assisted by TOTO subsidiaries and numerous TOTO employees during the product group definition, data collection, reporting and interpretation.

1.5 Structure

This report follows the structure of the life cycle assessment methodology defined in the Sustainable Minds Framework as well as the Part Bs of the respective products. It starts with the goals and scope in Chapter 2. Chapter 3 includes the inventory, and the impact assessment can be found in Chapter 4. Chapter 5 details the interpretation phase.

This report includes LCA terminology. To assist the reader, special attention has been given to list definitions of important terms used at the end of this report.

2 GOAL AND SCOPE

This chapter explains the starting points for the LCA. The aim of the goal and scope is to define the products under study and the depth and width of the analysis.

The objective of the report is to develop a Life Cycle Inventory (LCI) and Assessment (LCA) Model for the products below from cradle to grave, to apprehend the environmental impact of products throughout all life cycle stages, and to be informed of the range of impactful aspects to initiate serious conversations regarding how to reduce the impacts on a broader scale.

The Life Cycle Inventory (LCI) developed includes all resource inputs (materials, energy, etc.), all waste (e.g., overburden waste, fines, etc.) and emission streams (e.g., all gaseous emissions including CO2, Particulate Matter, etc.) throughout the system and enable the user of the LCA Model to ascertain and quantify the relevant environmental impacts at each phase in the product life cycle.

The LCI system developed also provides the facility to consider the relative proximity of sources of primary aggregates and recycled aggregates to the marketplace as well as disposal options for inert construction and demolition wastes.

2.1 Intended application and audience

This report intends to define the specific application of the LCA methodology to the life cycle of TOTO residential toilets and commercial faucets and flush valves. It is intended for both internal and external business-to-consumer communication purposes. The Transparency Report, a Type III Environmental Declaration per ISO 14025, will communicate the results of this study which is focused on products that are available and sold in the US market.

2.2 TOTO products

TOTO is the world's largest plumbing products manufacturer and offers a complete line of commercial and decorative plumbing fixtures and fittings, including toilets, lavatory sinks, urinals, faucets, flush valves, showerheads and valves, bathtubs, and their accessories. TOTO products infuse style with substance, optimize water conservation and strive for consistent and high performance. TOTO embraced water and energy conservation years before government mandates. Through their consistently evolving manufacturing practices, they aim to develop and manufacture plumbing fixtures that are efficient and sustainable. For more information on TOTO products, go to www.totousa.com.

The products studied in this report include ceramic residential single flush toilets manufactured at TOTO plants in Morrow, Lakewood (Georgia), Thailand, and Mexico, and faucets and flush valves manufactured in Vietnam. These products and their categories of Transparency Reports [EPDs]™ and manufacturing locations, as well as other product information, are presented in Tables 2.1a-b below.

Table 2.1a Product codes, names and project concepts

Product Code	**Product Description**	**Project concept**	**Production plant/vendors**	**Production Location**	**Declaration Type**
CST454CEFG	Drake® II 1.28gpf	LCA of a TOTO toilet	TMW, TLW, TTL	USA, Thailand	Product-specific, plant-average EPD (product-specific tabs)
CST454CUFG	Drake® II 1G®	LCA of a TOTO toilet	TMW, TLW, TTL	USA, Thailand	
MS854114E	Eco Ultramax® 1.28gpf	LCA of a TOTO toilet	TMX	Mexico	Product-specific, plant-average EPD (product-specific tabs)
MS604124CUFG	Ultramax II 1G®	LCA of a TOTO toilet	TMW, TTL	USA, Thailand	
MS604124CEFG	Ultramax® II 1.28gpf	LCA of a TOTO toilet	TMW, TTL	USA, Thailand	
T28S32E, T28S32EM & T28S32ET	Standard-R Faucet Series	LCA of a TOTO faucet	TVN	Vietnam	Product-specific, plant-specific EPD (product-specific tabs)
T27S32E, T27S32EM & T27S32ET	Standard-S Faucet Series	LCA of a TOTO faucet	TVN	Vietnam	
TEU1LAR	EcoPower HE Urinal EFV	LCA of a TOTO EFV	TVN	Vietnam	Product-specific, plant-specific EPD
TEU1UAR	EcoPower Ultra Urinal EFV	LCA of a TOTO EFV	TVN	Vietnam	Product-specific, plant-specific EPD
TEU2LAR	EcoPower® Urinal Flush Valve	LCA of a TOTO EFV	TVN	Vietnam	Product-specific, plant-specific EPD
TEU2UAR	EcoPower® Urinal Flush Valve	LCA of a TOTO EFV	TVN	Vietnam	Product-specific, plant-specific EPD
TET1(6)UB(X)	EcoPower® Toilet Flush Valve	LCA of a TOTO EFV	TVN	Vietnam	Product-specific, plant-specific EPD
TET1(6)LB(X)	EcoPower® Toilet Flush Valve	LCA of a TOTO EFV	TVN	Vietnam	Product-specific, plant-specific EPD
TET2UB(X)	EcoPower® Toilet Flush Valve	LCA of a TOTO EFV	TVN	Vietnam	Product-specific, plant-specific EPD
TET2LB(X)	EcoPower® Toilet Flush Valve	LCA of a TOTO EFV	TVN	Vietnam	Product-specific, plant-specific EPD

Table 2.1b Product information

Product code	CSI master format classification	ASTM or ANSI product specification	Physical properties and technical information or any other market identification
CST454CEFG	22 42 13.13	ASME A112.19.2/CSA B45.1 Certifications: IAPMO(cUPC)	Vitreous China Plumbing Fixture
CST454CUFG			
MS854114E			
MS604124CUFG			
MS604124CEFG			
T28S32E, T28S32EM & T28S32ET	22 49 39	ASME A112.18.1, CSA B125.1 IAPMO(cUPC)	Commercial Faucet
T27S32E, T27S32EM & T27S32ET			
TEU1LAR	22 42 43	ASSE 1037, CSA B125.3 IAPMO(cUPC)	Commercial Flushometer
TEU1UAR			
TEU2LAR			
TEU2UAR			
TET1(6)UB(X)			
TET1(6)LB(X)			
TET2UB(X)			
TET2LB(X)			

Table 2.2 lists the 2023 production volumes of the modeled products which are used in the declaration of the corresponding product, and the manufacturing locations are also listed. Additionally, the weights of the products are listed in Tables 2.3a-b.

Table 2.2 Production volumes of the modeled products for 2023
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Table 2.3a Toilet raw material weights per functional unit

Product code	Tank and bowl (ceramic)		Packaging (corrugated board, paper inserts)		Seat (polypropylene)		Other (spud nut and washer)	
	Mass (kg)	%	Mass (kg)	%	Mass (kg)	%	Mass (kg)	%
CST454CEFG	38.7	78.2%	7.08	14.3%	2.9	5.9%	0.83	1.7%
CST454CUFG	37.5	76.2%	6.49	13.2%	2.09	4.2%	3.13	6.4%
MS854114E	30.4	76.4%	4.5	11.3%	2.09	5.3%	2.79	7.0%
MS604124CUFG	41	79.8%	4.86	9.5%	2.09	4.1%	3.46	6.7%
MS604124CEFG	38	80.2%	4.51	9.5%	2.09	4.4%	2.8	5.9%

Table 2.3b Faucet and flush valve raw material weights per functional unit

Product code	Product weight (g)	Cardboard (g)	Other packaging (g)*
T28S32E	2373.08	303.1	44.2
T27S32E	2446.56	303.1	44.2
T27S32EM	2759.2	370.4	74.2
T27S32ET	2872.5	360.2	80.6
T28S32EM	2759.2	370.4	74.2
T28S32ET	2872.5	360.2	80.6
TET1(6)UB(X) TET1(6)LB(X)	4918.9	681.1	69.6
TEU1LA(R) TEU1UA(R)	4349.1	681.1	151.0
TEU2LA(R) TEU2UA(R)	832.72	681.07	151.64
TET2UB(X) TET2LB(X)	832.72	681.07	151.64

* Others are manuals (paper) and bags (PE)

Some products are manufactured in TOTO USA at the Morrow and Lakewood plants and in TOTO subsidiaries outside the United States. Names of other vendors are TOTO Mexico (TMX) and TOTO Thailand (TTL) for toilets, and TOTO Vietnam (TVN) for faucets and flush valves.

Presented below are images and descriptions of the modeled products.

Table 2.4 Description of the modeled products

Drake II 1G Two-Piece Toilet 	• SanaGloss • Double Cyclone flushing system • Computer designed, fully glazed trapway • Elongated bowl • Chrome trip lever • Universal height • ADA compliant • 12" Rough-in See more at: http://www.totousa.com/drake%C2%AE-ii-1g-two-piece-toilet-10-gpf-elongated-bowl#sthash.OLKmuAkS.dpuf
Eco Ultramax One-Piece Toilet 	• E-Max flushing system • Elongated bowl with SoftClose seat • Chrome trip lever • 12" Rough-in See more at: http://www.totousa.com/ultimate%C2%AE-one-piece-toilet-16-gpf-elongated-bowl#sthash.3HOowPUL.dpuf

Drake II Two-Piece Toilet 	• SanaGloss • Double Cyclone flushing system • Computer designed, fully glazed trapway • Elongated bowl • Chrome trip lever • Universal height • ADA compliant • 12" Rough-in See more at: http://www.totousa.com/drake-II-two-piece-toilet-128-gpf-elongated-bowl#sthash.OwmKJ5Le.dpuf
Ultramax II One-Piece Toilet 	• SanaGloss • Double Cyclone flushing system • Computer designed, fully glazed trapway • Elongated bowl with SoftClose seat • Chrome trip lever • Universal height • ADA compliant • 12" Rough-in See more at: http://www.totousa.com/ultramax%C2%AE-II-one-piece-toilet-128-gpf-elongated-bowl#sthash.CigJ3x7o.dpuf
Ultramax II 1G One-Piece Toilet 	• SanaGloss • Double Cyclone flushing system • Computer designed, fully glazed trapway • Elongated bowl with SoftClose seat • Chrome trip lever • Universal height • ADA compliant • 12" Rough-in See more at: http://www.totousa.com/ultramax%C2%AE-II-one-piece-toilet-128-gpf-elongated-bowl#sthash.CigJ3x7o.dpuf
T28S32E(M/T) 	• Operated entirely by hydropower. No external power source needed. • Strategic location of sensor at tip of spout for instant response time. • No wiring. Easy installation and low-cost maintenance. • 0.35 GPM/0.12GPC water-saving flow rate • ADA compliant • Consists of spout and controller See more at: https://www.totousa.com/filemanager_uploads/product_assets/SpecSheet/SS-01953_T28S32_Series.pdf

T27S32E(M/T) 	• Operated entirely by hydropower. No external power source needed. • Strategic location of sensor at tip of spout for instant response time. • No wiring. Easy installation and low-cost maintenance. • 0.35 GPM water-saving flow rate • ADA compliant • Consists of spout and controller See more at: https://www.totousa.com/filemanager_uploads/product_assets/SpecSheet/SS-01949_T27S32_Series.pdf
TEU1LA(R) 	• 0.5 GPF • Self-powered hydroelectric flush valve system • No minimum daily usage requirement • Durable chrome plated body with tamper-proof screws and solid bronze valve body • Self-cleaning piston valve with 360° filter screen • Neutral rough-in and adjustable tail piece connection • True mechanical flush override • Smart sensor with self-adjusting detection range • 6-second detection time to prevent ghost flushing • ADA compliant See more at: http://www.totousa.com/ecopower%C2%AE-high-efficiency-urinal-flush-valve-only-05-gpf
TEU1UA(R) 	• 0.125 GPF • Self-powered hydroelectric flush valve system • No minimum daily usage requirement • Durable chrome plated body with tamper-proof screws and solid bronze valve body • Neutral rough-in and adjustable tail piece connection • True mechanical flush override • Smart sensor with self-adjusting detection range • 6-second detection time to prevent ghost flushing • ADA compliant See more at: http://www.totousa.com/ecopower%C2%AE-ultra-high-efficiency-urinal-flush-valve-only-0125-gpf

TEU2LA(R) 	• 0.5 GPF • Self-powered hydroelectric flush valve system • No minimum daily usage requirement • Durable chrome plated body with tamper-proof screws and solid bronze valve body • Self-cleaning piston valve with 360° filter screen • Neutral rough-in and adjustable tail piece connection • True mechanical flush override • Smart sensor with self-adjusting detection range • 6-second detection time to prevent ghost flushing • ADA compliant See more at: http://www.totousa.com/ecopower%C2%AE-high-efficiency-urinal-flush-valve-only-05-gpf
TEU2UA(R) 	• 0.125 GPF • Self-powered hydroelectric flush valve system • No minimum daily usage requirement • Durable chrome plated body with tamper-proof screws and solid bronze valve body • Neutral rough-in and adjustable tail piece connection • True mechanical flush override • Smart sensor with self-adjusting detection range • 6-second detection time to prevent ghost flushing • ADA compliant See more at: http://www.totousa.com/ecopower%C2%AE-ultra-high-efficiency-urinal-flush-valve-only-0125-gpf
TET1(6)UB(X) 	• 1.0 GPF • Self-powered hydroelectric flush valve system • No minimum daily usage requirement • Durable chrome plated body with tamper-proof screws and solid bronze valve body • Self-cleaning piston valve with 360° filter screen • Neutral rough-in and adjustable tail piece connection • True mechanical flush override • Smart sensor with self-adjusting detection range • 6-second detection time to prevent ghost flushing • For toilet with 1-1/2" top spud inlet • Exposed flush valve with 1" angle stop and 1-1/2" vacuum breaker set • ADA compliant See more at: http://www.totousa.com/ecopower%C2%AE-high-efficiency-toilet-flush-valve-only

TET1(6)LB(X) 	• 1.28 GPF • Self-powered hydroelectric flush valve system • No minimum daily usage requirement • Durable chrome plated body with tamper-proof screws and solid bronze valve body • Self-cleaning piston valve with 360° filter screen • Neutral rough-in and adjustable tail piece connection • True mechanical flush override • Smart sensor with self-adjusting detection range • 6-second detection time to prevent ghost flushing • For toilet with 1-1/2" top spud inlet • Exposed flush valve with 1" angle stop and 1-1/2" vacuum breaker set • ADA compliant See more at: http://www.totousa.com/ecopower%C2%AE-high-efficiency-toilet-flush-valve-only
TET2UB(X) 	• 1.0 GPF • Self-powered hydroelectric flush valve system • No minimum daily usage requirement • Durable chrome plated body with tamper-proof screws and solid bronze valve body • Self-cleaning piston valve with 360° filter screen • Neutral rough-in and adjustable tail piece connection • True mechanical flush override • Smart sensor with self-adjusting detection range • 6-second detection time to prevent ghost flushing • For toilet with 1-1/2" top spud inlet • Exposed flush valve with 1" angle stop and 1-1/2" vacuum breaker set • ADA compliant See more at: http://www.totousa.com/ecopower%C2%AE-high-efficiency-toilet-flush-valve-only
TET2LB(X) 	• 1.28 GPF • Self-powered hydroelectric flush valve system • No minimum daily usage requirement • Durable chrome plated body with tamper-proof screws and solid bronze valve body • Self-cleaning piston valve with 360° filter screen • Neutral rough-in and adjustable tail piece connection • True mechanical flush override • Smart sensor with self-adjusting detection range • 6-second detection time to prevent ghost flushing • For toilet with 1-1/2" top spud inlet • Exposed flush valve with 1" angle stop and 1-1/2" vacuum breaker set • ADA compliant See more at: http://www.totousa.com/ecopower%C2%AE-high-efficiency-toilet-flush-valve-only

2.3 Functional units

The results of the LCA in this report are expressed in terms of a functional unit as it covers the entire life cycle of the product. The functional units of the products are presented in Table 2.5. The Transparency Reports [EPDs]™ of the corresponding products listed are expressed in terms of one respective piece of the product as well as all life cycle modules which are presented later in this report. The functional units in Table 2.5 serve as the reference unit for the products' LCA. These functional units are taken from Part Bs of the SM Transparency Report Framework [7]. TOTO products comply with the functional performance specifications defined in the aforementioned Part Bs.

Table 2.5 Functional unit of the modeled products

Product	Functional Unit
CST454CEFG	One single toilet in an average residential environment without an electronic bidet seat, over the estimated service life of the building
CST454CUFG	
MS854114E	
MS604124CUFG	
MS604124CEFG	
T28S32E, T28S32EM & T28S32ET	One metered lavatory faucet in an average commercial environment over the estimated service life of the building of the building
T27S32E, T27S32EM & T27S32ET	
TEU1LAR	One flushometer valve for single flush toilets (TET) and urinals (TEU) used in an average commercial environment over the estimated service life of the building
TEU1UAR	
TEU2LAR	
TEU2UAR	
TET1(6)UB(X)	
TET1(6)LB(X)	
TET2UB(X)	
TET2LB(X)	

The Expected Service life (ESL) for the study is 75 years and All use stage activity and impacts are counted for the full ESL period. The reference service life (RSL) of each product category is as follows:

- 20 years for a residential toilet without a bidet
- 10 years for a commercial flush valve
- 10 years for a commercial lavatory faucet

These RSLs are industry accepted average lifespans that are based on the economic lifespan of a product. Electrical and other hardware components, especially related to rubbers for watertight connections and moving parts, will require replacement earlier than the respective RSL.

2.4 System boundaries

To define what is included and what is excluded in an LCA, the system boundaries are described in this section. In general, the system boundaries as defined in Part A [3] are followed. This section details some of the aspects to assist the reader to understand what is included in the models.

The system boundaries reflect the life cycle phases that have been modeled. It defines which life cycle phases and processes are included and which are not. The LCA is modeled according to specific system boundaries and is quantified in such a way that they reflect the respective reference units of the modeled products. This study follows the modularity principle, where all environmental impacts and potential impacts are declared in the life cycle stage where they can be attributed.

This LCA's system boundaries include the following life cycle phases:

- Production
- Construction/Installation
- Use
- End of life

These boundaries apply to the modeled products and can be referred to as "cradle-to-grave" which means that it includes all life cycle stages and modules as identified in Part A [3].

The system boundaries for TOTO residential toilet & commercial faucet and flush valve products are detailed below.

	Product assessment information															
	Product life cycle information															Supplementary information (benefits and loads) beyond the product life cycle
Transparency Report aggregated modules	Production			Construction		Use							End of life				Recovery
Transparency Reports system boundary	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Raw Materials	Transport	Manufacturing	Transport	Construction / installation stage	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Cradle-to-grave Functional unit	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MND

X = a declared module

Figure 1. Applied system boundaries for the modeled residential toilet & commercial faucet and flush valve products

2.4.1. Production stage [A1-A3]

The product stage includes, where relevant, information modules for:

- A1: Extraction and processing of raw materials (e.g., mining processes) and biomass production and processing (e.g., agricultural or forestry operations)

- A1: Reuse of products or materials from a previous product system
- A1: Processing of secondary materials (e.g., scape metals to hold the primary products) used as input for manufacturing the product, but not including those processes that are part of the waste processing in the previous product system
- A1: Generation of electricity, steam and heat from primary energy resources, including extraction, refining and transport thereof
- A1: Energy recovery and other recovery processes from secondary fuels, but not including those processes that are part of waste processing in the previous product system
- A2: Transportation up to the factory gate in addition to internal transport
- A3: Production of ancillary materials or pre-products
- A3: Manufacturing of packaging
- A1-A3: Processing up to the end-of-waste state or disposal of final residues including any packaging not leaving the factory gate with the product.

A description of the most important modeling parameters is included below.

2.4.1.1. Raw Materials

The toilet raw materials have been majorly grouped into categories: body slip and glaze (ceramic materials), and casting materials.

Toilet bowls and tanks are mostly made of ceramic, which is then coated with body slip and glaze. The recipe of raw materials for the body slip and glaze for ceramic products in TOTO facilities including the transportation mode and distances when purchased are listed in the tables below. Also provided below is BOM of each product. The material inputs to the production system of the modeled ceramics are provided in Table 2.6. All materials that have a contribution greater than 0.15% weight of the total bill of materials are included. Additional raw materials data of the products as required by Part A is presented in appendix A.

Table 2.6 Ceramic production raw materials and transportation

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Ceramics manufacturing data was collected and compiled for TOTO USA (Morrow and Lakewood) and TOTO Thailand. Because some raw material data was not available from TOTO Mexico for 2023, some of the plant data from 2019 at TMX to model products made in the facility was used. Lakewood utilizes less efficient manual bench casting. TTL uses both pressure and bench casting in the facility. TMX uses bench casting and a similar method referred to a spagless casting.

For faucets and flush valves, the metal body makes up the largest portion of the product. Other materials, such as nuts, plastics and rubbers, are used for smaller parts of the assembly for both faucets and flush valves. The recycled content is particularly relevant for metal components. Material masses and the associated yield and recycled content have been provided by the vendors. The material inputs to the production system of the modeled fittings and their transportation details are provided in Tables 2.7-2.8. All materials that have a contribution greater than 0.15% weight of the total bill of materials are included. Additional raw materials data of the products as required by Part A is presented in appendix A.

For all manufactured components purchased from suppliers, upstream manufacturing data sets were applied to the raw materials to represent the upstream production of those parts.

Table 2.7a: Faucets raw materials
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Table 2.7b: Faucets raw material transportation information
Submitted to the verifier

Table 2.8a Flush valves raw materials
Submitted to the verifier

Table 2.8b Flush valves raw material transportation information
Submitted to the verifier

Non-ceramic parts that are included in a residential toilet are the spud nut and washer. All parts with a weight of >1% weight of the parts (excluding ceramic and packaging materials) are included in the LCA model. A check has been performed to make sure that the completeness of the overall material use is >99.0%wt. of the finished product after cut-off and including the ceramic and packaging materials. A yield loss of 10% for metals and 2% for plastics was assumed. Table 2.3 shows an aggregation of materials that make up the non-ceramic parts of the product that are > 1%. The residential toilet products have no materials considered hazardous.

The Li-ion battery used in faucets and flush valves is known to contain 1, 2-Dimethoxyethane (CAS# 110-71-4), a listed Substance of Very High Concern (SVHC) in a publicly available "Candidate List of Substances of Very High Concern for Auhorisation of the European Chemicals Agency". The list is the result of an assessment and evaluation scheme, which is part of the REACH Regulation (EC) No 1907/2006 (Registration, Evaluation, Authorisation and Restruction of Chemicals). Because the battery is sealed, 100% of the SVHC is confined in the battery. At end of life, the battery should be taken back to the nearest collection point established by a National Collection Scheme used for batteries.

Since data on recycled content was not provided, it was assumed that only primary materials were used and modeled accordingly. This is typically a worst-case scenario which would require an effort to improve future LCA modeling results. A more detailed raw materials definition of the products as required by Part A is presented in Appendix A.

The specific level of completeness is listed in Table 2.9.

Table 2.9 Completeness of the parts after 1% weight cut-off of the non-ceramic parts

Product code	%wt covered
CST454CUFG	99.75%
MS654114CUFG	98.76%
MS854114E	99.41%
CST454CEFG	99.39%
MS604114CEFG	99.61%
T28S32E	99.77%
T28S32E(T/M)	99.82%
T27S32E(T/M)	99.72%
T28S32E	99.77%
TET1(6)UB(X) TET1(6)LB(X) TET2UB(X) TET2LB(X)	99.68%
TEU1LA(R) TEU1UA(R) TEU2LA(R) TEU2UA(R)	99.78%

2.4.1.2. Manufacturing

The toilets at the TMW, TLW, TMX and TTL plants are manufactured as follows:

- Raw materials arrive by ocean freighter, truck and are unloaded / stored into silos or designated area.
- The preparation materials, primarily materials that embody the mass of the toilet, are batched into two different clay slurries called *slip;* the first is *casting slip* and the second is *glazing slip*.
- The casting slip is pumped into molds and a portion of the water is squeezed out, producing the toilet body. While still wet, the body is drilled for installation holes and shaped, and the product is sent to the dryer to be dried.
- The dry product is inspected. Minor defects can often be repaired prior to glazing; however, products with irreparable defects are recycled back into casting slip and placed into the system. Products that pass inspection are then sprayed with glaze. The water in the glaze absorbs into the dry body and leaves a powder coat of glaze.
- The glazed product is fired in a process called *vitrification* during which organic components in the raw materials are burned out to form CO_2, NO_x, and SO_x and released with exhaust gas stream through wet scrubber to the atmosphere. During vitrification, the pores close up. The glassy raw materials melt and make the body solid and impermeable, and the same materials in the glaze make the surface shiny and hard.
- The fired product is inspected. Products that pass inspection have the fixtures installed and are boxed. Products with defects are repaired and re-fired if possible. Products with irreparable defects are recycled as raw material for construction materials (e.g., tiles) or road bed aggregate.
- Finished products are boxed and shipped to the distribution center for distribution.

For the most part, the casting materials are process aids. Exceptions are soluble salts majorly within the bonding slip, which are applied to the toilets during casting and do remain as part of the toilet body. However, compared to the rest of the ceramic part, bonding slip is less than 0.02% of total weight.

The process flows for the production stage are presented in Figure 2.

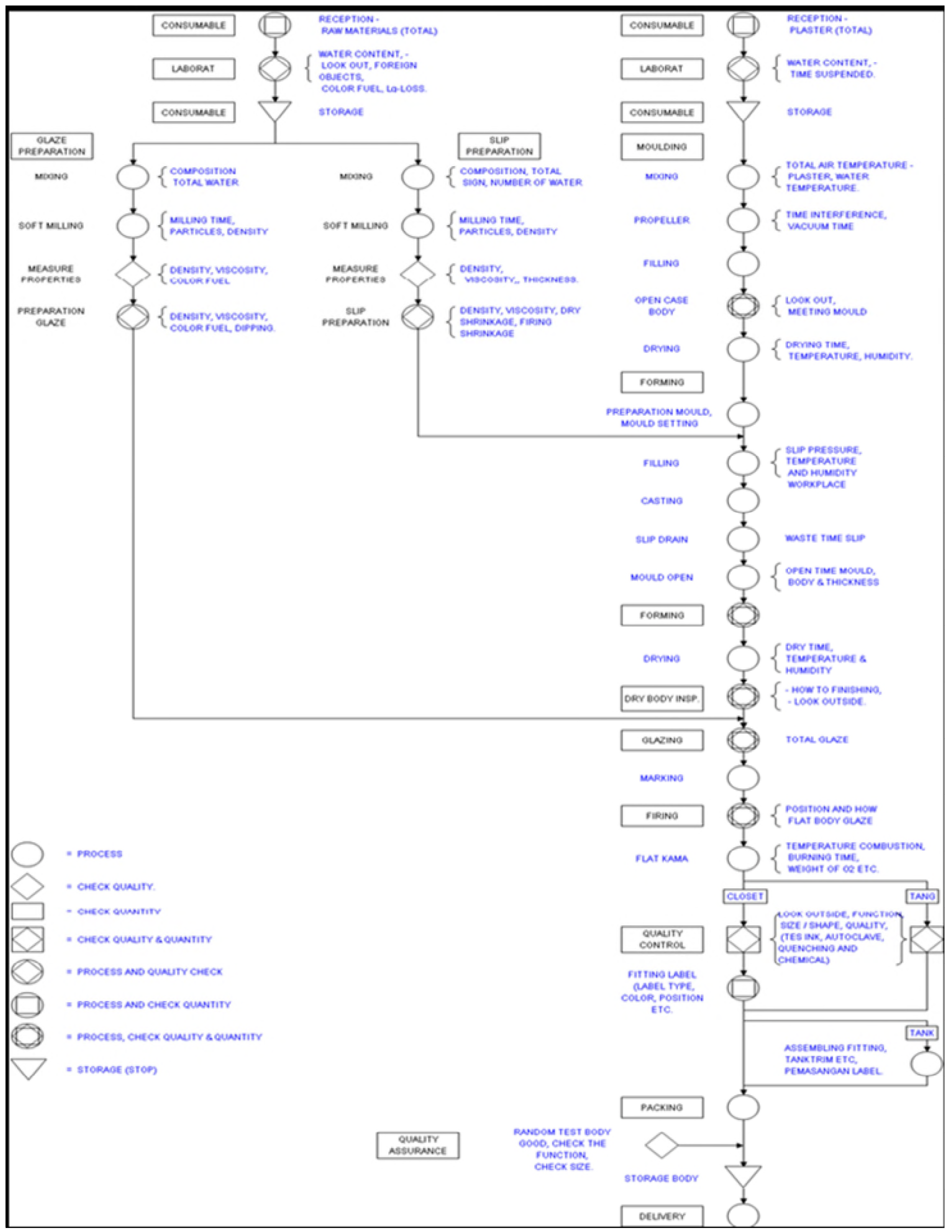

Figure 2. TOTO Ceramics Manufacturing Process Flow

Following discussions with TOTO manufacturing plants, it was determined that their manufacturing process flows are practically the same and that one process chart can be used to represent all plants.

The process flow for faucets and electronic flush valves is as follows:

- Raw materials, such as ores and petroleum byproducts, are purchased and utilized in the manufacturing of intermediates (materials with certain engineering properties). Intermediates include metal alloys such as brass, steel, bronze, zinc, etc. Others include non-metals such as rubbers and thermoplastics.
- Often, the intermediates are manufactured in the same facility in which the fittings' sub-assemblies are manufactured. If not, the intermediates are purchased and transported to the facility.
- The intermediates are manufactured into various fittings' sub-assemblies, each designated for a specific function. The primary methods used for shaping sub-assemblies include, but are not limited to:
  - Die casting
  - Sheet rolling
  - Turning
  - Injection molding
  - Wire drawing
  - Tempering
  - Extrusion
  - Potting
  - Soldering
- Depending on their function, some components undergo the following secondary and tertiary processes to alter aesthetics which include but are not limited to:
  - Polishing, brushing and etching
  - Electroplating and PVD plating
- TOTO purchases fittings products from the manufacturer as either finished goods or as sub-assemblies and components. These purchases are shipped to the TOTO Fairburn Assembly Plant (FAP).
  - **Finished goods**: Finished goods are visually and dimensionally inspected and water tested by the manufacturer to ensure that they meet TOTO's aesthetic and performance criteria. Electrical components are tested for proper function as well. The materials in the pieces that fail inspection are reworked, recycled as scrap metals, or sent to landfill. Pieces that pass are assembled and packaged as finished goods. Finished goods are shipped to FAP and go directly into inventory.
  - **Sub-assemblies**: Sub-assemblies and components undergo various levels of inspection by the manufacturer. They are packaged and shipped for further inspection, testing, and assembly by FAP.
- Further assembly by FAP may be required to the purchased sub-assemblies. This assembly is performed manually, sometimes using power tools in which the energy consumption would be negligible.
- Sub-assemblies are visually and dimensionally inspected and water tested in FAP to ensure that they meet TOTO's aesthetic and performance criteria. The materials in the pieces that fail inspection are reworked, recycled as scrap metals, or sent to landfill. Pieces that pass are assembled and packaged as finished goods and placed into inventory.

The faucet and fittings process flow is included in Figure 3.

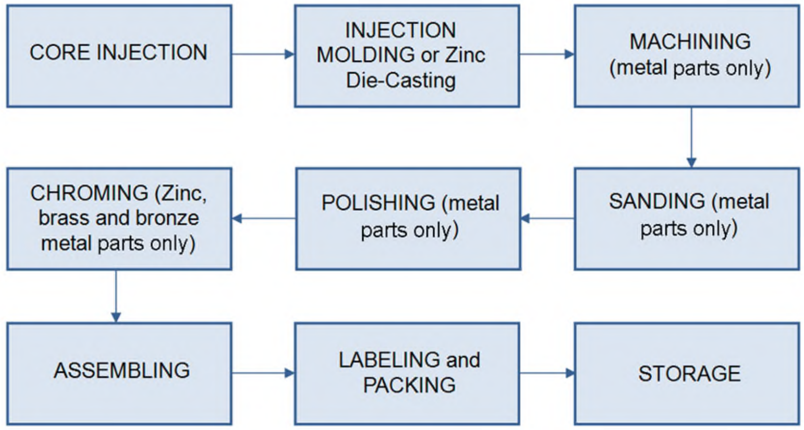

Figure 3. Faucet and flush valve manufacturing process flow

A summary of the mass balance calculations for the TOTO facilities in 2023 is provided in Table 2.10a. Individual inputs and outputs can be viewed in Appendix A.

Table 2.10a Mass balance calculation in 2023

Submitted to the verifier

For residential toilets, in order to allocate manufacturing data to the different products, it is necessary to have insight into the number of ceramic products made in the facilities as well as the yield percent of the plants. Yield is a composite of production losses at different stages in the manufacturing process. Product yield percentage is the percentage of final product compared to raw material input; while total plant yield is the average yield percentage for all the products manufactured in the plant. Differences in yield percentages are due to complexity of the products produced and differences in process, for example, method of casting.

Total energy consumption and emissions in the plant are allocated for different products based on the production efficiency. Production efficiency is the efficiency of energy input embedded in the product and emissions out from the production. Energy input and emission output would firstly be reported in average and plant level, and the product specific data would be reported later for each product. All processes are assigned to the final product based on the yields presented in Table 2.10b using the total yield and production efficiency, with the exception of natural gas use and associated emissions from the kiln. Natural gas usage and associated emissions are allocated by using the last column, the firing yield.

Table 2.10b Yield percentage and production efficiency for ceramic products

Submitted to the verifier

The loss of ignition is an important factor that influences the mass balance. Because water content, crystal water, and organic material in the raw materials are eliminated during the firing process, the ceramic loses mass. Loss of ignition is a good measure for these mass losses. This factor is included in calculating the overall mass balance and is presented in the table below.

Table 2.10c Loss of ignition in 2023

Submitted to the verifier

For faucets and flush valves, the combination of the processes and associated production yield, as well as material mass and recycled content of the material, is used as the basis for the manufacturing model. The primary processes involved and associated yield percentages of the primary processes were provided by the vendors and modeled. Secondary and tertiary processes were also provided by the vendors and are modeled. An overview of these processes for each corresponding product are included in Tables 2.10d-i. The tables list the types of processes, the materials and the average yield percentages for primary processes. A more detailed description of the modeled processes as required by Part A is presented in Appendix A. The modeling of primary and secondary processes was conducted via the utilization of datasets from Ecoinvent, USLCI, US-Ecoinvent or a modification of them to meet geographical boundaries.

Table 2.10d Primary processes, materials and yield for T27/28S32E

T27/28S32E		
Primary Process	**Material(s)**	**Average Yield (%)**
Extrusion	Polyethylene	Submitted to the verifier
Injection molding	ABS, EPDM, POM, NBR, PVC, PP, polyacetal, PPO, PU rigid	Submitted to the verifier
Sheet rolling, Steel	Steel	Submitted to the verifier
Turning, Brass	Brass (C360000), Brass, Brass (covalent coating), Pb free brass	Submitted to the verifier
Turning, Steel	SUS303, SUS304, Steel	Submitted to the verifier
Wire Drawing	Copper	Submitted to the verifier

Table 2.10e Primary processes, materials and yield for T27/28S32ET

T27/28S32ET		
Primary Process	**Material(s)**	**Average Yield (%)**
Casting Brass	Brass	Submitted to the verifier
Extrusion	Polyethylene	Submitted to the verifier
Injection molding	EPDM, POM, NBR, PVC, ABS, Polyacetal, PPO, PU Rigid, PPS	Submitted to the verifier
Sheet rolling, Steel	Steel, SUS	Submitted to the verifier
Turning, Brass	Brass (C360000), Brass, Pb free brass	Submitted to the verifier
Turning, Steel	SUS303, SUS304, steel, SUS	Submitted to the verifier
Wire Drawing	Copper	Submitted to the verifier

Table 2.10f Primary processes, materials and yield for T27/28S32EM

T27/28S32EM		
Primary Process	**Material(s)**	**Average Yield (%)**
Casting Brass	Brass	Submitted to the verifier
Extrusion	Polyethylene	Submitted to the verifier
Injection molding	EPDM, POM, NBR, PVC, ABS, Polyacetal, PPO, PU Rigid	Submitted to the verifier
Sheet rolling, Steel	Steel	Submitted to the verifier
Turning, Brass	Brass (C360000), Brass (covalent coating), Brass, Pb free brass, Brass (C49260)	Submitted to the verifier
Turning, Steel	SUS303, SUS304, steel	Submitted to the verifier
Wire Drawing	Copper	Submitted to the verifier

Table 2.10g Primary processes, materials and yield for TEU1LA(R), TEU1UA(R), TET1(6)UB(X) & TET1(6)LB(X)

TEU1LA(R), TEU1UA(R), TET1(6)UB(X) & TET1(6)LB(X)*		
Primary Process	**Material(s)**	**Average Yield (%)**
Bronze Casting	Bronze (C836000)	Submitted to the verifier
Zinc Die Casting	Zinc die cast	Submitted to the verifier
Extrusion	Polypropylene and Polyethylene	Submitted to the verifier
Injection Molding	EPDM, POM, PP, PPO, PPS, ABS, PU rigid, Polyacetal	Submitted to the verifier
Sheet Rolling, Steel	Steel, SUS, SUS304 and SUS305	Submitted to the verifier
Turning, Brass, CNC	Brass, Brass (360000) and Brass (covalent coating)	Submitted to the verifier
Turning, Bronze, CNC	Bronze (C836000) and Bronze	Submitted to the verifier
Turning, Steel, CNC	Steel, SUS303, SUS304 and SUS316	Submitted to the verifier
Wire Drawing	Copper	Submitted to the verifier

Table 2.10h Primary processes, materials and yield for TEU2LA(R), TEU2UA(R), TET2UB(X) & TET2LB(X)

TEU2LA(R), TEU2UA(R), TET2UB(X) & TET2LB(X)		
Primary Process	**Material(s)**	**Average Yield (%)**
Bronze Casting	Bronze (C836000)	Submitted to the verifier
Zinc Die Casting	Zinc die cast	Submitted to the verifier
Extrusion	Polypropylene and Polyethylene	Submitted to the verifier
Injection Molding	EPDM, POM, PP, PPO, ABS, PU rigid, Polyacetal, PPS	Submitted to the verifier
Sheet Rolling, Steel	Steel, SUS304 and SUS305	Submitted to the verifier
Turning, Brass, CNC	Brass, Brass (covalent coating)	Submitted to the verifier
Turning, Bronze, CNC	Bronze (C836000) and Bronze	Submitted to the verifier

Turning, Steel, CNC	Steel, SUS, SUS303, SUS304	Submitted to the verifier
Wire Drawing	Copper	Submitted to the verifier

Table 2.10i Secondary processes and materials fittings for all fittings

Secondary and Tertiary Process	Material(s)
Electroplating	Brass, Brass (covalent coating), Brass (C360000), Pb free brass, Steel, SUS, SUS303, SUS304
Polishing	Brass, Brass (covalent coating), Brass (C360000), Pb free brass, Steel, SUS, SUS303, SUS304
Potting	Copper, Epoxy resin, Surfacemount w/ Pb, PP, PU rigid
Soldering	Copper, Surfacemount

Secondary data for residential toilets, faucets and flush valves are provided in the tables in Appendix A with an asterisk (*).

2.4.1.3. Energy Requirements

The major manufacturing processes were described in section 2.4.1.4. Table 2.11 below provides the energy requirement to produce one kg of ceramic in TOTO facilities.

Table 2.11 Energy usage for ceramics manufacturing per 1kg of ceramic

Energy Usage						
		TMW	TLW	TMX	TTL	TVN
Electricity from grid	kWh/kg	Submitted to the verifier				
Natural gas	Cu.ft./kg					

Electricity is purchased from Georgia Power[1] for LW and MW. Generation sources, as reported by Georgia Power[1] in 2023, are 48% gas and oil, 23% nuclear, 15% coal, 7% renewable, 5% renewable generating facilities and 2% hydrogen[1]. As required by SM Part A, the latest eGRID subregion[5] data set was used to model the electricity used in Morrow and Lakewood Plant in Georgia.

Generation sources in Thailand is 43.7% from oil, 26.4% from natural oil, 16.4% from biofuels and waste and 12.4% from coal[2], while sources in Mexico are 44.3% from oil, 39% from natural gas, 5.4% from coal and 5% from Biofuels and waste[3]. Generation sources in Vietnam is 47% from coal, 33% from hydro power, 10% from natural gas and 10% from geothermal[4]. Impact factors for this electricity source were created when modeling in SimaPro.

[1]Georgia Power Facts and Figures 2023. https://www.georgiapower.com/company/about-us/facts-and-financials.html
[2]Thailand Facts and Figures 2021 https://www.iea.org/countries/thailand
[3] Mexico Facts and Figures 2022 https://www.iea.org/countries/mexico
[4] Vietnam Facts and Figures 2022 https://www.statista.com/topics/8530/energy-sector-in-vietnam/
[5] US EPA's eGrid Subregion Data 2023. https://www.epa.gov/system/files/images/2024-05/egrid-subregion-map.png

2.4.1.4. Water consumption

The ceramics manufacturing operation requires the consumption of water. Table 2.12 shows the amount of water per kilogram of ceramic produced per year in TOTO facilities.

Table 2.12 Water usage in ceramics production per kilogram of ceramic

	TMW	TLW	TMX	TTL
Liters per kg ceramic	Submitted to the verifier	Submitted to the verifier	Submitted to the verifier	Submitted to the verifier

Lakewood uses much less water in their operation due to less automation and less slip processing. Despite the relatively high water usage, TOTO's operations are always evolving in order to find ways to reduce the use of natural resources. For example, programs implemented in 2012 in TOTO Morrow in the USA casting department (highest water consuming department) resulted in significant reductions in water use. Also, Morrow utilizes roughly 20,000 gallons of on-site recycled greywater per production day, thereby setting a great example for its sister companies.

All water waste is processed on site in TOTO Morrow in the wastewater treatment plant (WWTP). Treatment utilizes a number of cationic polymer, anionic polymer, polymer flocculants and sodium hydroxide. Much of the greywater from this process is reused in the plant. The remainder of water is discharged to the respective city and county water systems via the public sewer system. While finding ways to be more efficient during production and transportation, TOTO subsidiaries overseas are having more opportunities to learn from the TOTO Morrow plant and to mitigate their environmental impacts.

There is no major additional water consumed resulting from the residential toilets assembly process, or from the production of faucets and flush valves.

2.4.1.5. Environmental outputs

The major air emission during manufacturing from materials is carbon dioxide, coming from natural gas combustion as well as through carbonate decomposition and organic combustion of raw materials during the firing process during ceramics manufacturing. Because the drying and firing temperature is high enough for carbonation, we assume the worst-case scenario that all possible raw materials are carbonated and combusted during the process.

Table 2.13 Air emissions for ceramics manufacturing in 2023 per kg ceramic

Air emission	Grams per kg of ceramic			
	TMW	TLW	TMX	TTL
NO_x	Submitted to the verifier	Submitted to the verifier	Submitted to the verifier	Submitted to the verifier
SO_2	Submitted to the verifier	Submitted to the verifier	Submitted to the verifier	Submitted to the verifier
CO	Submitted to the verifier	Submitted to the verifier	Submitted to the verifier	Submitted to the verifier
CO_2	Submitted to the verifier	Submitted to the verifier	Submitted to the verifier	Submitted to the verifier

Wastewater treatment plants treat all wastewater before it is returned to the water authority. Discharged water is tested for various effluents in accordance with local ordinances. Wastewater emissions are listed in the table below:

Table 2.14 Water effluents for ceramics manufacturing in 2023 per kg ceramic
Submitted to the verifier

There are no major additional air or water emissions resulting from the residential toilets assembly process, or from the production of faucets and flush valves.

2.4.1.6. Other materials: parts and packaging

Finished products are packaged in carton boxes, most of which contain a top and bottom pad, along with some inserts and stickers. After packing, boxes are stapled, palletized and wrapped with stretch wrap. Because all the stickers and paper are less than 0.1kg, which is less than 1% of total weight, they are not included in the model. The corrugated board that makes up the boxes, pads, and insert are included for each product and are listed in Tables 2.3a-b.

The packaged product is ready for transportation to the distribution centers and ultimately to the US market. After the products are packaged, they are sent to the warehouse for final shipment. The boxes are stacked on pallets and wrapped in stretch wrap. The stretch wrap is below the cutoff of 1%wt and impact. The pallets are included based on purchasing data per facility. In 2023, Morrow purchased 32,240 pallets, and Lakewood purchased 8,112 pallets. They are purchased in sizes of 48*48 and 54*48, with an average weight of 31.5lb per unit as manually weighed by engineers. For TMX, the average data for MW and LW in 2023 is assumed. In 2013, Morrow purchased 32,173 pallets, Lakewood 9,336 and TMX 22,460.

2.4.1.7. Transportation

Transportation distances of the components and processing aids were provided by TOTO's purchasing, production, and logistics department. Trucks and ocean freighters are assumed to be diesel-powered. No empty returns are accounted for in truck and trailer transportation.

2.4.1.8. Solid waste

Solid waste from facilities includes sludge, ceramic/slip scrap, mold scrap, carton boxes, metal scrap and other wastes. Among them, ceramic/slip scrap, mold scrap and metal scrap can all be reused, and carton box packaging is sent to off-site recycling facilities. All the wastes and their weight as well as their fate are listed below. Sludge, also known as filter cake, refers to the slip and glaze solids removed during the wastewater treatment process. Sludge contains approximately 30-40% water, as measured by samples taken from the plant. The percentage water weight of sludge is not routinely monitored; however, wastewater specialists have measured the content in the past and observe the process every day. They confirmed that the consistency is constant due to the efficiency of the press. The content was measured again for this study in order to verify. Transportation of solid wastes to the sites for treatment is included in the model. It was assumed that all the solid wastes were conveyed by diesel-powered trucks. Where transportation distances were not known, 75 miles was used for commingled, single stream waste recycling, 50 miles for pallet recycle, and 25 miles for metal and oil waste.

Table 2.15 Solid waste from ceramics production per kg ceramic

Solid waste (g per kg of ceramic)	TMW		TLW		TMX		TTL	
	Weight	Fate	Weight	Fate	Weight	Fate	Weight	Fate
Sludge	150.1	Landfill	107.42	Landfill	83.95	Landfill	1004.8	Landfill
Wasted gypsum	128.17	Reuse	84.27	Reuse	148.43	Reuse	293.35	Reuse
Ceramic scrap	40.65	Reuse	394.51	Reuse	214.38	Reuse	829.44	Reuse
Slip scrap	0	Landfill	4.67	Landfill	0	Landfill	0	Landfill
Pallet scrap	3.96	70.60% recycled, others to landfill	1.62	70.60% recycled, others to landfill	10.24	83% recycled, others to landfill	14.68	83% recycled, others to landfill
Carton scrap	2.39	Recycle	12.15	Recycle	3.94	Recycle	24.53	Recycle
Hazardous waste	0	Incineration	4.84	Incineration	0	Incineration	0	Incineration
Wastepaper	0.13	Recycle	0.13	Recycle	0.13	Recycle	0.13	Recycle
Metal scrap	3.85	Recycle	0.32	Recycle	0.8	Recycle	11.08	Recycle
Waste plastic containers	10.86	Recycle	1.5	Recycle	1.13	Recycle	0.28	Recycle
Waste oil	0.3	Hazardous Landfill	0.3	Hazardous Landfill	0.14	Hazardous Landfill	0.64	Hazardous Landfill

2.4.2. Construction/Installation stage [A4-A5]

The construction process stage includes the following information modules:

- A4: Transport to the building site
- A5: Construction / installation in the building

2.4.2.1. Transportation to site

After faucet and electronic flush valve products are purchased by distributors, dealers, and showrooms for purchase by the end users, they are transported from the FAP warehouse to these purchasers. Transportation and distance vary and are dependent on the locations of the purchasers and their choice of shipping mode. Transportation of finished packaged products to the warehouse from vendors is done by diesel trucks (average of 30mi). Outbound shipments to customers from FAP are transported by both diesel truck (average of 947mi) and rail (average of 1114mi). These numbers are estimated based on actual 2023 shipment averages.

All toilets and their components are packaged in the manufacturing plants and are shipped directly to TOTO owned distribution centers. The distribution center for products in the report is the Fairburn Assembly Plant (FAP), located in Fairburn, GA (east distribution center). Toilet components from the facilities arrive finished and require no further assembly. The distance from the Port of Savannah to FAP is approximately 252 miles via diesel-powered trucks. After products are purchased by distributers, dealers, and showrooms for purchase by the end users, they are transported from the FAP warehouse to these purchasers. Transportation and distance would vary and are dependent on the locations of the purchasers and shipping mode. Outbound shipments to customers travel via rail and/or diesel truck. In 2023, outbound shipments were transported an average of 883 miles by diesel truck and an average of 1269 miles by rail. When factoring the quantity transported by truck and rail (83% and 17% respectively), the weighted average transported distance comes to approximately 949 miles.

TOTO toilet sourcing data is based on actual 2023 shipment averages. All transportation LCI data comes from the U.S. LCI database.

2.4.2.2. Construction / Installation

After customers purchase the products from distribution centers, they are installed. Other than packaging, which mainly consists of cartons, becoming waste, nothing else is required or removed at this stage. Waste processing of the waste from product packaging up to the end-of-waste state or disposal of final residues is included in this module.

Materials needed for installation of toilets include a wax ring or wax-free gasket and flange, and the most common slack wax ring is used as an ancillary product for this study. The weight of these materials may vary in size based on customer needs and range from 0.1 kg to 0.15 kg; therefore, a 0.15kg wax ring is assumed for this study. These are necessary for creating a seal between the toilet outlet and drain line to ensure no leakage of sewer gas into the bathroom. The wax ring is generally a high-grade petroleum wax and often includes a polyethylene sleeve. The wax-free gasket and flange consists of a rubber gasket affixed to a plastic flange. These are generally used to install toilets to a recessed floor drain or for a no-mess installation. Supply lines are needed to supply the toilet bowls with water. These supply lines consist of copper pipe, angle stop and a flexible hose. The nut connecting to the water supply is normally brass alloy which is a part of flushometer valve. The nut which connects to the toilet bowl will include an inner gasket for proper sealing. The toilet bowl does not include these materials, and they are not included in the LCA. These materials are assumed to have a low additional environmental impact as compared to the toilet bowls and flushometer valves.

2.4.3. Use stage [B1-B5]

The use stage includes the following information modules:

- B1: Use or application of the installed product
- B2: Maintenance
- B3: Repair
- B4: Replacement
- B5: Refurbishment
- B6-B7: Operational energy and water use

2.4.3.1. Use or application of the installed product

There are no additional activities or construction work needed or associated with the installation of the product during the use phase. Therefore, this module's LCIA is considered to be zero.

2.4.3.2. Maintenance

Maintenance of the toilets, faucets and electronic flush valves would include regular cleaning.

For residential toilets, the use of 50mL/clean twice per month for 75 years gives a total of 90L of solution. Taking a density of 1.01kg/L for a 1% SLS solution, 90kg of solution will be required over the course of 75 years. Hence, 0.9kg of SLS and 90kg of water will be required.

For the faucets and electronic flush valves, the use of 10mL/clean over 260days/year for 75 years gives a total of 195L of solution. Taking a density of 1.01kg/L for a 1% SLS solution, 195kg of solution will be required over the course of 75 years. Hence, 2kg of SLS and 195kg of water will be required.

2.4.3.3. Repair

It is assumed the following components of a residential toilet are fully replaced once during the Reference Service Life (RSL) of 20 years if the component is found in the product:

- Trip lever handle
- Flapper seal
- Fill valve seal

These residential toilet components are therefore assumed to be replaced 2.75 times during the building estimated service life (ESL) of 75 years. Landfilling of the waste trip lever handles, flapper seals, and fill valve seals after repair is included in this module, modeled based on the mass of the different materials in each component.

For faucets and electronic flush valves, the service life is defined in such a way that for a typical installation, no repair is required. Repair would be incidental.

2.4.3.4. Replacement

Replacements for the duration of the building estimated service life (ESL) of 75 years for the residential toilets, faucets and electronic flush valves are counted proportionally to the nearest tenth of each product category in the report. Hence,

- 2.75 replacement residential toilets and
- 6.5 replacement faucets and electronic flush valves

are considered in B4 for the respective 20 and 10 RSL years. Replacements must include the sum of impacts from stages A1-A5 and C1-C4 multiplied by the number of replacements.

2.4.3.5. Refurbishment

The service life is defined in such a way that for a typical installation, no refurbishment is required. There is no refurbishment as such included in the model.

2.4.3.6. Operational energy and water use

The use stage related to the operation of the building includes:
- B6: Operational energy use
- B7: Operational water use

The use phase of the modeled products in this report follows the declared default life cycle use phase scenarios in the relevant Part Bs. The water usage of the products was calculated as shown in Table 2.16.

Table 2.16 Water usage of the products

Product codes	Product type	Total number of uses during modeled life	Water consumption (gal/use)	Total consumption during modeled life (gal)
CST454CEFG, MS604124CEFG and MS854114E	Residential toilet	365 days/year x 75 years x 13 uses/day = 355,875 uses	1.28gallon/flush	455,520.00
CST454CUFG and MS604124CUFG	Residential toilet	365 days/year x 75 years x 13 uses/day = 355,875 uses	1 gallon/flush	355,875.00
T28/27S32E (T/M)	Commercial faucet	260 days/year x 75 years x 90 uses/day = 1,755,000 uses	0.09 (15second duration of each use)	153,562.50
TEU1/2LA(R)	Commercial flush valve	260 days/year x 75 years x 60uses/day = 1,170,000 uses	0.50	585,000.00
TEU1/2UA(R)	Commercial flush valve	260 days/year x 75 years x 60 uses/day = 1,170,000 uses	0.125	146,250.00
TET1(6)/2UB(X)	Commercial flush valve	365 days/year x 75 years x 90 uses/day = 1,755,000 uses	1.0	1,755,000.00
TET1(6)/2LB(X)	Commercial flush valve	365 days/year x 75 years x 90 uses/day = 1,755,000 uses	1.28	2,246,400.00

Water usage in a residential or commercial environment would also include electricity usage for acquisition, treatment and distribution of water to households and collection, conveyance and wastewater treatment of domestic wastewater. Heating for hot water use was not included in the model for toilets and flush valves. Electric Power Research Institute (EPRI) published this type of data in a study on water and sustainability. U.S. EPA data were used to establish weighted average composite factors, to obtain an electricity usage per gallon of water consumed. The foregoing is summarized in Table 2.17 below.

Table 2.17 Average national electricity usage per gallon of water consumed

Activity	**EPRI factors: kWh / MMgal**[Note 1]	**Weighted avg composite factors: kWh / MMgal**
Acquisition, treatment and distribution of surface water by a Public Water System (PWS)	1,406	1,540[Note 2]
Acquisition, treatment and distribution of ground water by a PWS	1,824	
Self-supply of drinking water (typically pumping from private wells)	700	700
Collection, conveyance and < secondary treatment of domestic wastewater	661	1,399[Note 3]
Collection, conveyance and secondary treatment of domestic wastewater	1,212	
Collection, conveyance and advanced treatment of domestic wastewater	1,726	
Collection, conveyance and zero discharge/other treatment of domestic wastewater	400	
Total electricity per million gallons →		3,639
Total kWh electricity per 1 gallon →		**0.0036**

Note 1: Source: EPRI, Water & Sustainability (Volume 4): U.S. Electricity Consumption for Water Supply & Treatment -- The Next Half Century, March 2002.
Note 2: 68% of population served by PWSs relies on surface water, 32% on ground water. Calculated from http://water.epa.gov/lawsregs/guidance/sdwa/upload/2009_08_28_sdwa_fs_30ann_treatment_web.pdf.
Note 3: 1.7% of POTW-served population receives < secondary treatment, 40.9% receives secondary treatment, 49.9% receives advanced treatment, and 7.5% receives zero discharge or other treatment. Source: EPA, 2008 Clean Watersheds Needs Survey.

The summary of the water consumption and associated electricity used for acquisition, treatment and distribution of water to households and collection, conveyance and wastewater treatment of domestic wastewater for the toilets, faucets, and flush valves over their respective reference service life is provided in Table 2.18 below.

Table 2.18 Water consumption and associated electricity consumption for upstream acquisition, treatment and distribution and downstream conveyance and wastewater treatment

Product code	**Product type**	**Water usage (gallon)**	**Electricity usage (kWh)**
CST454CEFG, MS604124CEFG and MS854114E	Residential toilet	455,520.00	1639.87
CST454CUFG and MS604124CUFG	Residential toilet	355,875.00	1281.15
T28/27S32E (T/M)	Commercial faucet	153,562.50	552.83
TEU1/2LA(R)	Commercial flush valve	585,000.00	2106.00
TEU1/2UA(R)	Commercial flush valve	146,250.00	526.50
TET1(6)/2UB(X)	Commercial flush valve	1,755,000.00	6318.00
TET1(6)/2LB(X)	Commercial flush valve	2,246,400.00	8087.04

For faucets, a mix of 70% hot water and 30% cold water was assumed. Water heating assumed a blend of 67% natural gas and 33% electricity. Per the PCR, natural gas consumption was assumed to be 0.8784 Mcf of natural gas per 1,000 gallons of water, for a total of 63.3 Mcf natural gas over the ESL. Electricity consumption was assumed to be 0.1765 kWh of electricity per gallon of water, for a total of 6,261 kWh electricity over the ESL.

Use-stage electricity does not account for anticipated future grid mix changes. Incoming water is municipal tap water, which does not require incoming filtration.

2.4.4. End-of-life stage [C1-C4]

The end-of-life stage includes:

- C1: Deconstruction / demolition
- C2: Transport to waste processing
- C3: Waste processing for reuse, recovery and/or recycling
- C4: Disposal

The toilets, faucets and electronic flush valves are assumed to have a useful life of beyond the 20 year and 10 year RSLs, respectively. At the end of life, it is assumed that the products are landfilled. TOTO ceramic and alloy materials can be recycled as aggregate in several applications; however, this is not a common practice at the moment for the ceramic. According to the data from the U.S. EPA's Municipal Solid Waste Generation, Recycling, and Disposal in the United States Report for 2018[5], 66.54% of paper and paperboard, 33.8% of the steel, 70.50% of other non-ferrous metals, 15.0% of rubber and 4.47% of plastics in municipal wastes are recycled. All burdens for the landfill of the primary product are assigned to the product system and no credits for energy recovery are given (cut-off, "polluter pays" principle). Secondary materials, including shredded and sorted metal waste used to hold the primary product, are valuable goods that will lose their waste status after the sorting process, and no additional waste processing is needed (e.g., melting); therefore, no credits for material recovery are given.

2.4.4.1. De-construction / demolition stage

At the end of life, de-construction of the products which include their dismantling as well as the initial on-site sorting is assumed to be manual. Therefore, no deconstruction activities were included in the model.

2.4.4.2. Transport to waste processing stage

The transport stage involves the transportation of the discarded products to waste processing either to recycling or to final disposal. The transport stage included in the model is based on the assumption that the product will travel 100 km on a truck either to a landfill as a final disposal or to a recycling site.

2.4.4.3. Waste processing stage

Since 100% of products are assumed to be disposed in a sanitary landfill at the end of life, no waste processing activity is applicable in this stage.

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[4] United States Environmental Protection Agency, Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2018.
https://www.epa.gov/environmental-topics/land-waste-and-cleanup-topics

2.4.4.4. Disposal stage

The landfilling of 100% of the products is included in this stage, modeled based on the mass of the different materials in each product.

3 INVENTORY

This chapter includes an overview of the obtained data and data quality that has been used in this study.

3.1 Data categories

The impacts have been inventoried for the following data categories:

- energy inputs
- material inputs
- emissions to air, water and soil
- production of waste and treatment
- produced products

The abovementioned flows are called data categories. They define the scope of the inventory.

3.2 Data selection and quality

Most of the manufacturing data came from primary sources for the calendar year 2023. The departments associated with production data at TOTO facilities collected all data using electric bills, purchasing orders, TOTO's production volume, data on waste and damaged final products, and production yield and efficiency. TOTO's project managers worked together on collecting data and undergoing a data validation process using mass balances and other calculation methods. No materials, components, emissions or energy flows have been left out, except for minor parts where the primary sources' data was incomplete or contradictory to the average industry data. This follows the general rule that either specific data or average data derived from specific production processes shall be the first choice as outlined in Part A of the Framework. Where products are declared together, weighted averages have been used based on the processes and materials for the individual products.

Materials Data and Modeling. The materials are modeled with facility data compiled from individual departmental data. Data validation/verification was done using the know-how and information on processes, equipment age and efficiency, machine power ratings, site conditions and labor force, electricity consumptions, yield and production efficiency information, production rates, and mass balances. The product was modeled according to the facility where it was manufactured. An overview of used data sources is presented in excel data sheets submitted with the report:

- LCA of TOTO Ceramic Products – Drakes and Ultramax Modeling Data and Results 06-2023.xlsx
- LCA of TOTO Fittings Products – EcoFaucets and EFVs Modeling Data and Results 06-2023.xlsx

Product composition data have been provided by TOTO subsidiaries. Some data was confidential and is therefore not included in this report. Publicly available data on composition and manufacturing for upstream and missing data were used and have been supplemented with literature data that is representative for the products on the US market.

Electricity is modeled with country specific grid mixed based on EcoInvent definitions. This relates to the country of manufacturing and the use phase in America. When transforming the inputs and outputs of combustible material into inputs and outputs of energy, the lower caloric value specific to the material was applied based on scientifically accepted values.

This study included products in a standard cotton finish. Products are offered in several different finishes to meet the customers' demands. The results included in this study are intended to represent an average performance for all available options, using a production-weighted average for all models produced in CY2023. These properties are used to calculate the mass reference flow, which was normalized to 1 kg for products with a standard cotton finish.

All manufacturing data used is primary data from the calendar year 2023, with regionally specific data. All background data used to model the LCA is reported in the appendices. Literature data is comprised of the best available data from consistent sources but varies from material to material in geographical, time related and technology coverage due to limited availability of specific data. Data from the EcoInvent database was aimed to be used mostly. However, this does not warrant full consistency between all data sets. Different data can result in differences per material and that can influence the comparison. By using the EcoInvent data, the report follows the data quality in these data sets as they relate to time period coverage. The main criterion for data selection was the technological coverage as to reflect the physical reality of the declared product or product group as closely as possible.

3.3 Limitations

The LCA is limited in the following ways:

- Vendors of raw materials and parts have responded to the request for data and cooperated with the LCA project manager in varying levels. Assumptions listed below originate from the quality of their response. This is the third time the vendors have been contacted with LCA related questions. It is therefore recommended that the vendors be contacted and engaged for future LCA work again and focus on some more details for the most important processes.
- No data on recycled content for any component of the modeled products was provided by vendors. No assumption of secondary material was made even when information was provided informally. This is likely a worst-case scenario. These assumptions need to be revisited in future LCA projects. There is a significant improvement potential for using more recycled content.
- Scenarios have been used for the end-of-life treatment of the materials.
- The impact assessment methodology categories do not represent all possible environmental impact categories.

- Characterization factors used within the impact assessment methodology may contain varying levels of uncertainty.
- Literature data has been used based on the USLCI database and the Ecoinvent database. With future updates and more and more LCA information becoming available, more representative and less generic data should be used for future LCA projects where possible.
- ISO 21930:2017 section 5.5 highlights the following limitations and clarifications in EPD comparability: EPDs are comparable only if they use the same PCR (or sub-category PCR where applicable), include all relevant information modules, and are based on equivalent scenarios with respect to the context of construction works. However, additional variations and deviations are possible. For example, different LCA software and background LCI datasets may lead to different results for the life cycle stages declared.
- The LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

A short summary of the most relevant assumptions that were made is presented here:

- Raw materials in all manufacturing plants are from reported use data inventories.
- Casting materials, inspection materials and installation materials are cut off.
- Maintenance and parts replacement of capital equipment, such as CNC machines, injection machines, mold equipment, etc. was not considered.
- Energy consumption in the warehouses, distribution centers, and retail facilities during the course of transport to the final customer was excluded from the system boundary.
- Transportation of Kaolin and products from vendors was estimated based on rail lines and port information. The worst case scenario of the furthest distance from each factory (TVN and STI) to the manufacturing facility to transport kaolin with an ocean freight method was considered.
- Water content of sludge was measured and reported; however, this measurement not performed routinely.
- Waste from pallets, cartons, wastepaper, metals, and plastics were allocated based on the product volume of each plant..
- General waste treatment data from EPA was used to create waste scenarios of products.
- Water and electricity consumption in the use phase is using general person and flush data from EPA.
- Pallet use is assumed based on the average numbers per unit of product and reported pallet quantity of specific models.

Data quality is further discussed in Section 5.4 herein.

3.4 Criteria for the exclusion of inputs and outputs

The time period over which inputs to and outputs from the system are accounted for is 100 years from the year for which the data set is deemed representative.

The cut-off criteria on a unit process level can be summarized as follows:

- *Mass* – If a flow is less than 1% of the cumulative mass of the model it may be excluded, providing its environmental relevance is not a concern.

- *Energy* – If a flow is less than 1% of the cumulative energy of the model it may be excluded, providing its environmental relevance is not a concern.
- *Environmental relevance* – If a flow meets the above criteria for exclusion yet is thought to potentially have a significant environmental impact, it is included. Material flows which leave the system (emissions) and whose environmental impact is greater than 1% of the whole impact of an impact category that has been considered in the assessment have been covered. This judgment is done based on experience and documented as necessary, but also relies on the used literature data.
- *Hazardous and toxic materials* – The study shall include all hazardous and toxic materials in the inventory therefore the cutoff rules shall not apply to such substances. All known hazardous waste released from the manufacturing facility have been included in this study.
- The sum of the neglected material flows does not exceed 5% of mass, energy or environmental relevance for flows indirectly related to the process (e.g. operating materials).

In this report, almost all flows in the primary data for all facilities have been reported; therefore, these criteria have been met. The completeness of the bill of materials is reported in the previous chapter and satisfies the above-defined cut-off criteria.

To reduce possible artificial variation in EPD results across the product groups, capital goods and system infrastructure flows are excluded from the system boundary by default, with justification required for alternative assumptions.

3.5 Allocation

Whenever a system boundary is crossed, environmental inputs and outputs have to be assigned to the different products. Where multi-inputs or multi-outputs are considered, the same applies. No co-product allocations had to be made in the model. When possible, datasets via cut-off approach were used that avoid allocation or substitution. The model used in this report ensures that the sum of the allocated inputs and outputs of a unit process shall be equal to the inputs and outputs of the unit process before allocation. This means that no double counting or omissions of inputs or outputs through allocation is occurring.

3.5.1 Use of secondary materials

In the manufacturing of the products, secondary materials (such as scape metals and metal bars to hold the primary products in place) were partly used for the manufacturing of the primary products but were not considered due to lack of background data in the LCA model.

Secondary products and materials could be part of the intermediary products from the upstream supply chain and background datasets used in the LCA model.

3.5.2 Allocation for reuse, recycling and recovery

According to the cut-off, waste content approach, all burdens were attributed to the product system, without giving credits for the energy and material recovery.

Packaging/cardboard waste from up- and downstream processes were assumed to be recycled without giving credits for the energy and thermal recovery.

In the modelling of the end-of-life of the primary products, it was assumed that 100% goes to landfill after the use phase. All burdens for the treatment of waste are assigned to the product system, without giving credits for energy and material recovery.

3.6 Software and database

The LCA model was created using SimaPro Analyst 9.5. The ecoinvent v3.9, US-EI 2.2 and USLCI databases provided the life cycle inventory data of the raw materials and processes for modeling the products.

4 IMPACT ASSESSMENT

4.1 Impact assessment

The environmental indicators required by the PCR are included as well as other indicators required to use the SM2013 Methodology [7] (see Table 4.1). The impact indicators are derived using the 100-year time horizon[6] factors, where relevant, as defined by TRACI 2.1 classification and characterization [8]. Long-term emissions (> 100 years) are not taken into consideration in the impact estimate. USEtox indicators[7] are used to evaluate toxicity. Emissions from waste disposal are considered part of the product system under study, according to the “polluter pays principle”.

Table 4.1 Selected impact categories and units

Impact category	Unit	Description
Acidification	kg SO_2 eq (sulphur dioxide)	Acidification processes increase the acidity of water and soil systems and causes damage to lakes, streams, rivers and various plants and animals as well as building materials, paints and other human-built structures.
Ecotoxicity	CTUe	Ecotoxicity causes negative impacts to ecological receptors and, indirectly, to human receptors through the impacts to the ecosystem.
Eutrophication	kg N eq (nitrogen)	Eutrophication is the enrichment of an aquatic ecosystem with nutrients (nitrates and phosphates) that accelerate biological productivity (growth of algae and weeds) and an undesirable accumulation of algal biomass.
Global warming	kg CO_2 eq (carbon dioxide)	Global warming is an average increase in the temperature of the atmosphere near the Earth’s surface and in the troposphere.
Ozone depletion	kg CFC-11 eq	Ozone depletion is the reduction of ozone in the stratosphere caused by the release of ozone depleting chemicals.
Carcinogenics	CTUh	Carcinogens have the potential to form cancers in humans.
Non-carcinogenics	CTUh	Non-Carcinogens have the potential to causes non-cancerous adverse impacts to human health.
Respiratory effects	kg $PM_{2.5}$ eq (fine particulates)	Particulate matter concentrations have a strong influence on chronic and acute respiratory symptoms and mortality rates.

[6] The 100 year period relates to the period in which the environmental impacts are modeled. This is different from the time period of the functional unit. The two periods are related as follows: all environmental impacts that are created in the period of the functional unit, are modeled through life cycle impact assessment using a 100 year time horizon to understand the impacts that take place.

[7] USEtox is available in TRACI and at http://www.usetox.org/

Smog	kg O_3 eq (ozone)	Smog formation (photochemical oxidant formation) is the formation of ozone molecules in the troposphere by complex chemical reactions.
Fossil fuel depletion	MJ surplus	Fossil fuel depletion is the surplus energy to extract minerals and fossil fuels.

With respect to global warming potential, biogenic carbon is included in impact category calculations. Greenhouse gas emissions from land-use change are expected to be insignificant and were assumed to be zero.

A definition of these impact categories is included in Appendix C. During the impact assessment stage of the modeling, the list of life cycle inventory (LCI) indicators for substances that may have not been recognized by the impact assessment methods was reviewed. SimaPro was used to perform the impact assessment.

This study follows the cut-off method. All environmental impacts associated with the production, use, and disposal of a product are allocated to the original product's life cycle. Secondary products (like recycled materials) enter the system with no burdens attached, as they do not carry over the environmental burdens from the original product. No credits are given for flows exiting the product system.

4.2 Normalization and weighting

To arrive to the single score indicator, normalization [9] and weighting [10] as shown in Table 4.2 conforming to the SM 2013 Methodology were applied. The SM 2013 Methodology uses TRACI 2.1 impact categories developed by U.S. EPA, and North American normalization and weighting values developed by EPA and NIST respectively, to calculate single figure LCA results. Sustainable Minds recognizes that weighting is socially defined based on the importance that society attaches to the different environmental impact categories. However, these single score indicators serve as an easy starting point to get to know the product under consideration across all impact categories, rather than focusing all efforts on just one impact category (like global warming potential). The interpretation of the results starts with the Sustainable Minds single score results and then allows users to further explore the underlying impact categories individually. Details including the characterization models, factors, and methods used, including all assumptions and limitations, can be found in the SM 2013 Methodology Report [7].

Table 4.2 Normalization and Weighting factors

Impact category	Normalization	Weighting (%)
Acidification	90.9	3.6
Ecotoxicity	11000	8.4
Eutrophication	21.6	7.2
Global warming	24200	34.9
Ozone depletion	0.161	2.4
Carcinogenics	5.07E-05	9.6
Non-carcinogenics	1.05E-03	6.0
Respiratory effects	24.3	10.8
Smog	1390	4.8
Fossil fuel depletion	17300	12.1

4.3 Life Cycle Inventory Results: LCI Indicators

Non-hazardous waste is calculated based on the amount of waste generated during the manufacturing, installation, and disposal life cycle stages. There is no hazardous or radioactive waste associated with the life cycle for the toilets, but both faucets and flush valves have a lithium-ion battery and a small circuit board which are considered hazardous. Additionally, all materials are assumed to be landfilled at the end of life rather than incinerated or reused/recycled, so no materials are available for energy recovery or reuse/recycling. Waste occurs at product end-of-life when it is disposed of in a landfill.

LCI flows were calculated with the help of American Center for Life Cycle Assessment's (ACLCA) guidance to the ISO 21930:2017 metrics [11]. The consumption of freshwater indicator, which was calculated in accordance with this guidance, is reported in compliance with ISO 14046. Abiotic depletion potential was calculated using the CML impact assessment methodology [12]. LCI flows were reported in conformance to ISO 21930:2017 [13].

The biogenic carbon content of bio-based materials was reported per module. CO_2 from calcination and carbonation does not apply to this study. Carbon emissions from combustion arose from bio-based packaging materials going to incineration.

4.3.1. Residential toilet: Drake® II 1.28gpf (CST454CEFG)

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	1.70E+02	1.28E+02	2.98E+02	2.05E+03	1.99E+01	2.07E+03	0	0	0	0	4.30E-05	1.70E+02
A4	-1.19E+02	1.19E+02	2.60E-01	1.39E+02	3.86E+00	1.42E+02	0	0	0	0	1.70E-03	-1.19E+02
A5	-1.19E+02	1.19E+02	2.66E-01	9.68E+00	3.86E+00	1.35E+01	0	0	0	0	1.19E-02	-1.19E+02
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	-1.13E+02	1.19E+02	6.64E+00	8.83E+01	3.86E+00	9.22E+01	0	0	0	0	1.00E-03	-1.13E+02
B3	2.10E+00	0.00E+00	2.10E+00	2.97E+01	0.00E+00	2.97E+01	0	0	0	0	0.00E+00	2.10E+00
B4	4.00E+03	1.53E+03	5.53E+03	7.75E+04	5.88E+01	7.75E+04	0	0	0	0	1.09E-02	4.00E+03
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	1.55E+03	0.00E+00	1.55E+03	2.40E+04	0.00E+00	2.40E+04	0	0	0	0	1.09E-02	1.55E+03
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-1.22E+02	1.22E+02	1.77E-02	4.44E+00	3.86E+00	8.30E+00	0	0	0	0	7.29E-04	-1.22E+02
C3	-2.91E+02	2.91E+02	1.96E-02	8.27E+00	0.00E+00	8.27E+00	0	0	0	0	1.04E-02	-2.91E+02
C4	-1.19E+02	1.19E+02	6.32E-02	4.98E+00	3.86E+00	8.84E+00	0	0	0	0	7.18E-04	-1.19E+02
Total	-6.81E+01	3.67E+02	2.99E+02	2.20E+03	2.76E+01	2.23E+03	0	0	0	0	1.37E-02	-6.81E+01

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	6.40E-01	2.99E+01	5.60E-03	3.04E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	5.93E-04	3.39E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	4.11E-05	1.40E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	3.50E-04	8.13E-07	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0.00E+00	1.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	0.00E+00	1.32E+02	3.17E-01	2.69E-03	0.00E+00	4.49E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.61E-06	1.55E-08	0.00E+00	2.20E-01	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	8.03E-07	2.17E-09	0.00E+00	2.20E-01	0.00E+00	0.00E+00
C4	0.00E+00	2.59E+01	5.31E-06	2.78E-08	0.00E+00	2.20E-01	0.00E+00	0.00E+00
Total	6.40E-01	3.26E+01	6.24E-03	3.09E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	7.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	0.00E+00	0.00E+00	7.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	0.00E+00	0.00E+00	1.05E+01	1.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	0.00E+00	0.00E+00	7.00E+00	7.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.2. Residential toilet: Drake® II 1G® (CST454CUFG)

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	1.70E+02	1.28E+02	2.98E+02	2.05E+03	1.99E+01	2.07E+03	0	0	0	0	1.70E+02	1.28E+02
A4	-1.19E+02	1.19E+02	2.60E-01	1.39E+02	3.86E+00	1.42E+02	0	0	0	0	-1.19E+02	1.19E+02
A5	-1.19E+02	1.19E+02	2.66E-01	9.68E+00	3.86E+00	1.35E+01	0	0	0	0	-1.19E+02	1.19E+02
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	-1.13E+02	1.19E+02	6.64E+00	8.83E+01	3.86E+00	9.22E+01	0	0	0	0	-1.13E+02	1.19E+02
B3	2.10E+00	0.00E+00	2.10E+00	2.97E+01	0.00E+00	2.97E+01	0	0	0	0	2.10E+00	0.00E+00
B4	3.04E+03	1.53E+03	4.57E+03	6.31E+04	5.88E+01	6.32E+04	0	0	0	0	3.04E+03	1.53E+03
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	1.21E+03	0.00E+00	1.21E+03	1.88E+04	0.00E+00	1.88E+04	0	0	0	0	1.21E+03	0.00E+00
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-1.22E+02	1.22E+02	1.77E-02	4.44E+00	3.86E+00	8.30E+00	0	0	0	0	-1.22E+02	1.22E+02
C3	-2.91E+02	2.91E+02	1.41E-02	5.85E-01	0.00E+00	5.85E-01	0	0	0	0	-2.91E+02	2.91E+02
C4	-1.19E+02	1.19E+02	6.32E-02	4.98E+00	3.86E+00	8.84E+00	0	0	0	0	-1.19E+02	1.19E+02
Total	-6.81E+01	3.67E+02	2.99E+02	2.20E+03	2.76E+01	2.23E+03	0	0	0	0	-6.81E+01	3.67E+02

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	6.40E-01	2.99E+01	5.60E-03	3.04E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	5.93E-04	3.39E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	4.11E-05	1.40E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	3.50E-04	8.13E-07	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0.00E+00	1.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	0.00E+00	1.32E+02	2.54E-01	2.14E-03	0.00E+00	4.49E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.61E-06	1.55E-08	0.00E+00	2.20E-01	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	8.03E-07	2.17E-09	0.00E+00	2.20E-01	0.00E+00	0.00E+00
C4	0.00E+00	2.59E+01	5.31E-06	2.78E-08	0.00E+00	2.20E-01	0.00E+00	0.00E+00
Total	6.40E-01	3.26E+01	6.24E-03	3.09E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	7.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	0.00E+00	0.00E+00	7.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	0.00E+00	0.00E+00	1.05E+01	1.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	0.00E+00	0.00E+00	7.00E+00	7.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.3. Residential toilet: Eco Ultramax® 1.28gpf (MS854114E)

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	2.61E+01	1.28E+02	1.54E+02	1.43E+03	5.68E+00	1.44E+03	0	0	0	0	0.00E+00	1.34E+03
A4	-7.83E+01	7.85E+01	2.06E-01	1.07E+02	1.10E+00	1.08E+02	0	0	0	0	1.20E-03	1.07E+02
A5	-7.82E+01	7.85E+01	2.59E-01	1.21E+01	1.10E+00	1.32E+01	0	0	0	0	1.44E-03	1.20E+01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	-7.19E+01	7.85E+01	6.64E+00	9.11E+01	1.10E+00	9.22E+01	0	0	0	0	1.00E-03	8.46E+01
B3	2.10E+00	0.00E+00	2.10E+00	2.97E+01	0.00E+00	2.97E+01	0	0	0	0	0.00E+00	2.59E+01
B4	3.83E+03	1.09E+03	4.91E+03	7.39E+04	1.68E+01	7.39E+04	0	0	0	0	0.00E+00	5.52E+04
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	1.55E+03	0.00E+00	1.55E+03	2.40E+04	0.00E+00	2.40E+04	0	0	0	0	1.09E-02	7.47E+00
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-7.79E+01	7.79E+01	1.44E-02	5.67E+00	1.10E+00	6.77E+00	0	0	0	0	5.94E-04	6.68E+00
C3	-2.06E+02	2.06E+02	1.59E-03	1.82E-01	0.00E+00	1.82E-01	0	0	0	0	1.30E-04	1.71E-01
C4	-7.84E+01	7.85E+01	5.04E-02	6.53E+00	1.10E+00	7.64E+00	0	0	0	0	5.80E-04	7.47E+00
Total	-1.30E+02	2.85E+02	1.55E+02	1.55E+03	7.89E+00	1.56E+03	0	0	0	0	2.64E-03	1.46E+03

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	6.40E-01	2.99E+01	6.07E-02	1.39E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	3.48E-04	2.44E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	4.05E-05	1.34E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	3.50E-04	8.13E-07	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0.00E+00	1.19E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	0.00E+00	1.51E+02	6.20E-01	2.60E-03	0.00E+00	7.65E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.32E-06	1.26E-08	0.00E+00	7.25E+00	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	1.64E-07	1.18E-09	0.00E+00	7.25E+00	0.00E+00	0.00E+00
C4	0.00E+00	3.80E+01	4.96E-06	2.58E-08	0.00E+00	7.25E+00	0.00E+00	0.00E+00
Total	6.40E-01	3.26E+01	6.11E-02	1.43E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	4.49E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	0.00E+00	0.00E+00	4.49E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	0.00E+00	0.00E+00	6.74E+00	6.74E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	0.00E+00	0.00E+00	4.49E+00	4.49E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.4. Residential toilet: Ultramax II 1G® (MS604124CUFG)

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	3.54E+02	1.28E+02	4.82E+02	1.85E+03	5.68E+00	1.86E+03	0	0	0	0	3.18E-05	1.65E+03
A4	-7.83E+01	7.85E+01	1.87E-01	7.76E+01	1.10E+00	7.87E+01	0	0	0	0	7.22E-04	7.77E+01
A5	-7.82E+01	7.85E+01	2.68E-01	1.25E+01	1.10E+00	1.36E+01	0	0	0	0	1.20E-02	1.24E+01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	-7.19E+01	7.85E+01	6.64E+00	9.11E+01	1.10E+00	9.22E+01	0	0	0	0	1.00E-03	8.46E+01
B3	2.10E+00	0.00E+00	2.10E+00	2.97E+01	0.00E+00	2.97E+01	0	0	0	0	0.00E+00	2.59E+01
B4	4.44E+03	1.09E+03	5.53E+03	6.18E+04	1.68E+01	6.19E+04	0	0	0	0	0.00E+00	4.64E+04
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	1.21E+03	0.00E+00	1.21E+03	1.88E+04	0.00E+00	1.88E+04	0	0	0	0	1.09E-02	7.63E+00
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-7.79E+01	7.79E+01	1.77E-02	7.23E+00	1.10E+00	8.33E+00	0	0	0	0	7.32E-04	8.22E+00
C3	-2.06E+02	2.06E+02	1.62E-03	1.82E-01	0.00E+00	1.82E-01	0	0	0	0	1.34E-04	1.71E-01
C4	-7.84E+01	7.85E+01	5.16E-02	6.70E+00	1.10E+00	7.80E+00	0	0	0	0	5.93E-04	7.63E+00
Total	1.97E+02	2.85E+02	4.83E+02	1.94E+03	7.89E+00	1.95E+03	0	0	0	0	1.27E-02	1.74E+03

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	6.40E-01	2.99E+01	5.00E-03	2.81E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	1.51E-05	1.24E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	4.13E-05	1.41E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	3.50E-04	8.13E-07	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0.00E+00	1.19E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	0.00E+00	1.51E+02	2.49E-01	2.13E-03	0.00E+00	7.65E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.62E-06	1.55E-08	0.00E+00	7.25E+00	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	1.67E-07	1.20E-09	0.00E+00	7.25E+00	0.00E+00	0.00E+00
C4	0.00E+00	3.80E+01	5.06E-06	2.64E-08	0.00E+00	7.25E+00	0.00E+00	0.00E+00
Total	6.40E-01	3.26E+01	5.05E-03	2.84E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	4.49E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	0.00E+00	0.00E+00	4.49E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	0.00E+00	0.00E+00	6.74E+00	6.74E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	0.00E+00	0.00E+00	4.49E+00	4.49E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.5. Residential toilet: Ultramax® II 1.28gpf (MS604124CEFG)

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	1.69E+02	1.28E+02	2.97E+02	1.82E+03	5.68E+00	1.83E+03	0	0	0	0	8.90E-04	1.64E+03
A4	-7.79E+01	7.85E+01	6.45E-01	2.26E+02	1.10E+00	2.27E+02	0	0	0	0	1.75E-03	2.26E+02
A5	-7.82E+01	7.85E+01	2.59E-01	1.21E+01	1.10E+00	1.32E+01	0	0	0	0	1.17E-02	1.20E+01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	-7.19E+01	7.85E+01	6.64E+00	9.11E+01	1.10E+00	9.22E+01	0	0	0	0	1.00E-03	8.46E+01
B3	2.10E+00	0.00E+00	2.10E+00	2.97E+01	0.00E+00	2.97E+01	0	0	0	0	0.00E+00	2.59E+01
B4	4.60E+03	1.09E+03	5.69E+03	7.65E+04	1.68E+01	7.65E+04	0	0	0	0	0.00E+00	5.72E+04
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	1.55E+03	0.00E+00	1.55E+03	2.40E+04	0.00E+00	2.40E+04	0	0	0	0	1.06E-02	7.77E+00
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-7.79E+01	7.79E+01	1.77E-02	7.23E+00	1.10E+00	8.33E+00	0	0	0	0	7.32E-04	8.22E+00
C3	-2.06E+02	2.06E+02	1.59E-03	1.82E-01	0.00E+00	1.82E-01	0	0	0	0	1.30E-04	1.71E-01
C4	-7.84E+01	7.85E+01	5.24E-02	6.83E+00	1.10E+00	7.93E+00	0	0	0	0	6.02E-04	7.77E+00
Total	1.26E+01	2.85E+02	2.98E+02	2.06E+03	7.89E+00	2.07E+03	0	0	0	0	1.43E-02	1.88E+03

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	6.40E-01	2.99E+01	4.32E-03	2.45E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	6.58E-04	2.59E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	4.05E-05	1.34E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	0.00E+00	2.93E+01	3.50E-04	8.13E-07	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0.00E+00	1.19E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	0.00E+00	1.51E+02	3.10E-01	2.66E-03	0.00E+00	7.65E+01	0.00E+00	0.00E+00
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	0.00E+00	5.40E-01	1.62E-06	1.55E-08	0.00E+00	7.25E+00	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	#NAME?	1.18E-09	0.00E+00	7.25E+00	0.00E+00	0.00E+00
C4	0.00E+00	3.80E+01	5.13E-06	2.67E-08	0.00E+00	7.25E+00	0.00E+00	0.00E+00
Total	6.40E-01	3.26E+01	5.02E-03	2.49E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	6.40E-01	2.99E+01	4.32E-03	2.45E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	6.58E-04	2.59E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	4.05E-05	1.34E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	3.50E-04	8.13E-07	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	0.00E+00	1.51E+02	3.10E-01	2.66E-03	0.00E+00	7.65E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.62E-06	1.55E-08	0.00E+00	7.25E+00	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	#NAME?	1.18E-09	0.00E+00	7.25E+00	0.00E+00	0.00E+00
C4	0.00E+00	3.80E+01	5.13E-06	2.67E-08	0.00E+00	7.25E+00	0.00E+00	0.00E+00
Total	6.40E-01	3.26E+01	5.02E-03	2.49E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.6. Commercial faucet: Standard-R (T28S32E(M/T)) and Standard-S (T27S32E(M/T)) Faucet Series

Resource use indicators: T28S32E

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-7.65E+01	1.28E+02	5.18E+01	6.47E+02	1.57E+01	6.63E+02	0	0	0	0	8.23E-04	6.45E+02
A4	-5.28E+00	5.30E+00	1.83E-02	5.53E+00	3.05E+00	8.59E+00	0	0	0	0	7.54E-04	8.47E+00
A5	-5.30E+00	5.30E+00	1.28E-03	-2.99E+00	3.05E+00	6.41E-02	0	0	0	0	1.03E-02	5.46E-02
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	9.45E+00	5.30E+00	1.47E+01	2.02E+02	3.05E+00	2.05E+02	0	0	0	0	1.70E-04	1.88E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	3.82E+03	2.53E+02	4.07E+03	6.24E+04	4.65E+01	6.24E+04	0	0	0	0	1.63E-02	4.71E+04
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	5.55E+02	0.00E+00	5.55E+02	1.89E+04	0.00E+00	1.89E+04	0	0	0	0	1.09E-02	5.16E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-5.25E+00	5.25E+00	6.63E-04	-2.74E+00	3.05E+00	3.12E-01	0	0	0	0	2.74E-05	3.07E-01
C3	-1.37E+01	1.39E+01	1.66E-01	1.13E+00	0.00E+00	1.13E+00	0	0	0	0	1.12E-02	1.04E+00
C4	-5.28E+00	5.30E+00	1.36E-02	-2.45E+00	3.05E+00	6.06E-01	0	0	0	0	1.18E-03	5.16E-01
Total	-8.71E+01	1.39E+02	5.18E+01	6.50E+02	2.18E+01	6.71E+02	0	0	0	0	1.19E-02	6.54E+02

Output flows and waste category indicators: T28S32E

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	2.34E-03	1.87E-06	0	0	0	0
A4	0	1.20E+00	1.67E-06	1.60E-08	0	0	0	0
A5	0	1.43E+00	1.19E-07	1.03E-09	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	2.93E+01	7.76E-04	1.80E-06	0	2.93E+01	0	0
B3	0	0	0	0	0	0	0	0
B4	0	9.35E+01	2.48E-01	2.04E-03	0	5.45E+01	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	5.40E-01	6.06E-08	5.80E-10	0	2.37E+00	0	0
C3	3.40E-02	0	1.98E-05	3.01E-08	0	2.37E+00	0	0
C4	3.40E-02	0	1.58E-06	1.02E-08	0	2.37E+00	0	0
Total	3.38E-03	3.26E+01	2.34E-03	1.89E-06	0	0	0	0

Carbon emissions and removals: T28S32E

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0	0	3.04E-01	0	0	0	0	0
A4	0	0	0	0	0	0	0	0
A5	0	0	0	3.04E-01	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	0	0	0	0	0	0	0
B3	0	0	0	0	0	0	0	0
B4	0	0	4.56E-01	4.56E-01	0	0	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	0	0	0	0	0	0	0
C3	0	0	0	0	0	0	0	0
C4	0	0	0	0	0	0	0	0
Total	0	0	3.04E-01	3.04E-01	0	0	0	0

Resource use indicators: T27S32E

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-7.47E+01	1.28E+02	5.36E+01	6.67E+02	1.57E+01	6.83E+02	0	0	0	0	8.26E-04	6.65E+02
A4	-5.28E+00	5.30E+00	1.83E-02	5.53E+00	3.05E+00	8.59E+00	0	0	0	0	7.54E-04	8.47E+00
A5	-5.30E+00	5.30E+00	1.28E-03	-2.99E+00	3.05E+00	6.41E-02	0	0	0	0	1.03E-02	5.46E-02
B1	0	0	0	0	0	0	0	0	0	0	0	1
B2	9.45E+00	5.30E+00	1.47E+01	2.02E+02	3.05E+00	2.05E+02	0	0	0	0	1.70E-04	1.88E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	3.84E+03	2.53E+02	4.09E+03	6.26E+04	4.65E+01	6.27E+04	0	0	0	0	1.63E-02	1.17E+05
B5	0	0	0	0	0	0	0	0	0	0	0	1
B6-B7	5.55E+02	0.00E+00	5.55E+02	1.89E+04	0.00E+00	1.89E+04	0	0	0	0	9.99E-03	5.16E-01
C1	0	0	0	0	0	0	0	0	0	0	0	1
C2	-5.25E+00	5.25E+00	6.63E-04	-2.74E+00	3.05E+00	3.12E-01	0	0	0	0	2.74E-05	3.07E-01
C3	-1.37E+01	1.39E+01	1.66E-01	1.13E+00	0.00E+00	1.13E+00	0	0	0	0	1.12E-02	1.04E+00
C4	-5.28E+00	5.30E+00	1.36E-02	-2.45E+00	3.05E+00	6.06E-01	0	0	0	0	1.18E-03	5.16E-01
Total	-8.53E+01	1.39E+02	5.36E+01	6.70E+02	2.18E+01	6.91E+02	0	0	0	0	1.19E-02	6.73E+02

Output flows and waste category indicators: T27S32E

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	2.38E-03	1.92E-06	0	0	0	0
A4	0	1.20E+00	1.67E-06	1.60E-08	0	0	0	0
A5	0	1.43E+00	1.19E-07	1.03E-09	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	2.93E+01	7.76E-04	1.80E-06	0	2.93E+01	0	0
B3	0	0	0	0	0	0	0	0
B4	0	9.35E+01	2.48E-01	2.04E-03	0	5.49E+01	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	5.40E-01	6.06E-08	5.80E-10	0	2.44E+00	0	0
C3	3.40E-02	0	1.98E-05	3.01E-08	0	2.44E+00	0	0
C4	3.40E-02	0	1.58E-06	1.02E-08	0	2.44E+00	0	0
Total	3.38E-03	3.26E+01	2.38E-03	1.94E-06	0	0	0	0

Carbon emissions and removals: T27S32E

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0	0	3.04E-01	0	0	0	0	0
A4	0	0	0	0	0	0	0	0
A5	0	0	0	3.04E-01	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	0	0	0	0	0	0	0
B3	0	0	0	0	0	0	0	0
B4	0	0	4.56E-01	4.56E-01	0	0	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	0	0	0	0	0	0	0
C3	0	0	0	0	0	0	0	0
C4	0	0	0	0	0	0	0	0
Total	0	0	3.04E-01	3.04E-01	0	0	0	0

Resource use indicators: T28S32EM

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-6.84E+01	1.28E+02	5.99E+01	6.77E+02	1.59E+01	6.93E+02	0	0	0	0	9.14E-04	6.71E+02
A4	-5.28E+00	5.30E+00	2.05E-02	6.51E+00	3.10E+00	9.61E+00	0	0	0	0	8.43E-04	9.48E+00
A5	-5.30E+00	5.30E+00	1.60E-03	-3.02E+00	3.10E+00	7.95E-02	0	0	0	0	1.04E-02	6.76E-02
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	9.45E+00	5.30E+00	1.47E+01	2.02E+02	3.10E+00	2.05E+02	0	0	0	0	1.70E-04	1.88E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	3.90E+03	2.53E+02	4.16E+03	6.27E+04	4.72E+01	6.28E+04	0	0	0	0	1.76E-02	1.17E+05
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	5.55E+02	0.00E+00	5.55E+02	1.89E+04	0.00E+00	1.89E+04	0	0	0	0	1.09E-02	5.36E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-5.25E+00	5.25E+00	1.01E-03	-2.62E+00	3.10E+00	4.73E-01	0	0	0	0	4.15E-05	4.66E-01
C3	-1.36E+01	1.39E+01	2.98E-01	1.83E+00	0.00E+00	1.83E+00	0	0	0	0	1.32E-02	1.68E+00
C4	-5.28E+00	5.30E+00	1.37E-02	-2.47E+00	3.10E+00	6.26E-01	0	0	0	0	1.20E-03	5.36E-01
Total	-7.90E+01	1.39E+02	5.99E+01	6.81E+02	2.21E+01	7.03E+02	0	0	0	0	1.21E-02	6.81E+02

Output flows and waste category indicators: T28S32EM

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	7.76E-03	2.72E-06	0	0	0	0
A4	0	1.20E+00	1.87E-06	1.79E-08	0	0	0	0
A5	0	1.43E+00	1.48E-07	1.28E-09	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	2.93E+01	7.76E-04	1.80E-06	0	2.93E+01	0	0
B3	0	0	0	0	0	0	0	0
B4	0	9.35E+01	3.16E-01	2.05E-03	0	5.58E+01	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	5.40E-01	9.20E-08	8.80E-10	0	2.66E+00	0	0
C3	3.40E-02	0	3.45E-05	5.08E-08	0	2.66E+00	0	0
C4	3.40E-02	0	1.59E-06	1.03E-08	0	2.66E+00	0	0
Total	3.38E-03	3.26E+01	7.76E-03	2.74E-06	0	0	0	0

Carbon emissions and removals: T28S32EM

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0	0	3.04E-01	0	0	0	0	0
A4	0	0	0	0	0	0	0	0
A5	0	0	0	3.04E-01	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	0	0	0	0	0	0	0
B3	0	0	0	0	0	0	0	0
B4	0	0	4.56E-01	4.56E-01	0	0	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	0	0	0	0	0	0	0
C3	0	0	0	0	0	0	0	0
C4	0	0	0	0	0	0	0	0
Total	0	0	3.04E-01	3.04E-01	0	0	0	0

Resource use indicators: T27S32EM

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-6.63E+01	1.28E+02	6.20E+01	6.96E+02	1.59E+01	7.12E+02	0	0	0	0	9.42E-04	6.89E+02
A4	-5.28E+00	5.30E+00	2.05E-02	6.51E+00	3.10E+00	9.61E+00	0	0	0	0	8.43E-04	9.48E+00
A5	-5.30E+00	5.30E+00	1.60E-03	-3.02E+00	3.10E+00	7.95E-02	0	0	0	0	1.04E-02	6.76E-02
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	9.45E+00	5.30E+00	1.47E+01	2.02E+02	3.10E+00	2.05E+02	0	0	0	0	1.70E-04	1.88E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	3.93E+03	2.53E+02	4.18E+03	6.30E+04	4.72E+01	6.30E+04	0	0	0	0	1.76E-02	1.18E+05
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	5.55E+02	0.00E+00	5.55E+02	1.89E+04	0.00E+00	1.89E+04	0	0	0	0	1.09E-02	5.36E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-5.25E+00	5.25E+00	1.01E-03	-2.62E+00	3.10E+00	4.73E-01	0	0	0	0	4.15E-05	4.66E-01
C3	-1.36E+01	1.39E+01	2.98E-01	1.83E+00	0.00E+00	1.83E+00	0	0	0	0	1.32E-02	1.68E+00
C4	-5.28E+00	5.30E+00	1.37E-02	-2.47E+00	3.10E+00	6.26E-01	0	0	0	0	1.20E-03	5.36E-01
Total	-7.69E+01	1.39E+02	6.20E+01	7.00E+02	2.21E+01	7.22E+02	0	0	0	0	1.22E-02	6.98E+02

Output flows and waste category indicators: T27S32EM

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	9.12E-03	2.97E-06	0	0	0	0
A4	0	1.20E+00	1.87E-06	1.79E-08	0	0	0	0
A5	0	1.43E+00	1.48E-07	1.28E-09	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	2.93E+01	7.76E-04	1.80E-06	0	2.93E+01	0	0
B3	0	0	0	0	0	0	0	0
B4	0	9.35E+01	3.31E-01	2.06E-03	0	5.62E+01	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	5.40E-01	1.08E-07	8.80E-10	0	2.73E+00	0	0
C3	3.40E-02	0	3.45E-05	5.08E-08	0	2.73E+00	0	0
C4	3.40E-02	0	1.59E-06	1.03E-08	0	2.73E+00	0	0
Total	3.38E-03	3.26E+01	9.12E-03	2.99E-06	0	0	0	0

Carbon emissions and removals: T27S32EM

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0	0	3.04E-01	0	0	0	0	0
A4	0	0	0	0	0	0	0	0
A5	0	0	0	3.04E-01	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	0	0	0	0	0	0	0
B3	0	0	0	0	0	0	0	0
B4	0	0	4.56E-01	4.56E-01	0	0	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	0	0	0	0	0	0	0
C3	0	0	0	0	0	0	0	0
C4	0	0	0	0	0	0	0	0
Total	0	0	3.04E-01	3.04E-01	0	0	0	0

Resource use indicators: T28S32ET

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-6.76E+01	1.28E+02	6.07E+01	6.86E+02	1.59E+01	7.02E+02	0	0	0	0	8.84E-04	6.79E+02
A4	-5.27E+00	5.30E+00	2.25E-02	7.46E+00	3.10E+00	1.06E+01	0	0	0	0	9.27E-04	8.47E+00
A5	-5.30E+00	5.30E+00	1.32E-03	-3.03E+00	3.10E+00	6.47E-02	0	0	0	0	1.03E-02	5.49E-02
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	9.45E+00	5.30E+00	1.47E+01	2.02E+02	3.10E+00	2.05E+02	0	0	0	0	1.70E-04	1.88E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	3.91E+03	2.53E+02	4.16E+03	6.28E+04	4.72E+01	6.29E+04	0	0	0	0	1.81E-02	1.18E+05
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	5.55E+02	0.00E+00	5.55E+02	1.89E+04	0.00E+00	1.89E+04	0	0	0	0	1.09E-02	5.41E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-5.25E+00	5.25E+00	7.72E-04	-2.73E+00	3.10E+00	3.63E-01	0	0	0	0	3.18E-05	3.58E-01
C3	-1.36E+01	1.39E+01	3.07E-01	1.71E+00	0.00E+00	1.71E+00	0	0	0	0	1.35E-02	1.56E+00
C4	-5.28E+00	5.30E+00	1.38E-02	-2.47E+00	3.10E+00	6.32E-01	0	0	0	0	1.21E-03	5.41E-01
Total	-7.81E+01	1.39E+02	6.08E+01	6.91E+02	2.21E+01	7.13E+02	0	0	0	0	1.22E-02	6.88E+02

Output flows and waste category indicators: T28S32ET

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	7.87E-03	2.79E-06	0	0	0	0
A4	0	1.20E+00	2.05E-06	1.97E-08	0	0	0	0
A5	0	1.43E+00	1.22E-07	1.06E-09	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	2.93E+01	7.76E-04	1.80E-06	0	2.93E+01	0	0
B3	0	0	0	0	0	0	0	0
B4	0	9.35E+01	3.13E-01	2.05E-03	0	5.71E+01	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	5.40E-01	7.06E-08	6.75E-10	0	2.94E+00	0	0
C3	3.40E-02	0	3.54E-05	5.14E-08	0	2.94E+00	0	0
C4	3.40E-02	0	1.60E-06	1.04E-08	0	2.94E+00	0	0
Total	3.38E-03	3.26E+01	7.87E-03	2.81E-06	0	0	0	0

Carbon emissions and removals: T28S32ET

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0	0	3.04E-01	0	0	0	0	0
A4	0	0	0	0	0	0	0	0
A5	0	0	0	3.04E-01	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	0	0	0	0	0	0	0
B3	0	0	0	0	0	0	0	0
B4	0	0	4.56E-01	4.56E-01	0	0	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	0	0	0	0	0	0	0
C3	0	0	0	0	0	0	0	0
C4	0	0	0	0	0	0	0	0
Total	0	0	3.04E-01	3.04E-01	0	0	0	0

Resource use indicators: T27S32ET

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-6.55E+01	1.28E+02	6.28E+01	7.05E+02	1.59E+01	7.21E+02	0	0	0	0	8.88E-04	6.97E+02
A4	-5.27E+00	5.30E+00	2.25E-02	7.46E+00	3.10E+00	1.06E+01	0	0	0	0	9.27E-04	1.04E+01
A5	-5.30E+00	5.30E+00	1.32E-03	-3.03E+00	3.10E+00	6.47E-02	0	0	0	0	2.90E-03	5.49E-02
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	9.45E+00	5.30E+00	1.47E+01	2.02E+02	3.10E+00	2.05E+02	0	0	0	0	1.70E-04	1.88E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	3.94E+03	2.53E+02	4.19E+03	6.31E+04	4.72E+01	6.31E+04	0	0	0	0	1.81E-02	1.18E+05
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	5.55E+02	0.00E+00	5.55E+02	1.89E+04	0.00E+00	1.89E+04	0	0	0	0	1.09E-02	5.41E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-5.25E+00	5.25E+00	7.72E-04	-2.73E+00	3.10E+00	3.63E-01	0	0	0	0	3.18E-05	3.58E-01
C3	-1.36E+01	1.39E+01	3.07E-01	1.71E+00	0.00E+00	1.71E+00	0	0	0	0	1.35E-02	1.56E+00
C4	-5.28E+00	5.30E+00	1.38E-02	-2.47E+00	3.10E+00	6.32E-01	0	0	0	0	1.21E-03	5.41E-01
Total	-7.61E+01	1.39E+02	6.28E+01	7.10E+02	2.21E+01	7.32E+02	0	0	0	0	4.71E-03	7.08E+02

Output flows and waste category indicators: T27S32ET

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	9.23E-03	3.04E-06	0	0	0	0
A4	0	1.20E+00	2.05E-06	1.97E-08	0	0	0	0
A5	0	1.43E+00	1.22E-07	1.06E-09	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	2.93E+01	7.76E-04	1.80E-06	0	2.93E+01	0	0
B3	0	0	0	0	0	0	0	0
B4	0	9.35E+01	3.30E-01	2.06E-03	0	5.74E+01	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	5.40E-01	7.06E-08	6.75E-10	0	3.01E+00	0	0
C3	3.40E-02	0	3.54E-05	5.14E-08	0	3.01E+00	0	0
C4	3.40E-02	0	1.60E-06	1.04E-08	0	3.01E+00	0	0
Total	3.38E-03	3.26E+01	9.23E-03	3.06E-06	0	0	0	0

Carbon emissions and removals: T27S32ET

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0	0	3.04E-01	0	0	0	0	0
A4	0	0	0	0	0	0	0	0
A5	0	0	0	3.04E-01	0	0	0	0
B1	0	0	0	0	0	0	0	0
B2	0	0	0	0	0	0	0	0
B3	0	0	0	0	0	0	0	0
B4	0	0	4.56E-01	4.56E-01	0	0	0	0
B5	0	0	0	0	0	0	0	0
B6-B7	0	0	0	0	0	0	0	0
C1	0	0	0	0	0	0	0	0
C2	0	0	0	0	0	0	0	0
C3	0	0	0	0	0	0	0	0
C4	0	0	0	0	0	0	0	0
Total	0	0	3.04E-01	3.04E-01	0	0	0	0

4.3.7. Commercial flush valve: EcoPower® HE Urinal EFV (TEU1LAR)

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-3.46E+01	1.28E+02	9.37E+01	1.03E+03	7.65E+00	1.04E+03	0	0	0.00E+00	0.00E+00	1.95E-04	1.01E+03
A4	-1.26E+01	1.27E+01	1.89E-02	7.38E+00	1.49E+00	8.86E+00	0	0	0.00E+00	0.00E+00	7.78E-04	8.74E+00
A5	-1.27E+01	1.27E+01	2.76E-03	-1.35E+00	1.49E+00	1.37E-01	0	0	0.00E+00	0.00E+00	1.05E-02	1.21E-01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	2.09E+00	1.27E+01	1.47E+01	2.03E+02	1.49E+00	2.05E+02	0	0	0.00E+00	0.00E+00	1.70E-04	1.89E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	1.34E+04	3.34E+02	1.38E+04	2.13E+05	2.26E+01	2.13E+05	0	0	0.00E+00	0.00E+00	1.09E-02	1.58E+05
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	1.99E+03	0.00E+00	1.99E+03	3.09E+04	0.00E+00	3.09E+04	0	0	0.00E+00	0.00E+00	1.09E-02	4.99E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-1.19E+01	1.19E+01	1.34E-03	-8.57E-01	1.49E+00	6.28E-01	0	0	0.00E+00	0.00E+00	5.51E-05	6.19E-01
C3	-3.15E+01	3.15E+01	1.41E-02	2.58E+00	0.00E+00	2.58E+00	0	0	0.00E+00	0.00E+00	1.02E-02	2.50E+00
C4	-1.26E+01	1.27E+01	1.40E-02	-9.09E-01	1.49E+00	5.76E-01	0	0	0.00E+00	0.00E+00	1.11E-03	4.99E-01
Total	-5.99E+01	1.54E+02	9.37E+01	1.03E+03	1.06E+01	1.04E+03	0	0	0.00E+00	0.00E+00	1.14E-02	1.02E+03

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	2.42E-03	2.70E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	1.72E-06	1.65E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	2.56E-07	2.22E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	7.76E-04	1.80E-06	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0	0	0	0	0	0	0	0
B4	0.00E+00	9.35E+01	3.51E-01	7.60E-03	0.00E+00	6.59E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.22E-07	1.17E-09	0.00E+00	4.90E+00	0.00E+00	0.00E+00
C3	3.40E-02	0.00E+00	1.38E-06	1.09E-08	0.00E+00	4.90E+00	0.00E+00	0.00E+00
C4	3.40E-02	0.00E+00	1.59E-06	1.04E-08	0.00E+00	4.90E+00	0.00E+00	0.00E+00
Total	3.38E-03	3.26E+01	2.42E-03	2.72E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	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
A5	0.00E+00	0.00E+00	0.00E+00	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0	0	0
B2	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
B3	0	0	0	0	0	0	0	0	0	0
B4	0.00E+00	0.00E+00	1.11E+00	1.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0	0	0
B6-B7	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
C1	0	0	0	0	0	0	0	0	0	0
C2	0.00E+00	0.00E+00	1.11E+00	1.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C3	0.00E+00	0.00E+00	1.11E+00	1.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C4	0.00E+00	0.00E+00	1.11E+00	1.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total	0.00E+00	0.00E+00	7.40E-01	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.8. Commercial flush valve: EcoPower® Ultra Urinal EFV (TEU1UAR)

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-3.92E+01	1.28E+02	8.91E+01	9.53E+02	7.65E+00	9.61E+02	0	0	0.00E+00	0.00E+00	1.69E-04	9.37E+02
A4	-1.26E+01	1.27E+01	1.97E-02	7.75E+00	1.49E+00	9.24E+00	0	0	0.00E+00	0.00E+00	8.11E-04	9.11E+00
A5	-1.27E+01	1.27E+01	3.34E-03	-1.30E+00	1.49E+00	1.84E-01	0	0	0.00E+00	0.00E+00	7.40E-03	1.63E-01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	2.09E+00	1.27E+01	1.47E+01	2.03E+02	1.49E+00	2.05E+02	0	0	0.00E+00	0.00E+00	1.70E-04	1.89E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	3.69E+03	3.34E+02	4.02E+03	6.22E+04	2.26E+01	6.22E+04	0	0	0.00E+00	0.00E+00	2.29E-02	4.84E+04
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	4.97E+02	0.00E+00	4.97E+02	7.72E+03	0.00E+00	7.72E+03	0	0	0.00E+00	0.00E+00	1.09E-02	4.80E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-1.19E+01	1.19E+01	1.18E-03	-9.30E-01	1.49E+00	5.55E-01	0	0	0.00E+00	0.00E+00	4.87E-05	5.48E-01
C3	-3.08E+01	3.15E+01	6.39E-01	3.82E+00	0.00E+00	3.82E+00	0	0	0.00E+00	0.00E+00	1.54E-02	3.54E+00
C4	-1.26E+01	1.27E+01	1.39E-02	-9.29E-01	1.49E+00	5.56E-01	0	0	0.00E+00	0.00E+00	1.10E-03	4.80E-01
Total	-6.45E+01	1.54E+02	8.91E+01	9.59E+02	1.06E+01	9.70E+02	0	0	0.00E+00	0.00E+00	8.38E-03	9.46E+02

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	2.39E-03	2.54E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	1.80E-06	1.72E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	3.12E-07	2.67E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	7.76E-04	1.80E-06	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0	0	0	0	0	0	0	0
B4	0.00E+00	9.35E+01	-2.61E-01	1.86E-03	0.00E+00	6.35E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.08E-07	1.03E-09	0.00E+00	4.36E+00	0.00E+00	0.00E+00
C3	3.40E-02	0.00E+00	7.32E-05	1.05E-07	0.00E+00	4.36E+00	0.00E+00	0.00E+00
C4	3.40E-02	0.00E+00	1.58E-06	1.03E-08	0.00E+00	4.36E+00	0.00E+00	0.00E+00
Total	3.38E-03	3.26E+01	2.40E-03	2.56E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	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
A5	0.00E+00	0.00E+00	0.00E+00	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0	0	0
B2	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
B3	0	0	0	0	0	0	0	0	0	0
B4	0.00E+00	0.00E+00	1.11E+00	1.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0	0	0
B6-B7	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
C1	0	0	0	0	0	0	0	0	0	0
C2	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
C3	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
C4	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
Total	0.00E+00	0.00E+00	7.40E-01	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.9. Commercial flush valve: EcoPower® Urinal Flush Valve (TEU2LAR)

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-4.10E+01	1.28E+02	8.73E+01	8.12E+02	7.65E+00	8.20E+02	0	0	0.00E+00	0.00E+00	2.08E-04	7.99E+02
A4	-1.38E+01	1.38E+01	1.84E-02	7.17E+00	1.49E+00	8.66E+00	0	0	0.00E+00	0.00E+00	7.60E-04	8.54E+00
A5	-1.38E+01	1.38E+01	2.56E-03	-1.36E+00	1.49E+00	1.25E-01	0	0	0.00E+00	0.00E+00	1.04E-02	1.10E-01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	9.55E-01	1.38E+01	1.47E+01	2.03E+02	1.49E+00	2.05E+02	0	0	0.00E+00	0.00E+00	1.70E-04	1.89E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	1.36E+04	3.41E+02	1.39E+04	2.12E+05	2.26E+01	2.12E+05	0	0	0.00E+00	0.00E+00	2.36E-02	1.56E+05
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	1.99E+03	0.00E+00	1.99E+03	3.09E+04	0.00E+00	3.09E+04	0	0	0.00E+00	0.00E+00	1.09E-02	4.35E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-1.22E+01	1.22E+01	1.41E-03	-8.21E-01	1.49E+00	6.64E-01	0	0	0.00E+00	0.00E+00	5.83E-05	6.55E-01
C3	-3.11E+01	3.17E+01	6.30E-01	3.25E+00	0.00E+00	3.25E+00	0	0	0.00E+00	0.00E+00	1.52E-02	2.97E+00
C4	-1.38E+01	1.38E+01	1.19E-02	-9.86E-01	1.49E+00	4.99E-01	0	0	0.00E+00	0.00E+00	1.04E-03	4.35E-01
Total	-6.85E+01	1.56E+02	8.74E+01	8.18E+02	1.06E+01	8.29E+02	0	0	0.00E+00	0.00E+00	1.14E-02	8.08E+02

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	1.95E-03	1.99E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	1.68E-06	1.61E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	2.36E-07	2.06E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	7.76E-04	1.80E-06	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0	0	0	0	0	0	0	0
B4	0.00E+00	9.35E+01	7.85E-01	7.68E-03	0.00E+00	6.22E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.29E-07	1.24E-09	0.00E+00	4.08E+00	0.00E+00	0.00E+00
C3	3.40E-02	0.00E+00	7.22E-05	1.04E-07	0.00E+00	4.08E+00	0.00E+00	0.00E+00
C4	3.40E-02	0.00E+00	1.35E-06	8.67E-09	0.00E+00	4.08E+00	0.00E+00	0.00E+00
Total	3.38E-03	3.26E+01	1.95E-03	2.01E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	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
A5	0.00E+00	0.00E+00	0.00E+00	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0	0	0
B2	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
B3	0	0	0	0	0	0	0	0	0	0
B4	0.00E+00	0.00E+00	1.23E+00	1.23E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0	0	0
B6-B7	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
C1	0	0	0	0	0	0	0	0	0	0
C2	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
C3	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
C4	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
Total	0.00E+00	0.00E+00	8.20E-01	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.10. Commercial flush valve: EcoPower® Urinal Flush Valve (TEU2UAR)

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-4.58E+01	1.28E+02	8.25E+01	8.14E+02	7.65E+00	8.22E+02	0	0	0.00E+00	0.00E+00	1.98E-04	8.02E+02
A4	-1.38E+01	1.38E+01	1.75E-02	6.72E+00	1.49E+00	8.21E+00	0	0	0.00E+00	0.00E+00	7.20E-04	8.10E+00
A5	-1.38E+01	1.38E+01	2.56E-03	-1.36E+00	1.49E+00	1.25E-01	0	0	0.00E+00	0.00E+00	1.04E-02	1.10E-01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	9.55E-01	1.38E+01	1.47E+01	2.03E+02	1.49E+00	2.05E+02	0	0	0.00E+00	0.00E+00	1.70E-04	1.89E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	3.82E+03	3.41E+02	4.16E+03	6.10E+04	2.26E+01	6.11E+04	0	0	0.00E+00	0.00E+00	2.35E-02	4.70E+04
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	4.97E+02	0.00E+00	4.97E+02	7.72E+03	0.00E+00	7.72E+03	0	0	0.00E+00	0.00E+00	1.09E-02	4.11E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-1.22E+01	1.22E+01	7.23E-04	-8.65E-01	1.49E+00	6.20E-01	0	0	0.00E+00	0.00E+00	4.38E-04	6.19E-01
C3	-3.11E+01	3.17E+01	6.28E-01	3.29E+00	0.00E+00	3.29E+00	0	0	0.00E+00	0.00E+00	1.61E-02	3.03E+00
C4	-1.38E+01	1.38E+01	1.17E-02	-1.01E+00	1.49E+00	4.74E-01	0	0	0.00E+00	0.00E+00	1.00E-03	4.11E-01
Total	-7.34E+01	1.56E+02	8.25E+01	8.19E+02	1.06E+01	8.30E+02	0	0	0.00E+00	0.00E+00	1.14E-02	8.10E+02

TOTO

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	2.00E-03	2.02E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	1.60E-06	1.53E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	2.36E-07	2.06E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	7.76E-04	1.80E-06	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0	0	0	0	0	0	0	0
B4	0.00E+00	9.35E+01	1.21E-01	1.92E-03	0.00E+00	6.13E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	6.57E-07	6.20E-11	0.00E+00	3.87E+00	0.00E+00	0.00E+00
C3	3.40E-02	0.00E+00	7.19E-05	1.01E-07	0.00E+00	3.87E+00	0.00E+00	0.00E+00
C4	3.40E-02	0.00E+00	1.33E-06	8.57E-09	0.00E+00	3.87E+00	0.00E+00	0.00E+00
Total	3.38E-03	3.26E+01	2.00E-03	2.03E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	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
A5	0.00E+00	0.00E+00	0.00E+00	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0	0	0
B2	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
B3	0	0	0	0	0	0	0	0	0	0
B4	0.00E+00	0.00E+00	1.23E+00	1.23E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0	0	0
B6-B7	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
C1	0	0	0	0	0	0	0	0	0	0
C2	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
C3	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
C4	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
Total	0.00E+00	0.00E+00	8.20E-01	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.11. Commercial flush valve: EcoPower® Toilet Flush Valve (TET1(6)UB(X))

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-3.46E+01	1.28E+02	9.37E+01	1.03E+03	7.65E+00	1.04E+03	0	0	0.00E+00	0.00E+00	1.95E-04	1.01E+03
A4	-1.26E+01	1.27E+01	1.89E-02	7.38E+00	1.49E+00	8.86E+00	0	0	0.00E+00	0.00E+00	7.78E-04	8.74E+00
A5	-1.27E+01	1.27E+01	2.76E-03	-1.35E+00	1.49E+00	1.37E-01	0	0	0.00E+00	0.00E+00	1.05E-02	1.21E-01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	2.09E+00	1.27E+01	1.47E+01	2.03E+02	1.49E+00	2.05E+02	0	0	0.00E+00	0.00E+00	1.70E-04	1.89E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	3.93E+04	3.34E+02	3.96E+04	6.15E+05	2.26E+01	6.15E+05	0	0	0.00E+00	0.00E+00	1.09E-02	4.47E+05
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	5.96E+03	0.00E+00	5.96E+03	9.27E+04	0.00E+00	9.27E+04	0	0	0.00E+00	0.00E+00	1.09E-02	4.99E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-1.19E+01	1.19E+01	1.34E-03	-8.57E-01	1.49E+00	6.28E-01	0	0	0.00E+00	0.00E+00	5.51E-05	6.19E-01
C3	-3.15E+01	3.15E+01	1.41E-02	2.58E+00	0.00E+00	2.58E+00	0	0	0.00E+00	0.00E+00	1.02E-02	2.50E+00
C4	-1.26E+01	1.27E+01	1.40E-02	-9.09E-01	1.49E+00	5.76E-01	0	0	0.00E+00	0.00E+00	1.11E-03	4.99E-01
Total	-5.99E+01	1.54E+02	9.37E+01	1.03E+03	1.06E+01	1.04E+03	0	0	0.00E+00	0.00E+00	1.14E-02	1.02E+03

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	2.42E-03	2.70E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	1.72E-06	1.65E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	2.56E-07	2.22E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	7.76E-04	1.80E-06	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0	0	0	0	0	0	0	0
B4	0.00E+00	9.35E+01	2.10E+00	2.29E-02	0.00E+00	6.59E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.22E-07	1.17E-09	0.00E+00	4.90E+00	0.00E+00	0.00E+00
C3	3.40E-02	0.00E+00	1.38E-06	1.09E-08	0.00E+00	4.90E+00	0.00E+00	0.00E+00
C4	3.40E-02	0.00E+00	1.59E-06	1.04E-08	0.00E+00	4.90E+00	0.00E+00	0.00E+00
Total	3.38E-03	3.26E+01	2.42E-03	2.72E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	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
A5	0.00E+00	0.00E+00	0.00E+00	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0	0	0
B2	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
B3	0	0	0	0	0	0	0	0	0	0
B4	0.00E+00	0.00E+00	1.11E+00	1.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0	0	0
B6-B7	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
C1	0	0	0	0	0	0	0	0	0	0
C2	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
C3	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
C4	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
Total	0.00E+00	0.00E+00	7.40E-01	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.12. Commercial flush valve: EcoPower® Toilet Flush Valve (TET1(6)LB(X))

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-3.46E+01	1.28E+02	9.37E+01	1.03E+03	7.65E+00	1.04E+03	0	0	0.00E+00	0.00E+00	1.95E-04	1.01E+03
A4	-1.26E+01	1.27E+01	1.89E-02	7.38E+00	1.49E+00	8.86E+00	0	0	0.00E+00	0.00E+00	7.78E-04	8.74E+00
A5	-1.27E+01	1.27E+01	2.76E-03	-1.35E+00	1.49E+00	1.37E-01	0	0	0.00E+00	0.00E+00	1.05E-02	1.21E-01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	2.09E+00	1.27E+01	1.47E+01	2.03E+02	1.49E+00	2.05E+02	0	0	0.00E+00	0.00E+00	1.70E-04	1.89E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	5.01E+04	3.34E+02	5.05E+04	7.84E+05	2.26E+01	7.84E+05	0	0	0.00E+00	0.00E+00	9.69E-03	5.69E+05
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	7.63E+03	0.00E+00	7.63E+03	1.19E+05	0.00E+00	1.19E+05	0	0	0.00E+00	0.00E+00	1.09E-02	4.99E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-1.19E+01	1.19E+01	1.34E-03	-8.57E-01	1.49E+00	6.28E-01	0	0	0.00E+00	0.00E+00	5.51E-05	6.19E-01
C3	-3.15E+01	3.15E+01	1.41E-02	2.58E+00	0.00E+00	2.58E+00	0	0	0.00E+00	0.00E+00	1.02E-02	2.50E+00
C4	-1.26E+01	1.27E+01	1.40E-02	-9.09E-01	1.49E+00	5.76E-01	0	0	0.00E+00	0.00E+00	1.11E-03	4.99E-01
Total	-5.99E+01	1.54E+02	9.37E+01	1.03E+03	1.06E+01	1.04E+03	0	0	0.00E+00	0.00E+00	1.14E-02	1.02E+03

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	2.42E-03	2.70E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	1.72E-06	1.65E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	2.56E-07	2.22E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	7.76E-04	1.80E-06	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0	0	0	0	0	0	0	0
B4	0.00E+00	9.35E+01	2.83E+00	2.94E-02	0.00E+00	6.59E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.22E-07	1.17E-09	0.00E+00	4.90E+00	0.00E+00	0.00E+00
C3	3.40E-02	0.00E+00	1.38E-06	1.09E-08	0.00E+00	4.90E+00	0.00E+00	0.00E+00
C4	3.40E-02	0.00E+00	1.59E-06	1.04E-08	0.00E+00	4.90E+00	0.00E+00	0.00E+00
Total	3.38E-03	3.26E+01	2.42E-03	2.72E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	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
A5	0.00E+00	0.00E+00	0.00E+00	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0	0	0
B2	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
B3	0	0	0	0	0	0	0	0	0	0
B4	0.00E+00	0.00E+00	1.11E+00	1.11E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0	0	0
B6-B7	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
C1	0	0	0	0	0	0	0	0	0	0
C2	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
C3	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
C4	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
Total	0.00E+00	0.00E+00	7.40E-01	7.40E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.13. Commercial flush valve: EcoPower® Toilet Flush Valve (TET2UB(X))

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-4.10E+01	1.28E+02	8.73E+01	8.12E+02	7.65E+00	8.20E+02	0	0	0.00E+00	0.00E+00	2.08E-04	7.99E+02
A4	-1.38E+01	1.38E+01	1.84E-02	7.17E+00	1.49E+00	8.66E+00	0	0	0.00E+00	0.00E+00	7.60E-04	8.54E+00
A5	-1.38E+01	1.38E+01	2.56E-03	-1.36E+00	1.49E+00	1.25E-01	0	0	0.00E+00	0.00E+00	9.47E-04	1.10E-01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	9.55E-01	1.38E+01	1.47E+01	2.03E+02	1.49E+00	2.05E+02	0	0	0.00E+00	0.00E+00	1.70E-04	1.89E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	3.94E+04	3.41E+02	3.98E+04	6.13E+05	2.26E+01	6.13E+05	0	0	0.00E+00	0.00E+00	2.36E-02	4.45E+05
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	5.96E+03	0.00E+00	5.96E+03	9.27E+04	0.00E+00	9.27E+04	0	0	0.00E+00	0.00E+00	1.09E-02	4.35E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-1.22E+01	1.22E+01	1.41E-03	-8.21E-01	1.49E+00	6.64E-01	0	0	0.00E+00	0.00E+00	5.83E-05	6.55E-01
C3	-3.11E+01	3.17E+01	6.30E-01	3.25E+00	0.00E+00	3.25E+00	0	0	0.00E+00	0.00E+00	1.52E-02	2.97E+00
C4	-1.38E+01	1.38E+01	1.19E-02	-9.86E-01	1.49E+00	4.99E-01	0	0	0.00E+00	0.00E+00	1.04E-03	4.35E-01
Total	-6.85E+01	1.56E+02	8.74E+01	8.18E+02	1.06E+01	8.29E+02	0	0	0.00E+00	0.00E+00	1.92E-03	8.08E+02

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	1.95E-03	1.99E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	1.68E-06	1.61E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	2.36E-07	2.06E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	7.76E-04	1.80E-06	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0	0	0	0	0	0	0	0
B4	0.00E+00	9.35E+01	2.53E+00	2.30E-02	0.00E+00	6.22E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.29E-07	1.24E-09	0.00E+00	4.08E+00	0.00E+00	0.00E+00
C3	3.40E-02	0.00E+00	7.22E-05	1.04E-07	0.00E+00	4.08E+00	0.00E+00	0.00E+00
C4	3.40E-02	0.00E+00	1.35E-06	8.67E-09	0.00E+00	4.08E+00	0.00E+00	0.00E+00
Total	3.38E-03	3.26E+01	1.95E-03	2.01E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	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
A5	0.00E+00	0.00E+00	0.00E+00	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0	0	0
B2	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
B3	0	0	0	0	0	0	0	0	0	0
B4	0.00E+00	0.00E+00	1.23E+00	1.23E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0	0	0
B6-B7	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
C1	0	0	0	0	0	0	0	0	0	0
C2	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
C3	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
C4	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
Total	0.00E+00	0.00E+00	8.20E-01	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

4.3.14. Commercial flush valve: EcoPower® Toilet Flush Valve (TET2LB(X))

Resource use indicators

Parameter	RPRe	RPRm	RPRt	NRPRe	NRPRm	NRPRt	SM	RSF	NRSF	RE	FW	ADPf
Unit	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	MJ, LHV	kg	MJ, LHV	MJ, LHV	MJ, LHV	m3	MJ
A1-A3	-4.10E+01	1.28E+02	8.73E+01	8.12E+02	7.65E+00	8.20E+02	0	0	0.00E+00	0.00E+00	2.08E-04	7.99E+02
A4	-1.38E+01	1.38E+01	1.84E-02	7.17E+00	1.49E+00	8.66E+00	0	0	0.00E+00	0.00E+00	7.60E-04	8.54E+00
A5	-1.38E+01	1.38E+01	2.56E-03	-1.36E+00	1.49E+00	1.25E-01	0	0	0.00E+00	0.00E+00	1.04E-02	1.10E-01
B1	0	0	0	0	0	0	0	0	0	0	0	0
B2	9.55E-01	1.38E+01	1.47E+01	2.03E+02	1.49E+00	2.05E+02	0	0	0.00E+00	0.00E+00	1.70E-04	1.89E+02
B3	0	0	0	0	0	0	0	0	0	0	0	0
B4	5.03E+04	3.41E+02	5.06E+04	7.82E+05	2.26E+01	7.82E+05	0	0	0.00E+00	0.00E+00	2.36E-02	5.67E+05
B5	0	0	0	0	0	0	0	0	0	0	0	0
B6-B7	7.63E+03	0.00E+00	7.63E+03	1.19E+05	0.00E+00	1.19E+05	0	0	0.00E+00	0.00E+00	9.02E-03	4.35E-01
C1	0	0	0	0	0	0	0	0	0	0	0	0
C2	-1.22E+01	1.22E+01	1.41E-03	-8.21E-01	1.49E+00	6.64E-01	0	0	0.00E+00	0.00E+00	5.83E-05	6.55E-01
C3	-3.11E+01	3.17E+01	6.30E-01	3.25E+00	0.00E+00	3.25E+00	0	0	0.00E+00	0.00E+00	1.52E-02	2.97E+00
C4	-1.38E+01	1.38E+01	1.19E-02	-9.86E-01	1.49E+00	4.99E-01	0	0	0.00E+00	0.00E+00	1.04E-03	4.35E-01
Total	-6.85E+01	1.56E+02	8.74E+01	8.18E+02	1.06E+01	8.29E+02	0	0	0.00E+00	0.00E+00	1.14E-02	8.08E+02

Output flows and waste category indicators

Parameter	HWD	NHWD	HLRW	ILLRW	CRU	MR	MER	EE
Unit	kg	kg	kg	kg	kg	kg	kg	MJ, LHV
A1-A3	3.38E-03	2.99E+01	1.95E-03	1.99E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	0.00E+00	1.20E+00	1.68E-06	1.61E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A5	0.00E+00	1.43E+00	2.36E-07	2.06E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0
B2	0.00E+00	2.93E+01	7.76E-04	1.80E-06	0.00E+00	2.93E+01	0.00E+00	0.00E+00
B3	0	0	0	0	0	0	0	0
B4	0.00E+00	9.35E+01	3.27E+00	2.95E-02	0.00E+00	6.22E+01	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	0	0	0	0	0	0	0	0
C2	0.00E+00	5.40E-01	1.29E-07	1.24E-09	0.00E+00	4.08E+00	0.00E+00	0.00E+00
C3	3.40E-02	0.00E+00	7.22E-05	1.04E-07	0.00E+00	4.08E+00	0.00E+00	0.00E+00
C4	3.40E-02	0.00E+00	1.35E-06	8.67E-09	0.00E+00	4.08E+00	0.00E+00	0.00E+00
Total	3.38E-03	3.26E+01	1.95E-03	2.01E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Carbon emissions and removals

Parameter	BCRP	BCEP	BCRK	BCEK	BCEW	CCE	CCR	CWNR	CCR	CWNR
Unit	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2	kg CO2
A1-A3	0.00E+00	0.00E+00	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
A4	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
A5	0.00E+00	0.00E+00	0.00E+00	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	0	0	0	0	0	0	0	0	0	0
B2	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
B3	0	0	0	0	0	0	0	0	0	0
B4	0.00E+00	0.00E+00	1.23E+00	1.23E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	0	0	0	0	0	0	0	0	0	0
B6-B7	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
C1	0	0	0	0	0	0	0	0	0	0
C2	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
C3	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
C4	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
Total	0.00E+00	0.00E+00	8.20E-01	8.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

- [RPRE - Renewable primary energy used as energy carrier (fuel)];
- [RPRM - Renewable primary resources with energy content used as material];
- [NRPRE - Non-renewable primary resources used as an energy carrier (fuel)];
- [NRPRM - Non-renewable primary resources with energy content used as material];
- [SM - Secondary materials];
- [RSF - Renewable secondary fuels];
- [NRSF - Non-renewable secondary fuels];
- [RE - Recovered energy];
- [FW - Use of net fresh water resources]
- [HWD - Hazardous waste disposed];
- [NHWD - Non-hazardous waste disposed];
- [HLRW - High-level radioactive waste, conditioned, to final repository];
- [ILLRW - Intermediate- and low-level radioactive waste, conditioned, to final repository];
- [CRU - Components for re-use];
- [MR - Materials for recycling];
- [MER - Materials for energy recovery];
- [EE - Exported energy];
- [BCRP - Biogenic Carbon Removal from Product];
- [BCEP - Biogenic Carbon Emission from Product];
- [BCRK - Biogenic Carbon Removal from Packaging];
- [BCEK - Biogenic Carbon Emission from Packaging];
- [BCEW - Biogenic Carbon Emission from Combustion of Waste from Renewable Sources Used in Production Processes];
- [CCE - Calcination Carbon Emissions];
- [CCR - Carbonation Carbon Removals];
- [CWNR - Carbon Emissions from Combustion of Waste from Non-Renewable Sources used in Production Processes]
- [ADPf - Abiotic Depletion Potential, fossil]

5 INTERPRETATION

This chapter includes the results from the LCA for all the products studied. It details the results per product, outlines the sensitivity analyses and concludes with recommendations.

5.1 Residential toilets: Drake® II 1.28gpf (CST454CEFG) and Drake® II 1G® (CST454CUFG)

This section includes the weighted averaged results based on production volumes.

Cradle-to-gate

Figure 4 shows the results for the finished product. It shows that the ceramic parts, dominate the material contribution except for non-carcinogenics and eutrophication where zinc and stainless steel parts together with corrugated board and turning brass process have major contributions to these three categories. Injection molding process has significant contribution to the ozone depletion impact category. The other parts and processes contribute between 2% and 11% of the overall impacts in the remaining categories.

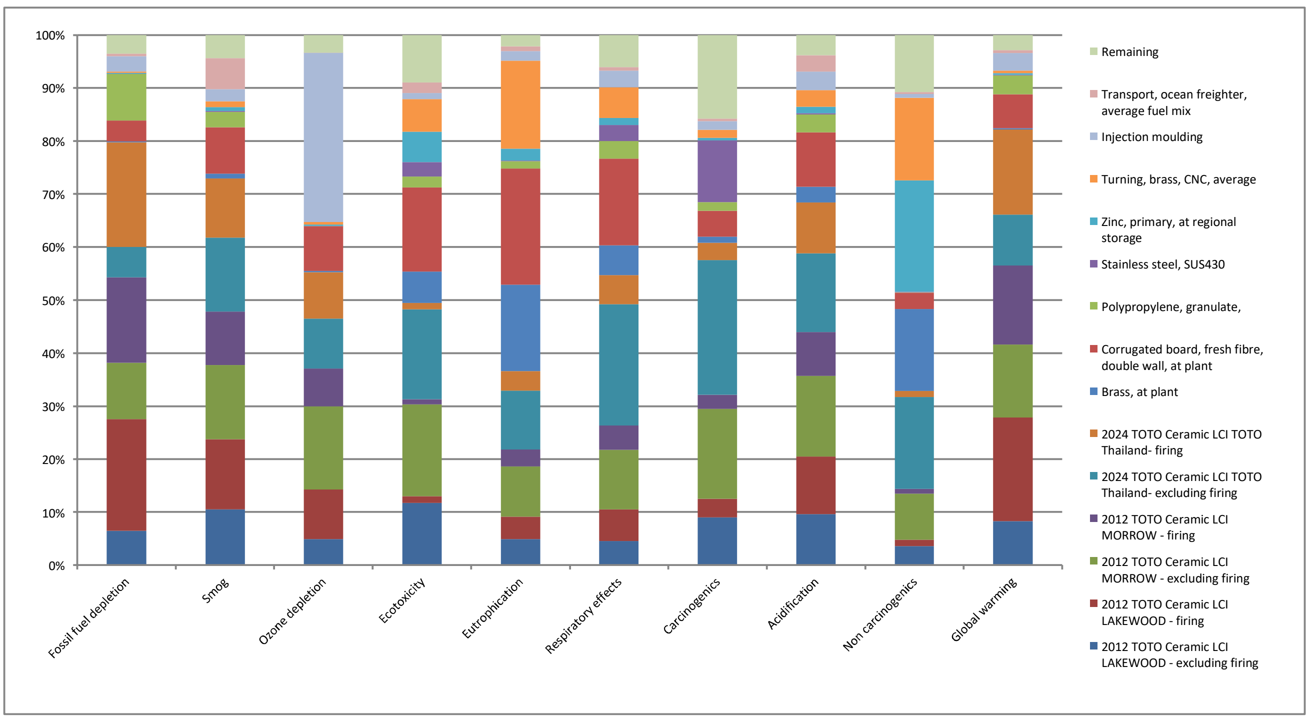


Figure 4. Cradle-to-gate impacts for average of CST454CEFG and CST454CUFG– relative results

Variations

The variation in the bill of materials is presented in Table 5.1a. It shows some similarities and some differences. Drake CST454CEFG has significantly less materials consisting of ABS, PET, PVC, Silicone and Stainless steel and their associated manufacturing processes than Drake CST454CUFG.

Table 5.1a Variations in the bill of materials for of CST454CEFG and CST454CUFG

Material	Average (kg)
Ceramic	38.56
ABS	0.04
Brass	0.09
Corrugated Board	6.93
EPDM	0.07
PET	0
POM	0.03
PP	2.19
PVC	0.06
Silicone	0
Stainless Steel	0.01
SUS430	0.09
Zinc	0.1

Numbers shown in orange have a variation of 10 to 20%
Numbers shown in red have a variation greater than 20%

Full life cycle

Figures 5-6 and Tables 5.1b-c show the results for the full life cycle of the product. They show that the use phase [B1-B7] and the product stage [A1-A3] are equally important and dominate the results for all impact categories. The impact of the use stage is mostly due to the embedded energy use (such as electricity) in the water used during the operation of the product (40-60%) [B6-B7]. [B4], replacement module, during 75 years of building's life, has the most significant contributions to all categories, followed by A1-A3, which contributes fossil fuel depletion (mostly defined by crude oil, hard coal, and natural gas extraction activities as well as polypropylene production and processing), non-carcinogenics (mostly defined by zinc production and processing as well as the natural gas used at the kiln and the disposal of hard coal ash) and ecotoxicity (mainly caused by electricity production using natural gas and crude oil as well as the disposal of slags and hard coal ash). The contribution of the delivery and installation of the product [A4-A5] which are covered under the construction stage is associated with the transportation for delivery to the market and the disposal of packaging materials which are mainly corrugated cardboard. The impact from repair [B3], replacement of Trip lever handle, Flapper seal and Fill valve seal over 75 years, varies from 0.1 to 4.1 % in different categories.

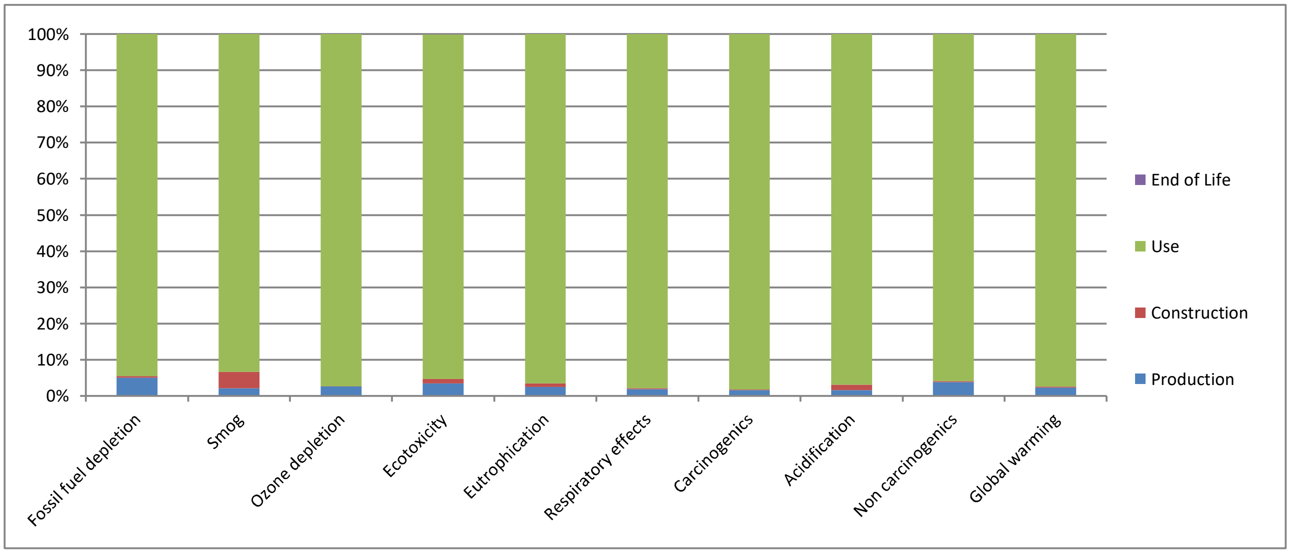


Figure 5. LCIA results for Drake HET– relative results

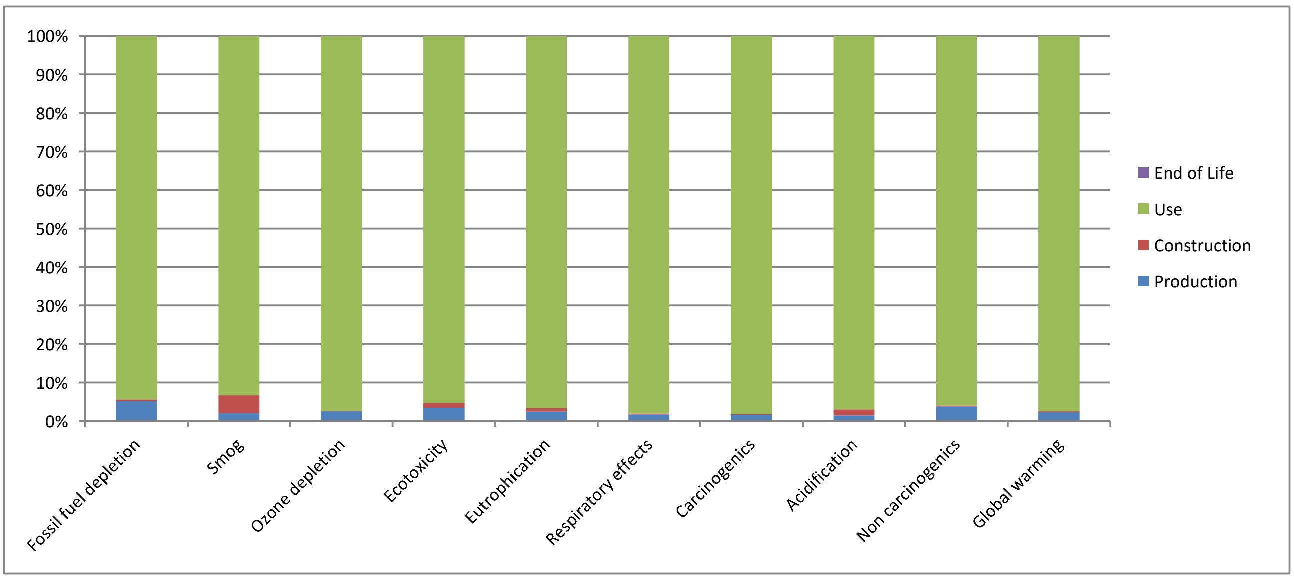


Figure 6. LCIA results for Drake 1G– relative results

The results above shall reflect the production data in both plants and transportation distance from the multiple suppliers for each mode of transport used, while different impact in use phase is because of difference flush volume of Drake® II 1.28 gallon/flush (CST454CEFG) and Drake® II 1gallon/flush (CST454CUFG)

Table 5.1b LCIA results for Drake HET (CST454CEFG)

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	6.07E+00	6.08E-06	7.63E-02	2.94E-02	3.85E-01	1.18E+02
A4	4.07E+00	1.67E-08	8.03E-03	2.26E-03	1.38E-01	1.06E+01
A5	1.01E+01	1.19E-07	2.23E-02	3.05E-03	2.85E-01	3.06E+00
B1	0	0	0	0	0	0
B2	1.70E-01	2.23E-07	2.18E-03	1.68E-03	1.95E-02	3.51E+00
B3	1.22E-01	1.77E-07	1.19E-02	2.05E-03	1.64E-02	1.46E+00
B4	2.69E+02	2.23E-04	2.89E+00	1.63E+00	2.47E+01	4.86E+03
B5	0	0	0	0	0	0
B6-B7	7.15E+01	6.86E-05	8.61E-01	5.29E-01	7.79E+00	1.52E+03
C1	0	0	0	0	0	0
C2	9.82E-02	1.08E-09	2.22E-04	5.32E-05	3.41E-03	6.16E-01
C3	7.54E-03	5.27E-09	1.22E-03	5.35E-05	4.75E-04	7.97E-01
C4	6.82E-02	1.24E-07	3.58E-04	2.54E-04	2.42E-03	5.30E-01
Total	3.61E+02	2.98E-04	3.87E+00	2.20E+00	3.34E+01	6.52E+03

Table 5.1c LCIA results for Drake 1G (CST454CUFG)

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	6.07E+00	6.08E-06	7.63E-02	2.94E-02	3.85E-01	1.18E+02
A4	4.07E+00	1.67E-08	8.03E-03	2.26E-03	1.38E-01	1.06E+01
A5	1.01E+01	1.19E-07	2.23E-02	3.05E-03	2.85E-01	3.06E+00
B1	0	0	0	0	0	0
B2	1.70E-01	2.23E-07	2.18E-03	1.68E-03	1.95E-02	3.51E+00
B3	1.22E-01	1.77E-07	1.19E-02	2.05E-03	1.64E-02	1.46E+00
B4	2.26E+02	1.82E-04	2.37E+00	1.31E+00	2.00E+01	3.95E+03
B5	0	0	0	0	0	0
B6-B7	5.59E+01	5.36E-05	6.73E-01	4.13E-01	6.08E+00	1.18E+03
C1	0	0	0	0	0	0
C2	9.82E-02	1.08E-09	2.22E-04	5.32E-05	3.41E-03	6.16E-01
C3	7.54E-03	5.27E-09	1.22E-03	5.35E-05	4.75E-04	7.97E-01
C4	6.82E-02	1.24E-07	3.58E-04	2.54E-04	2.42E-03	5.30E-01
Total	3.02E+02	2.42E-04	3.17E+00	1.76E+00	2.70E+01	5.28E+03

Variations

Deviations among the tables are throughout and that is mainly because Drake® II 1.28 gallon per flush (CST454CEFG) and Drake® II 1.0 gallon per flush (CST454CUFG) is mainly due to the differences in the use phase in that Drake CST454CUFG consumes approximately 22% less water during their life cycle. There is no deviation in the production due to the same the same raw material suppliers, the same yields and the same manufacturing plants, which also result in no deviation at the construction phase due to the same distance from each factory to the port of Savannah, Georgia for the toilet bowls made in TOTO Thailand and others made in Morrow and Lakewood in the state of Georgia. The firing yield and production yields are the same as shown in the table.

SM results

The SM millipoint scores per functional unit by life cycle phase for this product is presented below (Tables 5.1d-e). They confirm the trends in the results using the impact assessment results prior to normalization and weighting.

Table 5.1d SM millipoint scores for Drake HET (CST454CEFG) by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	480	8.88	1.71	470	0.11

Table 5.1e SM millipoint scores for Drake 1G (CST454CUFG) by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	390	8.88	1.71	380	0.11

Additional LCIA impact categories are reported as additional environmental information.

Table 5.1f: Additional Environmental Information: Drake HET

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	2.27E+02	7.42E+01	1.67E-06	2.02E-05
A4	1.88E+01	2.62E+01	1.46E-07	1.37E-06
A5	1.56E+00	1.64E+00	1.06E-08	1.01E-07
B1	0	0	0	0
B2	1.02E+01	1.72E+00	7.15E-08	7.01E-07
B3	2.88E+00	1.03E+01	6.65E-08	8.43E-06
B4	3.98E+03	1.96E+03	9.61E-05	4.91E-04
B5	0	0	0	0
B6-B7	9.63E+02	5.28E+02	3.15E-05	1.29E-04
C1	0	0	0	0
C2	1.09E+00	1.52E+00	8.52E-09	7.95E-08
C3	5.72E-02	3.70E-02	1.17E-09	8.69E-09
C4	1.14E+00	3.63E-01	3.58E-09	1.91E-08
Total	5.20E+03	2.61E+03	1.30E-04	6.50E-04

Table 5.1g: Additional Environmental Information: Drake 1G

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	2.27E+02	7.42E+01	1.67E-06	2.02E-05
A4	1.88E+01	2.62E+01	1.46E-07	1.37E-06
A5	1.56E+00	1.64E+00	1.06E-08	1.01E-07
B1	0	0	0	0
B2	1.02E+01	1.72E+00	7.15E-08	7.01E-07
B3	2.88E+00	1.03E+01	6.65E-08	8.43E-06
B4	3.40E+03	1.65E+03	7.72E-05	4.13E-04
B5	0	0	0	0
B6-B7	7.52E+02	4.12E+02	2.46E-05	1.00E-04
C1	0	0	0	0
C2	1.09E+00	1.52E+00	8.52E-09	7.95E-08
C3	5.72E-02	3.70E-02	1.17E-09	8.69E-09
C4	1.14E+00	3.63E-01	3.58E-09	1.91E-08
Total	4.41E+03	2.17E+03	1.04E-04	5.45E-04

5.2 Residential toilets: Eco Ultramax® 1.28gpf (MS854114E), Ultramax II 1G® (MS604124CUFG) and Ultramax® II 1.28gpf (MS604124CEFG)

This section includes the weighted averaged results based on production volumes of MS854114E, MS604124CUFG & MS604124CEFG.

Cradle-to-gate

Figures 7-8 illustrate the results per functional unit for the finished products, MS604124CUFG & MS604124CEFG, manufactured in the same plants, TOTO USA's Morrow, Georgia and TOTO Thailand, while Figure 5.2a illustrates the results per functional unit for the finished product, Eco Ultramax, MS854114E, manufactured in TOTO Mexico. It shows that the ceramic parts dominate the material contribution except for eutrophication where corrugated board and brass parts also have major contributions. Injection molding and turning brass processes have significant contribution to the ozone depletion impact category while zinc parts have significant contribution to the non-carcinogenics. The other parts and processes contribute between 1% and 19% of the overall impacts in the remaining categories.

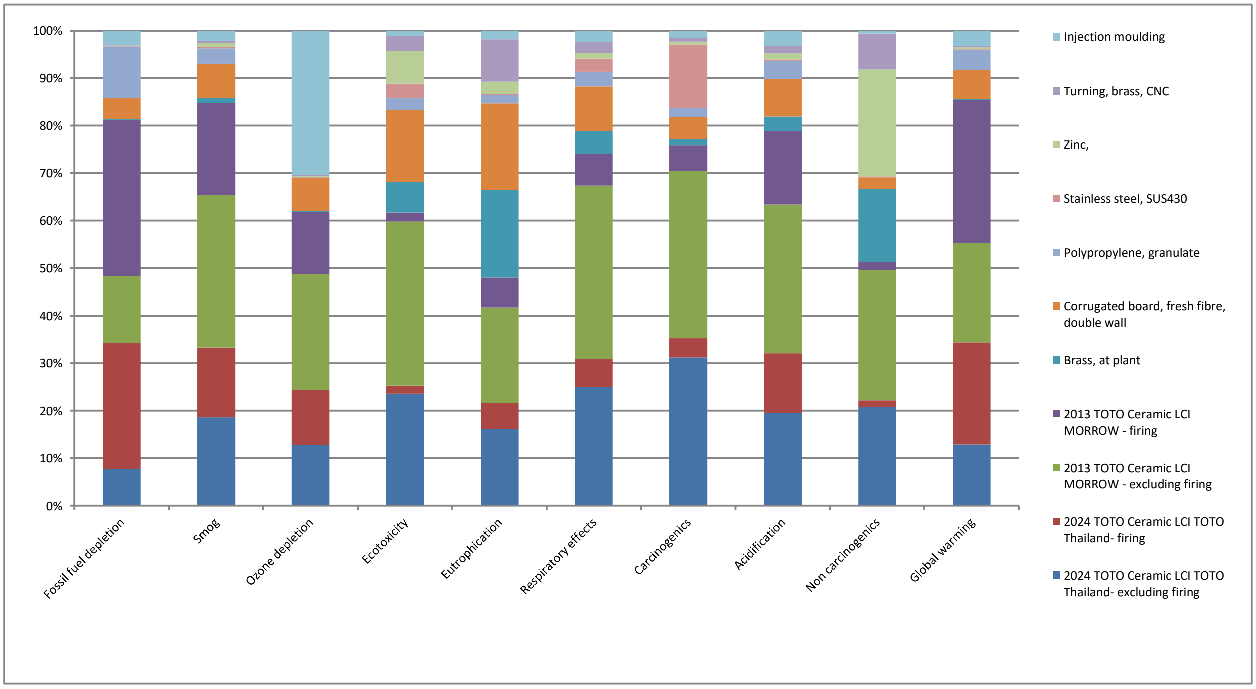


Figure 7. Cradle-to-gate impacts for average of MS604124CUFG & MS604124CEFG – relative results

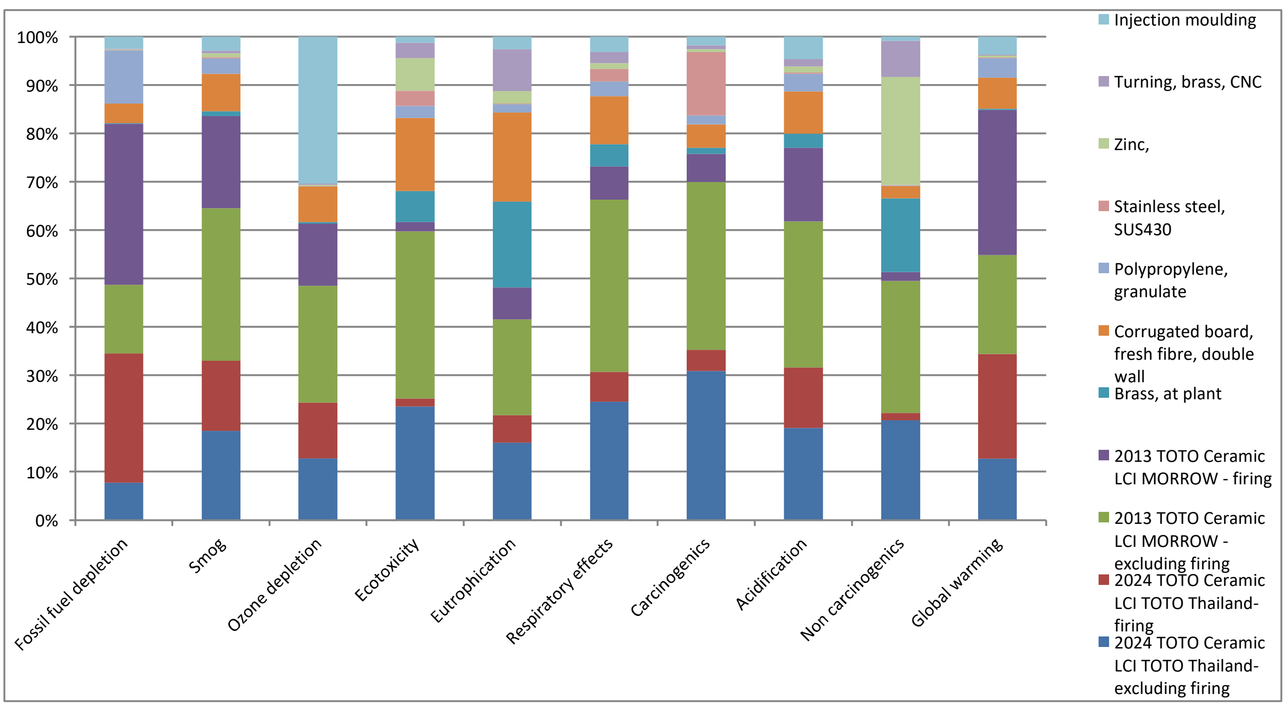


Figure 8. Cradle-to-gate impacts for Eco Ultramax MS854114E – relative results

Variations

The variation in the bill of materials is presented in Table 5.2a below. It shows extreme similarities, but there are some differences. The major driver of variation is the ceramic component of the two products in that Ultramax MS604124CEFG & MS604124CUFG uses 38.00kg compared to Eco Ultramax MS854114E which only uses 30.36kg.

Table 5.2a Variations in the bill of materials for of Ultramax MS854 & Ultramax CST604

Material	**Average (kg)**
Ceramic	37.19
Brass	0.10
Corrugated Board	4.45
POM	0.04
PP	2.20
PVC	0.05
SUS430	0.09
Zinc	0.10

Numbers shown in orange have a variation of 10 to 20%
Numbers shown in red have a variation greater than 20%

Full life cycle

Figures 9-11 show the results per functional unit for the full life cycle of the product. While the product itself [A1-A3] is significant in all impact categories, the use phase, which includes the 2.75 replacements [B4] to meet the 75-year estimated service life (ESL), is highly dominating in all categories. It shows that the use phase [B1-B7] and the product stage [A1-A3] are equally important and dominate the results for all impact categories. The impact of the use stage is mostly due to the embedded energy use (such as electricity) in the water used during the operation of the product [B6-B7]. B4, replacement module, during 75 years of building's life, has the most significant contributions to all categories, followed by A1-A3, which contributes fossil fuel depletion fossil fuel depletion (mostly defined by crude oil, hard coal, and natural gas extraction activities as well as polypropylene manufacturing), non-carcinogenics (mostly defined by zinc production and processing as well as the natural gas used at the kiln and the disposal of hard coal ash) and ecotoxicity (mainly caused by electricity production using natural gas and crude oil as well as the disposal of slags and hard coal ash and zinc and copper production and processing). The impacts for the product itself [A1-A3] are discussed above in the cradle-to-gate section. The installation of the product [A5] is associated with the disposal of packaging materials which are mainly cardboard shows up relevant in almost all of the impact categories. Additionally, the delivery and the processes for dismantling and final waste treatment [C1-C4] of the product show up slightly relevant in the majority of the impact categories. The impact from repair [B3], replacement of Trip lever handle, Flapper seal and Fill valve seal over 75 years, varies from 0.1 to 4.1 % in different categories.

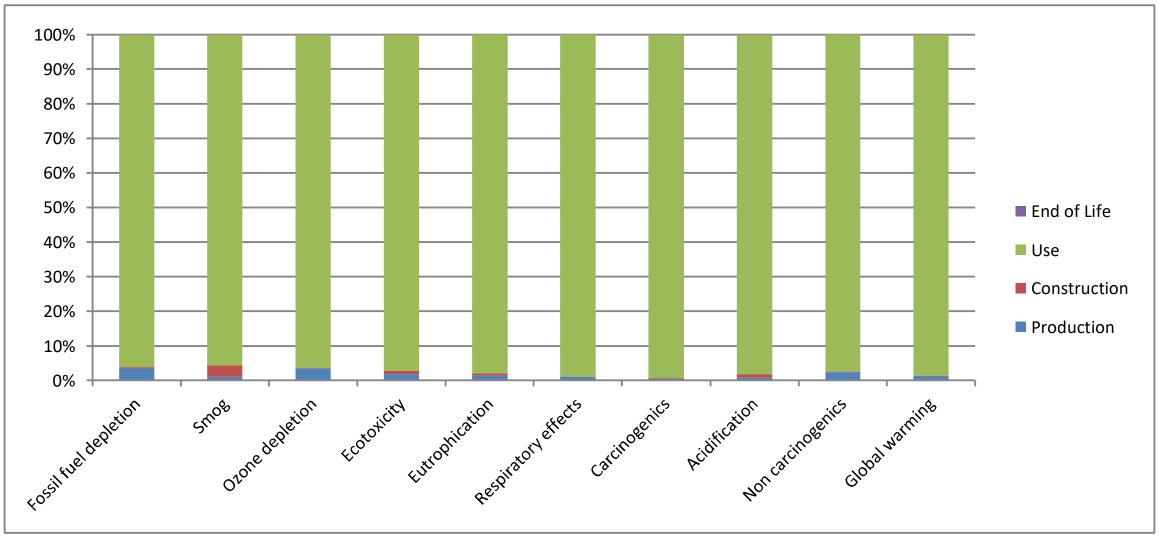


Figure 9. LCIA results for Eco-Ultramax (MS854114E) -- relative results

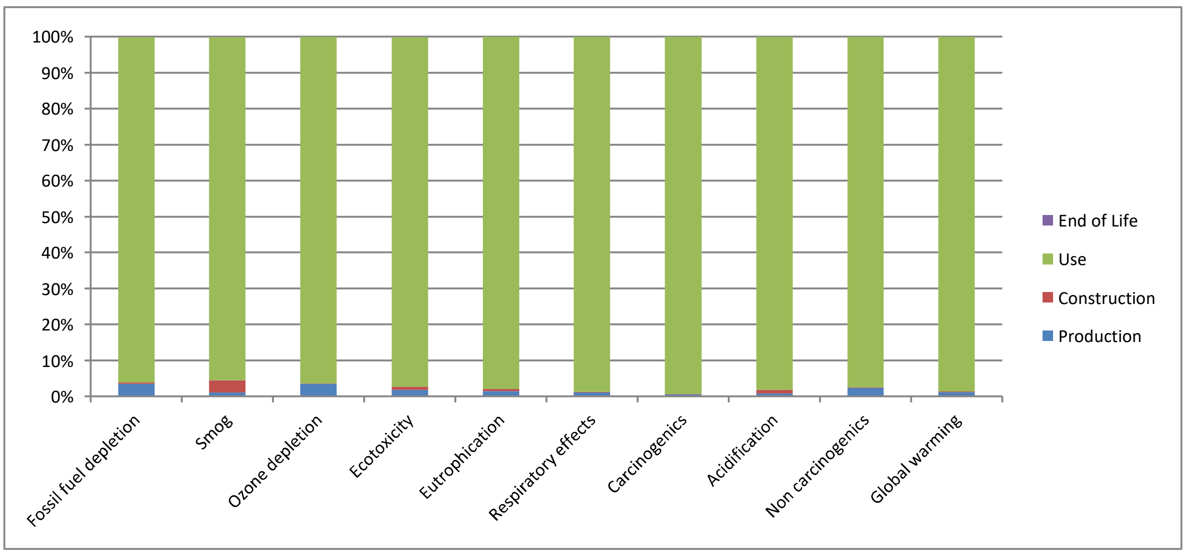


Figure 10. LCIA results for Ultramax HET (MS604124CEFG) -- relative results

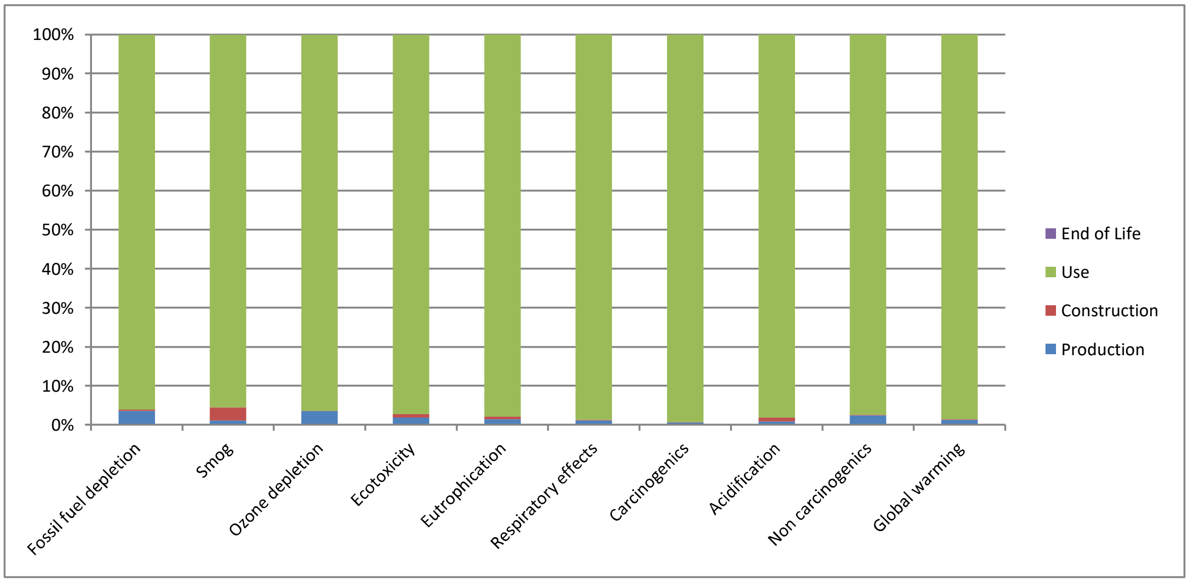


Figure 11. LCIA results for Ultramax 1G (MS604124CUFG) -- relative results

Variations

The variation in the bill of materials is presented in Table 5.2b. It shows extreme similarities, but it also shows one very significant difference. The major driver of variation is the different weight of the ceramic component of the products. The deviations at the production phase are due to differences in firing yield and the percentage of products manufactured in different countries as presented in Table 5.2c below. The deviations at the construction phase and end of life phase are mainly due to the different distance from the manufacturing plant to the port of Savannah, Georgia and the weight difference of the finished product after packaging, which is driven by the difference in the mass of the ceramic component in the products. Impact results among the 3 products will be, therefore, presented individually.

Table 5.2b Variations in the bill of materials for of MS854114E, MS604124CUFG & MS604124CEFG

Material	**Average (kg)**
Ceramic	37.19
Brass	0.10
Corrugated Board	4.45
POM	0.04
PP	2.20
PVC	0.05
SUS430	0.09
Zinc	0.10

Numbers shown in orange have a variation of 10 to 20%
Numbers shown in red have a variation greater than 20%

Table 5.2c Variations in percentage of products, MS854114E, MS604124CUFG & MS604124CEFG, manufactured for TOTO

Descriptions	Item #s	Plants	Manufacturing % for TOTO
Eco Ultramax® 1.28gpf	MS854114E	Mexico	100%
Ultramax II 1G®	MS604124CUFG	Morrow	93%
		Thailand	7%
Ultramax® II 1.28gpf	MS604124CEFG	Morrow	25%
		Thailand	75%

The results above shall reflect the production data in three plants and transportation distance from the multiple suppliers for each mode of transport used, while difference in use phase is because of difference flush volume of Eco Ultramax® 1.28gpf (MS854114E), Ultramax II 1.0gpf (MS604124CUFG) and Ultramax® II 1.28gpf (MS604124CEFG)

Table 5.2d LCIA results for MS854114E

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	3.70E+00	1.19E-05	5.14E-02	2.24E-02	2.55E-01	7.57E+01
A4	1.36E+00	1.31E-08	3.03E-03	7.73E-04	4.72E-02	8.01E+00
A5	1.01E+01	1.16E-07	2.10E-02	3.03E-03	2.85E-01	2.21E+00
B1	0	0	0	0	0	0
B2	1.70E-01	2.23E-07	2.18E-03	1.68E-03	1.95E-02	3.51E+00
B3	1.22E-01	1.77E-07	1.19E-02	2.05E-03	1.64E-02	1.46E+00
B4	2.49E+02	2.55E-04	2.74E+00	1.59E+00	2.38E+01	4.62E+03
B5	0	0	0	0	0	0
B6-B7	7.15E+01	6.86E-05	8.61E-01	5.29E-01	7.79E+00	1.52E+03
C1	0	0	0	0	0	0
C2	8.01E-02	8.83E-10	1.81E-04	4.34E-05	2.78E-03	5.03E-01
C3	2.42E-03	1.96E-09	1.31E-05	1.62E-05	8.49E-05	1.11E-02
C4	5.89E-02	1.08E-07	2.15E-04	2.17E-04	2.07E-03	2.87E-01
Total	3.36E+02	3.37E-04	3.69E+00	2.15E+00	3.22E+01	6.23E+03

Table 5.2e LCIA results for MS604124CUFG

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	6.57E+00	6.03E-06	7.26E-02	3.68E-02	4.01E-01	1.11E+02
A4	1.50E+00	9.11E-09	3.11E-03	8.87E-04	5.13E-02	5.88E+00
A5	1.01E+01	1.20E-07	2.27E-02	3.05E-03	2.85E-01	3.31E+00
B1	0	0	0	0	0	0
B2	1.70E-01	2.23E-07	2.18E-03	1.68E-03	1.95E-02	3.51E+00
B3	1.22E-01	1.77E-07	1.19E-02	2.05E-03	1.64E-02	1.46E+00
B4	2.21E+02	1.81E-04	2.33E+00	1.35E+00	1.99E+01	3.90E+03
B5	0	0	0	0	0	0

B6-B7	5.59E+01	5.36E-05	6.73E-01	4.13E-01	6.08E+00	1.18E+03
C1	0	0	0	0	0	0
C2	9.86E-02	1.09E-09	2.23E-04	5.34E-05	3.42E-03	6.18E-01
C3	2.38E-03	1.97E-09	1.30E-05	1.63E-05	8.37E-05	1.10E-02
C4	6.02E-02	1.11E-07	2.25E-04	2.22E-04	2.11E-03	2.97E-01
Total	2.96E+02	2.42E-04	3.12E+00	1.81E+00	2.68E+01	5.21E+03

Table 5.2f LCIA results for MS604124CEFG

Parameter	**Smog**	**Ozone depletion**	**Eutrophication**	**Acidification**	**Respiratory effects**	**Global warming**
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	5.68E+00	5.25E-06	6.10E-02	3.15E-02	3.52E-01	1.03E+02
A4	7.63E+00	1.53E-08	1.48E-02	4.99E-03	2.64E-01	1.72E+01
A5	1.01E+01	1.16E-07	2.10E-02	3.03E-03	2.85E-01	2.21E+00
B1	0	0	0	0	0	0
B2	1.70E-01	2.23E-07	2.18E-03	1.68E-03	1.95E-02	3.51E+00
B3	1.22E-01	1.77E-07	1.19E-02	2.05E-03	1.64E-02	1.46E+00
B4	2.77E+02	2.19E-04	2.82E+00	1.65E+00	2.49E+01	4.80E+03
B5	0	0	0	0	0	0
B6-B7	7.15E+01	6.86E-05	8.61E-01	5.29E-01	7.79E+00	1.52E+03
C1	0	0	0	0	0	0
C2	9.86E-02	1.09E-09	2.23E-04	5.34E-05	3.42E-03	6.18E-01
C3	2.42E-03	1.96E-09	1.31E-05	1.62E-05	8.49E-05	1.11E-02
C4	6.12E-02	1.13E-07	2.23E-04	2.26E-04	2.15E-03	2.98E-01
Total	3.72E+02	2.93E-04	3.80E+00	2.22E+00	3.36E+01	6.44E+03

SM results

The SM millipoint scores per functional unit by life cycle phase for this product are presented below (Tables 5.2g-i). They confirm the trends in the results using the impact assessment results prior to normalization and weighting.

Table 5.2g SM millipoint scores for MS854114E by life cycle phase – absolute results

Impact category	**Unit**	**Total**	**PRODUCTION (A1-A3)**	**CONSTRUCTION (A4-A5)**	**USE (B1-B7)**	**END OF LIFE (C1-C4)**
SM single figure score	mPts	456	5.2	1.34	449	0.0754

Table 5.2h SM millipoint scores for MS604124CUFG by life cycle phase – absolute results

Impact category	**Unit**	**Total**	**PRODUCTION (A1-A3)**	**CONSTRUCTION (A4-A5)**	**USE (B1-B7)**	**END OF LIFE (C1-C4)**
SM single figure score	mPts	384	8.26	1.2	375	0.08

Table 5.2i SM millipoint scores for MS604124CEFG by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	481	8.41	2.41	470	0.08

Additional LCIA impact categories are reported as additional environmental information.

Table 5.2j Additional Environmental Information: Eco Ultramax (MS854114E)

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	1.66E+02	4.28E+01	7.04E-07	1.42E-05
A4	1.43E+01	1.99E+01	1.11E-07	1.04E-06
A5	1.53E+00	1.62E+00	1.02E-08	9.65E-08
B1	0	0	0	0
B2	1.02E+01	1.72E+00	7.15E-08	7.01E-07
B3	2.88E+00	1.03E+01	6.65E-08	8.43E-06
B4	3.63E+03	1.77E+03	9.09E-05	4.57E-04
B5	0	0	0	0
B6-B7	9.63E+02	5.28E+02	3.15E-05	1.29E-04
C1	0	0	0	0
C2	8.88E-01	1.24E+00	6.95E-09	6.48E-08
C3	2.20E-02	3.24E-03	1.14E-10	4.73E-10
C4	9.87E-01	1.08E-01	2.92E-09	1.53E-08
Total	4.79E+03	2.38E+03	1.23E-04	6.11E-04

Table 5.2k Additional Environmental Information: Ultramax 1G (MS604124CUFG)

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	1.95E+02	7.41E+01	1.44E-06	2.13E-05
A4	1.03E+01	1.44E+01	8.09E-08	7.60E-07
A5	1.57E+00	1.65E+00	1.07E-08	1.02E-07
B1	0	0	0	0
B2	1.02E+01	1.72E+00	7.15E-08	7.01E-07
B3	2.88E+00	1.03E+01	6.65E-08	8.43E-06
B4	3.20E+03	1.61E+03	7.59E-05	4.18E-04
B5	0	0	0	0
B6-B7	7.52E+02	4.12E+02	2.46E-05	1.00E-04
C1	0	0	0	0
C2	1.09E+00	1.52E+00	8.55E-09	7.98E-08
C3	2.20E-02	3.27E-03	1.15E-10	4.76E-10
C4	1.01E+00	1.11E-01	2.98E-09	1.57E-08
Total	3.67E+02	2.76E+01	0.00E+00	0.00E+00

Table 5.2l Additional Environmental Information: Ultramax HET (MS604124CEFG)

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	1.99E+02	6.60E+01	1.66E-06	2.18E-05
A4	2.97E+01	4.21E+01	2.36E-07	2.25E-06
A5	1.53E+00	1.62E+00	1.02E-08	9.65E-08
B1	0	0	0	0
B2	1.02E+01	1.72E+00	7.15E-08	7.01E-07
B3	2.88E+00	1.03E+01	6.65E-08	8.43E-06
B4	3.85E+03	1.96E+03	9.65E-05	5.02E-04
B5	0	0	0	0
B6-B7	9.63E+02	5.28E+02	3.15E-05	1.29E-04
C1	0	0	0	0
C2	1.09E+00	1.52E+00	8.55E-09	7.98E-08
C3	2.20E-02	3.24E-03	1.14E-10	4.73E-10
C4	1.03E+00	1.12E-01	3.03E-09	1.59E-08
Total	5.06E+03	2.62E+03	1.30E-04	6.64E-04

5.3 Commercial faucets: Standard-R (T28S32E(M/T)) and Standard-S (T27S32E(M/T)) Faucet Series

This section includes results for the Standard-R and Standard-S Faucet Series. The faucets are available without a mixing valve (T28S32E and T27S32E), or with either a hot/cold mixing tee (T28S32EM and T27S32EM) or a thermostatic mixing valve (T28S32ET and T27S32ET). This section explores the potential environmental impact differences between the Standard-R and Standard-S styles (section 5.3.1), and reports impacts for each product individually (section 5.3.2).

5.3.1 Analysis of average results for a faucet without mixing valve (T28S32E and T27S32E) and a faucet with mixing valves (T28S32EM, T28S32ET, T27S32EM and T27S32ET)

Cradle-to-gate

Figure 12 shows the results for the finished products. The only difference between the two faucets is that T27S32E's decorative shell is 73.5 grams heavier than T28S32E and assembly results are averaged for the two models. Brass and the turning brass process, together with the printed wiring board have significant material contributions to the results. Stainless steel materials and the turning steel process are relevant to the carcinogenics category. The electroplating process along with injection molding are major contributors to the ozone depletion category. Furthermore, polishing has a somewhat significant processing contribution to the results. Because these products are manufactured in Vietnam but sold in the US market, the transportation via oceanic freighter appears as a relevant contributor to the fossil fuel depletion and smog categories. The other parts and processes contribute between 5% and 20% of the overall impacts in the remaining categories.

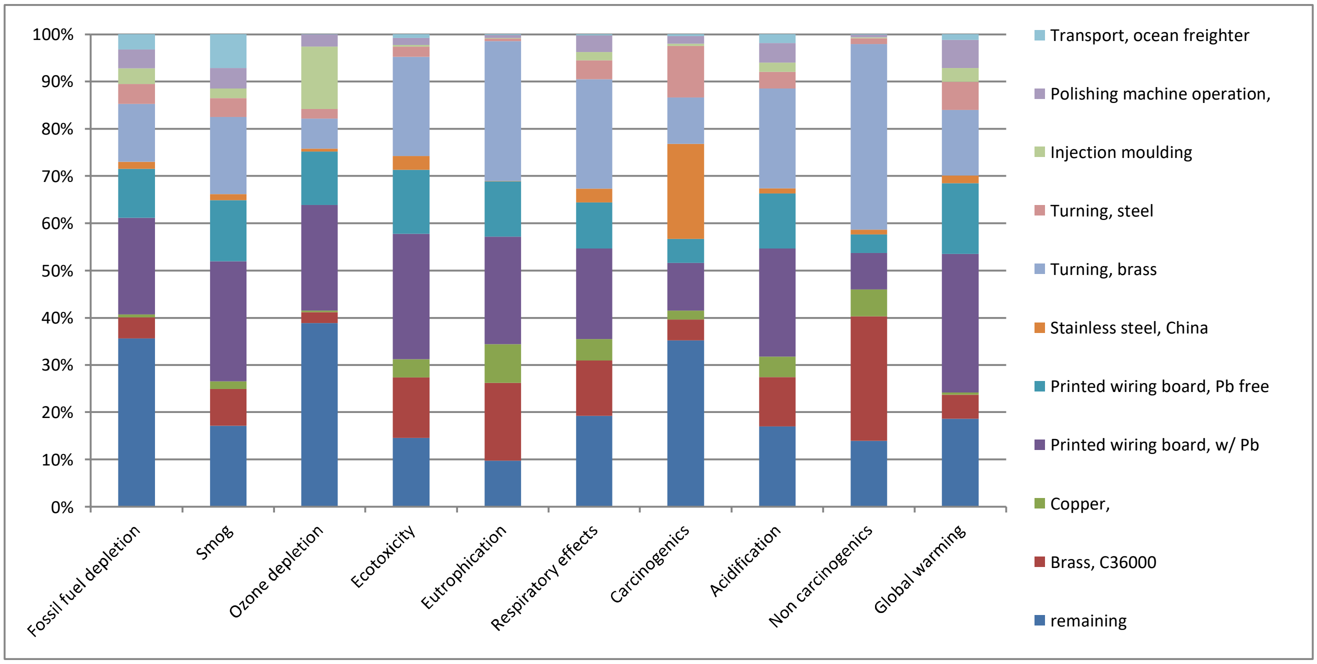


Figure 12. Cradle-to-gate impacts for average of T28S32E and T27S32E – relative results

Variations

There is 3% variation in weight between these two models. The same manufacturing plant, TOTO Vietnam, results in the same production, manufacturing process, machines and yields. With the accuracy of data received from the factory, the numbers in the results deviate to the average case.

Full life cycle

Figure 13 shows the results for the average of the full life cycle of the product. While the product itself [A1-A3] is significant in all impact categories, it is the impacts associated with the use phase which dominate all categories. The magnitude of the use phase impacts primarily results from the contributions of the 6.5 replacement faucets [B4] required to meet the estimated service life of the building (ESL), the reporting of which include all life-cycle impacts associated with the production, transport, use and disposal of the replacements. Results show that the production [A1-A3] dominates all impact categories and is most significant as a contributor to eutrophication (mostly defined by emissions from copper mining), non-carcinogens (emissions from the production of coal, copper and zinc) and ecotoxicity (mostly from disposal of steel slags and bottom ashes from coal fired power plants, and barium emissions to water from the extraction process of natural gas). The impacts for the production of the product itself [A1-A3] are discussed above in the cradle-to-gate section. The use phase [B6-B7] is relevant to most impact categories, especially fossil fuel depletion, ozone depletion, and global warming. This is mostly due to the embedded electricity used for the water supply and the water consumed during use. Relative to the other phases, it does not appear that the use phase is significant to ecotoxicity, eutrophication, or non-carcinogens. The transportation to the installation site [A4], the construction/installation of the product and the processes for dismantling [A5], and final waste treatment of the product [C1-C4] do not have a significant impact according to these results.

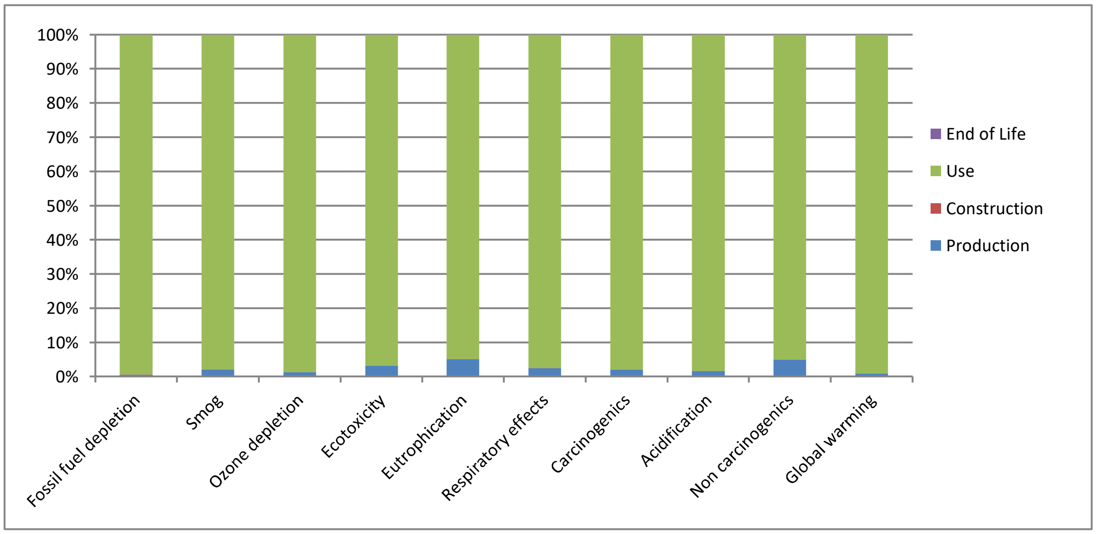


Figure 13. LCIA results for the average of T28S32E and T27S32E– relative results

Variations

Because there is a small variation in weight of the brass material between these two models while the rest of the raw materials, yield and factory location are the same, variation percentage in all life cycle stage impacts between the two models is between 1-10%. The variations in the production and construction phase are a result of the difference in weight, 73 grams between the two models.

Cradle-to-gate T28S32EM, T28S32ET, T27S32EM and T27S32ET

Figure 14 shows the results for T28S32EM, T28S32ET, T27S32EM and T27S32ET. Brass and its turning brass process, together with the printed wiring board have significant contributions to the results. Stainless steel and the turning steel process are relevant to the carcinogenics category. The electroplating process along with injection molding are major contributors to the ozone depletion category. Furthermore, polishing has a somewhat significant processing contribution to the results. Because these products are manufactured in Vietnam but sold in the US market, the transportation via oceanic freighter appears as a relevant contributor to the fossil fuel depletion and smog categories. The other parts and processes contribute between 5% and 20% of the overall impacts in the remaining categories.

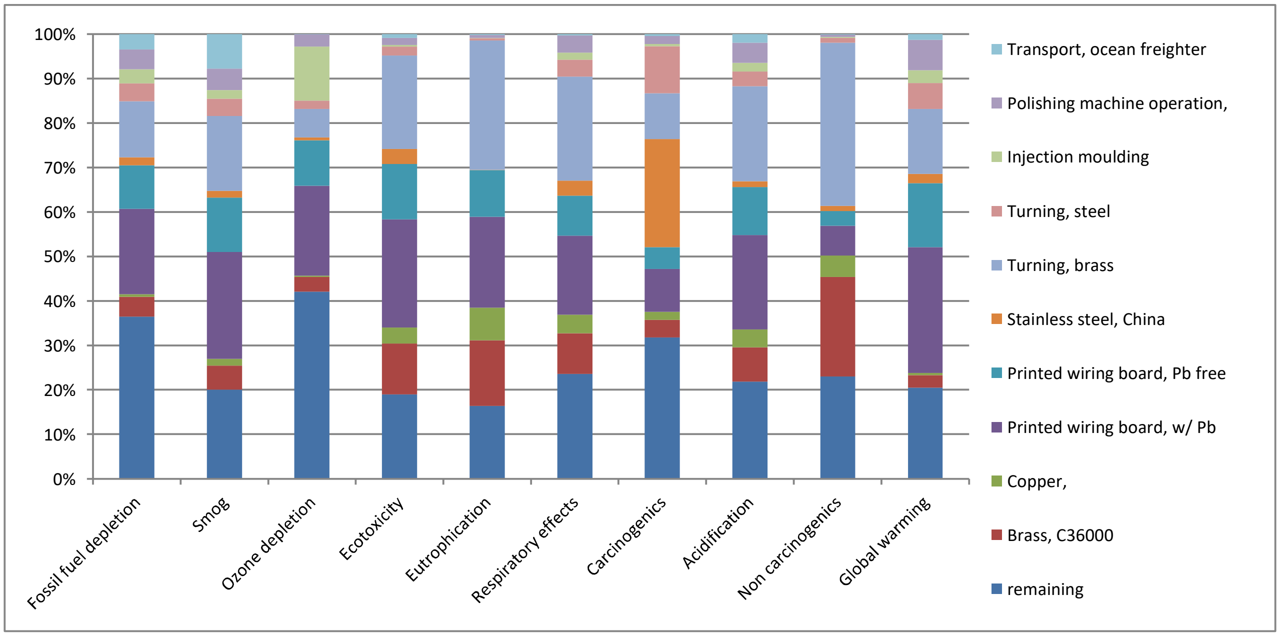


Figure 14. Cradle-to-gate impacts for the average of T28S32EM, T28S32ET, T27S32EM and T27S32ET – relative results

Full life cycle

Figure 15 shows the results for the average of the full life cycle of the products. While the product itself [A1-A3] is significant in all impact categories, it is the impacts associated with the use phase which dominate all categories. The magnitude of the use phase impacts primarily results from the contributions of the 6.5 replacement faucets [B4] required to meet the estimated service life of the building (ESL), the reporting of which include all life-cycle impacts associated with the production, transport, use and disposal of the replacements. Results also show that the production [A1-A3] dominates all impact categories and is most significant as a contributor to eutrophication (mostly defined by emissions from copper mining), non-carcinogens (emissions from the production of coal, copper and zinc) and ecotoxicity (mostly from disposal of steel slags and bottom ashes from coal fired power plants, and barium emissions to water from the extraction process of natural gas). The impacts for the production of the product itself [A1-A3] are discussed above in the cradle-to-gate section. The use phase [B1-B7] is relevant to most impact categories, especially fossil fuel depletion, ozone depletion, carcinogens, and global warming. This is mostly due to the embedded electricity used for the water supply and the water consumed during use. Relative to the other phases, it does not appear that the use phase is significant to ecotoxicity, eutrophication, or non-carcinogens. The transportation to the installation site [A4] the construction/installation of the product and the processes for dismantling [A5], and final waste treatment of the product [C1-C4] do not have a significant impact according to these results.

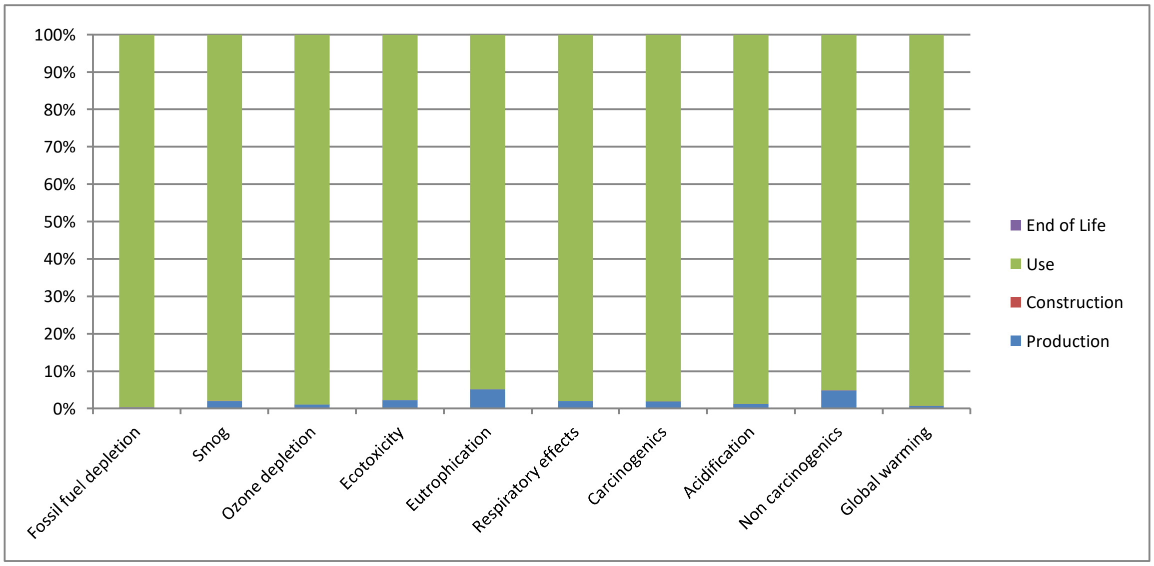


Figure 15. LCIA results for the average of T28S32EM, T28S32ET, T27S32EM and T27S32ET– relative results

Variations

Variations in the life cycle phases are a result of a difference in the BOM (shown in Table 5.3a). The difference in mass contributes to the variation in the construction and EOL phases. The amount of brass in the three products, varying by more than 20%, is the main contributor to a variation of greater than 10% in the total life cycle impact assessment results for some impact categories. Therefore, results for each product are reported separately.

Table 5.3a Variations in the bill of materials for T28S32EM, T28S32ET, T27S32EM and T27S32ET

Material	**Average (g)**
AA Li-ion Battery	18.12
ABS	365.46
Brass (C360000)	817.56
Brass (Covalent Coating)	34.83
Brass (primary)	**359.92**
Brass (secondary)	**139.29**
Brass C49260	**89.27**
Brass Pb free	141.18
Cu	71.31
Double Wall (primary)	327.39
Double Wall (secondary)	37.89
EPDM	**4.68**
Epoxy Resin	25.15
Magnet	15.87
NBR	48.15
Nickel Titanium Alloy	**8.58**
Paper (primary)	29.67
Paper (secondary)	3.50
Pb w/ Surface mount	43.19
PE	**13.03**
Polyacetal	29.45
POM	56.03
PP	98.74
PPO	37.73
PPS	**2.97**
PU Rigid	8.63
PVC	156.46
Steel	70.55
Surface mount	21.88
SUS	**2.21**
SUS303 (primary)	192.83
SUS303 (secondary)	98.29
SUS304	196.13

Numbers shown in **blue** have a variation of 10 to 20%
Numbers shown in **red** have a variation greater than 20%

5.3.2 Life cycle impact assessment results for each faucet series offering

Table 5.3b LCIA results for T28S32E – absolute results

Parameter	**Smog**	**Ozone depletion**	**Eutrophication**	**Acidification**	**Respiratory effects**	**Global warming**
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	6.11E+00	4.11E-06	4.21E-01	8.00E-01	9.63E-02	6.28E+01
A4	2.24E-01	1.12E-09	4.49E-04	7.00E-03	1.22E-04	6.37E-01
A5	4.32E-04	5.84E-10	2.39E-04	3.60E-05	2.98E-06	1.48E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.76E-01	4.95E-07	4.83E-03	4.33E-02	3.73E-03	7.79E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	2.38E+02	2.06E-04	7.35E+00	2.76E+01	2.40E+00	4.18E+03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	3.06E+01	5.05E-05	3.49E-01	8.27E+00	5.28E-01	1.24E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	3.69E-03	4.07E-11	8.32E-06	1.28E-04	2.00E-06	2.31E-02
C3	1.44E-02	1.11E-08	9.81E-05	6.17E-04	8.50E-05	7.86E-02
C4	3.90E-03	5.44E-09	9.09E-05	3.08E-04	2.36E-05	8.32E-02
Total	2.76E+02	2.61E-04	8.12E+00	3.68E+01	3.03E+00	5.49E+03

SM results

The SM millipoint scores by life cycle phase for this product are presented below (Table 5.3c). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.3c SM millipoint scores for T28S32E by life cycle phase – absolute results

Impact category	**Unit**	**Total**	**PRODUCTION (A1-A3)**	**CONSTRUCTION (A4-A5)**	**USE (B1-B7)**	**END OF LIFE (C1-C4)**
SM single figure score	mPts	522.23	14.31	0.07	509.09	0.02

Additional LCIA impact categories are reported as additional environmental information.

Table 5.3d: LCIA results **-** Additional Environmental Information: T28S32E

Parameter	**Fossil fuel depletion**	**Ecotoxicity**	**Carcinogenics**	**Non carcinogenics**
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	4.04E+01	2.24E+02	2.81E-06	7.82E-05
A4	1.13E+00	1.57E+00	8.81E-09	8.22E-08
A5	6.56E-03	5.05E-03	7.31E-11	7.26E-10
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	2.27E+01	3.82E+00	1.59E-07	1.56E-06
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	2.77E+03	3.99E+03	1.03E-04	1.25E-03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	1.76E+03	9.97E+02	1.49E-05	8.04E-05
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	4.09E-02	5.69E-02	3.20E-10	2.98E-09
C3	1.18E-01	9.81E-02	1.54E-09	6.62E-08
C4	5.92E-02	4.08E-02	4.64E-10	4.03E-09
Total	4.60E+03	5.22E+03	1.21E-04	1.41E-03

Table 5.3e LCIA results for T27S32E– absolute results

Parameter	**Smog**	**Ozone depletion**	**Eutrophication**	**Acidification**	**Respiratory effects**	**Global warming**
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	6.38E+00	4.17E-06	4.56E-01	8.45E-01	1.02E-01	6.48E+01
A4	2.24E-01	1.12E-09	4.49E-04	7.00E-03	1.22E-04	6.37E-01
A5	4.32E-04	5.84E-10	2.39E-04	3.60E-05	2.98E-06	1.48E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.76E-01	4.95E-07	4.83E-03	4.33E-02	3.73E-03	7.79E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	2.84E+02	3.85E-04	8.18E+00	6.49E+01	4.75E+00	8.91E+03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	3.06E+01	5.05E-05	3.49E-01	8.27E+00	5.28E-01	1.24E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	3.69E-03	4.07E-11	8.32E-06	1.28E-04	2.00E-06	2.31E-02
C3	1.44E-02	1.11E-08	9.81E-05	6.17E-04	8.50E-05	7.86E-02
C4	3.90E-03	5.44E-09	9.09E-05	3.08E-04	2.36E-05	8.32E-02
Total	3.21E+02	4.40E-04	8.99E+00	7.41E+01	5.38E+00	1.02E+04

SM results

The SM millipoint scores by life cycle phase for this product are presented below (Table 5.3f). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.3f SM millipoint scores for T27S32Eby life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	802.99	15.3	0.07	788.92	0.02

Additional LCIA impact categories are reported as additional environmental information.

Table 5.3g: LCIA results **-** Additional Environmental Information: T27S32E

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	4.16E+01	2.38E+02	2.88E-06	8.78E-05
A4	1.13E+00	1.57E+00	8.81E-09	8.22E-08
A5	6.56E-03	5.05E-03	7.31E-11	7.26E-10
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	2.27E+01	3.82E+00	1.59E-07	1.56E-06
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	1.21E+04	9.49E+03	1.31E-04	1.61E-03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	1.76E+03	9.97E+02	1.49E-05	8.04E-05
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	4.09E-02	5.69E-02	3.20E-10	2.98E-09
C3	1.18E-01	9.81E-02	1.54E-09	6.62E-08
C4	5.92E-02	4.08E-02	4.64E-10	4.03E-09
Total	1.40E+04	1.07E+04	1.49E-04	1.78E-03

Table 5.3h LCIA results for T28S32EM– absolute results

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	6.67E+00	4.54E-06	5.00E-01	8.90E-01	1.08E-01	6.67E+01
A4	2.51E-01	1.25E-09	5.03E-04	7.84E-03	1.37E-04	7.12E-01
A5	5.35E-04	7.22E-10	2.97E-04	4.40E-05	3.68E-06	1.82E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.76E-01	4.95E-07	4.83E-03	4.33E-02	3.73E-03	7.79E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	2.87E+02	3.90E-04	8.74E+00	6.55E+01	4.83E+00	8.94E+03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	3.06E+01	5.05E-05	3.49E-01	8.27E+00	5.28E-01	1.24E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	5.59E-03	6.17E-11	1.26E-05	1.94E-04	3.03E-06	3.51E-02
C3	2.21E-02	1.74E-08	1.53E-04	9.76E-04	1.33E-04	1.27E-01
C4	4.12E-03	5.68E-09	9.70E-05	3.16E-04	2.45E-05	8.73E-02
Total	3.25E+02	4.45E-04	9.60E+00	7.47E+01	5.47E+00	1.02E+04

SM results

The SM millipoint scores by life cycle phase for this product are presented below (Table 5.3i). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.3i SM millipoint scores for T28S32EM by life cycle phase – absolute results

Impact category	**Unit**	**Total**	**PRODUCTION (A1-A3)**	**CONSTRUCTION (A4-A5)**	**USE (B1-B7)**	**END OF LIFE (C1-C4)**
SM single figure score	mPts	806.92	15.74	0.07	792.62	0.03

Additional LCIA impact categories are reported as additional environmental information.

Table 5.3j: LCIA results **-** Additional Environmental Information: T28S32EM

Parameter	**Fossil fuel depletion**	**Ecotoxicity**	**Carcinogenics**	**Non carcinogenics**
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	4.38E+01	2.56E+02	3.01E-06	9.98E-05
A4	1.26E+00	1.75E+00	9.86E-09	9.20E-08
A5	8.14E-03	6.22E-03	9.09E-11	8.94E-10
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	2.27E+01	3.82E+00	1.59E-07	1.56E-06
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	1.22E+04	9.70E+03	1.33E-04	1.75E-03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	1.76E+03	9.97E+02	1.49E-05	8.04E-05
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	6.20E-02	8.63E-02	4.85E-10	4.53E-09
C3	1.88E-01	1.70E-01	2.44E-09	1.19E-07
C4	6.17E-02	4.51E-02	4.75E-10	4.09E-09
Total	1.40E+04	1.10E+04	1.51E-04	1.93E-03

Table 5.3k LCIA results for T27S32EM – absolute results

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	6.67E+00	4.54E-06	5.00E-01	8.90E-01	1.08E-01	6.67E+01
A4	2.51E-01	1.25E-09	5.03E-04	7.84E-03	1.37E-04	7.12E-01
A5	5.35E-04	7.22E-10	2.97E-04	4.40E-05	3.68E-06	1.82E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.76E-01	4.95E-07	4.83E-03	4.33E-02	3.73E-03	7.79E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	2.87E+02	3.90E-04	8.74E+00	6.55E+01	4.83E+00	8.94E+03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	3.06E+01	5.05E-05	3.49E-01	8.27E+00	5.28E-01	1.24E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	5.59E-03	6.17E-11	1.26E-05	1.94E-04	3.03E-06	3.51E-02
C3	2.21E-02	1.74E-08	1.53E-04	9.76E-04	1.33E-04	1.27E-01
C4	4.12E-03	5.68E-09	9.70E-05	3.16E-04	2.45E-05	8.73E-02
Total	3.25E+02	4.45E-04	9.60E+00	7.47E+01	5.47E+00	1.02E+04

SM results

The SM millipoint scores by life cycle phase for this product are presented below (Table 5.3l). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.3l SM millipoint scores for T27S32EM by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	819.94	16.71	0.07	804.75	0.03

Additional LCIA impact categories are reported as additional environmental information.

Table 5.3m: LCIA results **-** Additional Environmental Information: T27S32EM

Parameter	**Fossil fuel depletion**	**Ecotoxicity**	**Carcinogenics**	**Non carcinogenics**
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	4.38E+01	2.56E+02	3.01E-06	9.98E-05
A4	1.26E+00	1.75E+00	9.86E-09	9.20E-08
A5	8.14E-03	6.22E-03	9.09E-11	8.94E-10
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	2.27E+01	3.82E+00	1.59E-07	1.56E-06
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	1.22E+04	9.70E+03	1.33E-04	1.75E-03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	1.76E+03	9.97E+02	1.49E-05	8.04E-05
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	6.20E-02	8.63E-02	4.85E-10	4.53E-09
C3	1.88E-01	1.70E-01	2.44E-09	1.19E-07
C4	6.17E-02	4.51E-02	4.75E-10	4.09E-09
Total	1.40E+04	1.10E+04	1.51E-04	1.93E-03

Table 5.3n LCIA results for T28S32ET – absolute results

Parameter	**Smog**	**Ozone depletion**	**Eutrophication**	**Acidification**	**Respiratory effects**	**Global warming**
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	6.55E+00	4.60E-06	4.77E-01	8.85E-01	1.06E-01	6.56E+01
A4	2.24E-01	1.12E-09	4.49E-04	7.00E-03	1.22E-04	6.37E-01
A5	4.34E-04	5.83E-10	2.48E-04	3.83E-05	3.11E-06	1.60E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.76E-01	4.95E-07	4.83E-03	4.33E-02	3.73E-03	7.79E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	2.85E+02	3.90E-04	8.44E+00	6.54E+01	4.80E+00	8.92E+03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	3.06E+01	5.05E-05	3.49E-01	8.27E+00	5.28E-01	1.24E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	4.29E-03	4.73E-11	9.68E-06	1.49E-04	2.32E-06	2.69E-02
C3	1.94E-02	1.60E-08	1.46E-04	8.95E-04	1.22E-04	1.20E-01
C4	4.14E-03	5.75E-09	9.95E-05	3.17E-04	2.46E-05	8.97E-02
Total	3.23E+02	4.46E-04	9.27E+00	7.46E+01	5.43E+00	1.02E+04

SM results

The SM millipoint scores by life cycle phase for this product are presented below (Table 5.3o). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.3o SM millipoint scores for T28S32ET by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	810.32	15.81	0.07	795.88	0.02

Additional LCIA impact categories are reported as additional environmental information.

Table 5.3p: LCIA results **-** Additional Environmental Information: T28S32ET

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	4.34E+01	2.48E+02	2.95E-06	9.40E-05
A4	1.13E+00	1.57E+00	8.81E-09	8.22E-08
A5	6.59E-03	3.88E-03	7.46E-11	7.59E-10
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	2.27E+01	3.82E+00	1.59E-07	1.56E-06
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	1.22E+04	9.59E+03	1.32E-04	1.67E-03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	1.76E+03	9.97E+02	1.49E-05	8.04E-05
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	4.76E-02	6.62E-02	3.72E-10	3.47E-09
C3	1.71E-01	1.73E-01	2.39E-09	1.22E-07
C4	6.24E-02	4.69E-02	4.80E-10	4.12E-09
Total	1.40E+04	1.08E+04	1.50E-04	1.84E-03

Table 5.3q LCIA results for T27S32ET – absolute results

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	6.80E+00	4.67E-06	5.12E-01	9.26E-01	1.12E-01	6.73E+01
A4	2.85E-01	1.38E-09	5.69E-04	8.86E-03	1.55E-04	7.83E-01
A5	4.34E-04	5.83E-10	2.48E-04	3.83E-05	3.11E-06	1.60E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.76E-01	4.95E-07	4.83E-03	4.33E-02	3.73E-03	7.79E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	2.89E+02	3.91E-04	8.89E+00	6.59E+01	4.87E+00	8.94E+03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	3.06E+01	5.05E-05	3.49E-01	8.27E+00	5.28E-01	1.24E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	4.29E-03	4.73E-11	9.68E-06	1.49E-04	2.32E-06	2.69E-02
C3	1.94E-02	1.60E-08	1.46E-04	8.95E-04	1.22E-04	1.20E-01
C4	4.14E-03	5.75E-09	9.95E-05	3.17E-04	2.46E-05	8.97E-02
Total	3.27E+02	4.47E-04	9.75E+00	7.51E+01	5.51E+00	1.03E+04

SM results

The SM millipoint scores by life cycle phase for this product are presented below (Table 5.3r). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.3r SM millipoint scores for T27S32ET by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	823.64	16.78	0.08	808.27	0.02

Additional LCIA impact categories are reported as additional environmental information.

Table 5.3s: LCIA results **-** Additional Environmental Information: T27S32ET

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	4.47E+01	2.61E+02	3.02E-06	1.04E-04
A4	1.38E+00	1.93E+00	1.08E-08	1.01E-07
A5	6.59E-03	3.88E-03	7.46E-11	7.59E-10
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	2.27E+01	3.82E+00	1.59E-07	1.56E-06
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	1.22E+04	9.76E+03	1.33E-04	1.79E-03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	1.76E+03	9.97E+02	1.49E-05	8.04E-05
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	4.76E-02	6.62E-02	3.72E-10	3.47E-09
C3	1.71E-01	1.73E-01	2.39E-09	1.22E-07
C4	6.24E-02	4.69E-02	4.80E-10	4.12E-09
Total	1.40E+04	1.10E+04	1.51E-04	1.97E-03

5.4 Commercial flush valve: TEU1LA(R)

Cradle-to-gate

Figure 16 shows the results per functional unit for the finished product. Bronze and zinc parts, together with the printed wiring board have significant material contributions to the results. The stainless steel material is relevant to the carcinogenics category. The electroplating process is a major contributor to the ozone depletion category while the die casting process is relevant to the ecotoxicity and non-carcinogenics categories. Furthermore, polishing and potting have somewhat significant processing contribution to the results. Because these products are manufactured in Vietnam but sold in the US market, the transportation via oceanic freighter appears as a relevant contributor to the fossil fuel depletion and smog categories. The other parts and processes contribute between 3% and 15% of the overall impacts in the remaining categories.

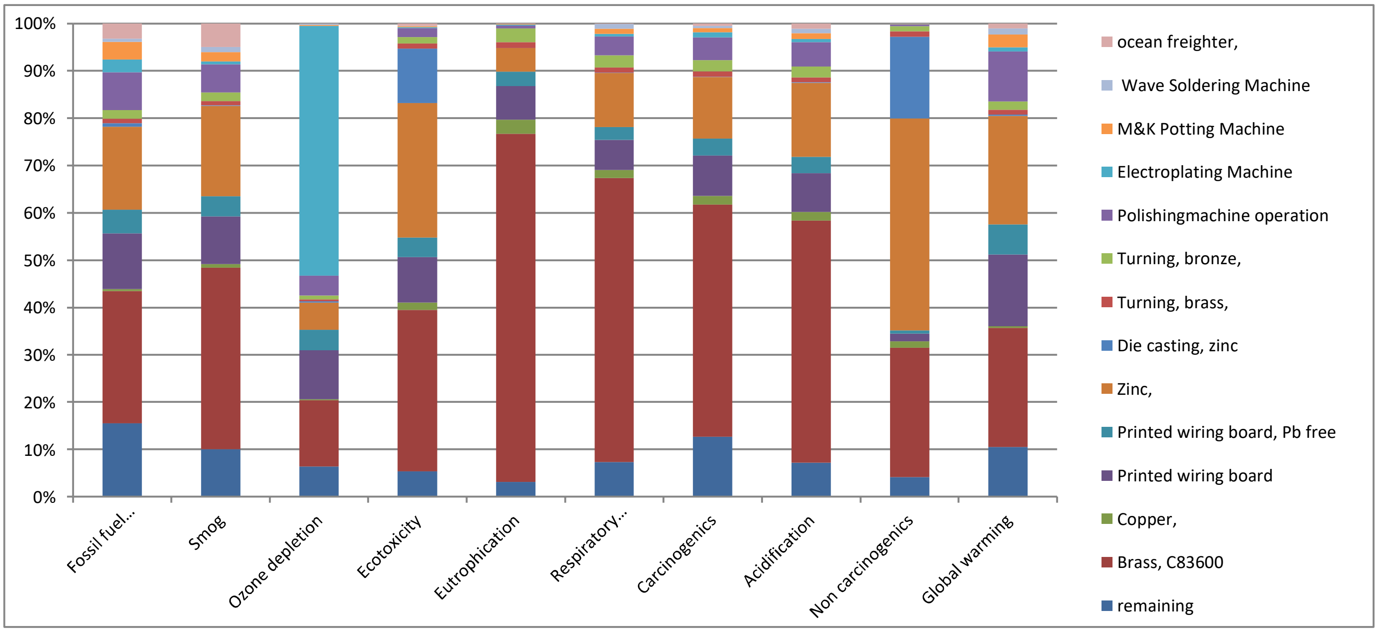


Figure 16. Cradle-to-gate impacts for TEU1LA(R) – relative results

Full life cycle

Figure 17 and Table 5.4a show the results for the full life cycle of the product. While the product itself [A1-A3] is significant in all impact categories, it is the impacts associated with the use phase [B1-B7] which dominate all categories. The magnitude of the use phase impacts primarily results from the contributions of the 6.5 replacement flush valves [B4] required to meet the estimated service life of the building (ESL), the reporting of which include all life-cycle impacts associated with the production, transport, use and disposal of the replacements.

Although impacts from the rest (other than [B4]) are rather insignificant, it can be noted that results also show that the production [A1-A3] dominates all impact categories except for global warming and fossil fuel depletion, in which the use phase appears to be as significant. The production [A1-A3] is most significant as a contributor to eutrophication (mostly defined by emissions from copper mining), non carcinogenics (emissions from the production of coal, copper and zinc) and ecotoxicity (mostly from disposal of steel slags and bottom ashes from coal fired power plants, and barium emissions to water from the extraction process of natural gas). The impacts for the production of the product itself [A1-A3] are discussed above in the cradle-to-gate section. The use phase [B1-B7] is relevant to all impact categories, especially fossil fuel depletion, carcinogens, and global warming. This is mostly due to the embedded electricity used for the water supply and the water consumed during use. The transportation to the installation site [A4], the construction/installation of the product and the processes for dismantling [A5], and the final waste treatment of the product [C1-C4] do not have a significant impact according to these results.

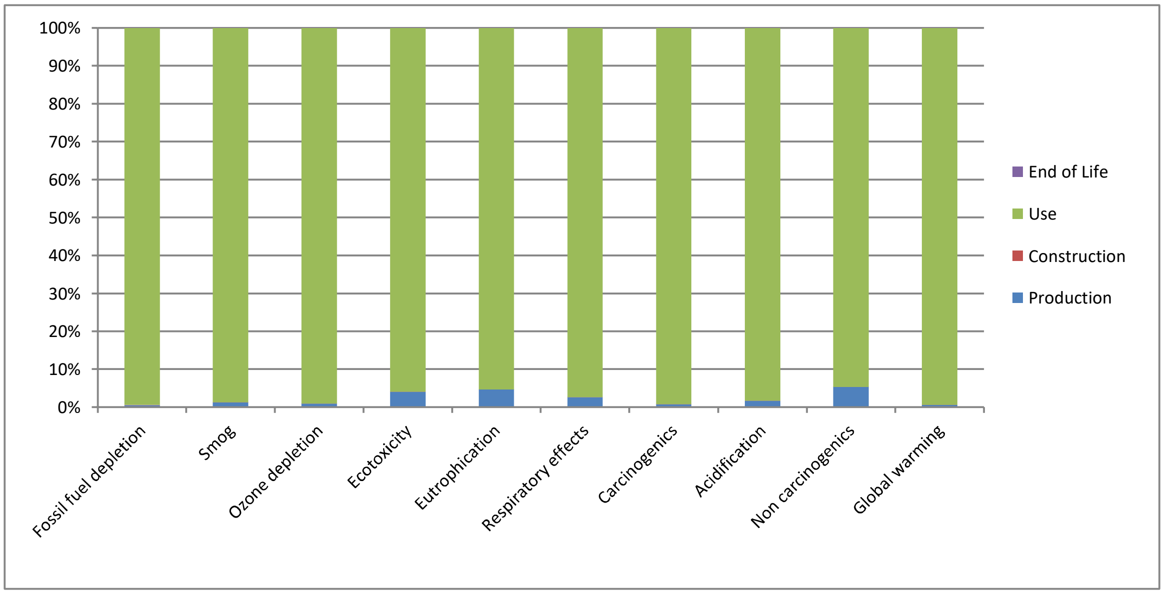


Figure 17. LCIA results for TEU1LA(R) – relative results

Table 5.4a LCIA results for TEU1LA(R) – absolute results

Parameter	**Smog**	**Ozone depletion**	**Eutrophication**	**Acidification**	**Respiratory effects**	**Global warming**
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	1.30E+01	7.34E-06	1.16E+00	1.89E+00	2.47E-01	1.02E+02
A4	1.18E-01	1.16E-09	2.60E-04	4.01E-03	6.40E-05	6.58E-01
A5	9.83E-04	1.28E-09	5.15E-04	8.55E-05	6.83E-06	3.24E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.95E-01	5.06E-07	5.07E-03	4.57E-02	3.85E-03	8.08E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	7.64E+02	6.73E-04	2.19E+01	8.98E+01	7.44E+00	1.41E+04
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	9.44E+01	8.97E-05	1.14E+00	1.03E+01	6.95E-01	1.98E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	7.43E-03	8.22E-11	1.68E-05	2.58E-04	4.02E-06	4.66E-02
C3	4.67E-02	2.71E-08	1.58E-04	1.61E-03	2.04E-04	1.72E-01
C4	4.07E-03	5.00E-09	5.37E-05	3.08E-04	2.45E-05	5.15E-02
Total	8.72E+02	7.70E-04	2.42E+01	1.02E+02	8.38E+00	1.62E+04

SM results

The SM millipoint scores by life cycle phase for this product are presented below (Table 5.4b). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.4bc SM millipoint scores for TEU1LA(R) by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	1543	35.8	0.0659	1507	0.0192

Additional LCIA impact categories are reported as additional environmental information.

Table 5.4c: LCIA results **-** Additional Environmental Information: TEU1LA(R)

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	5.85E+01	5.25E+02	2.77E-06	3.24E-04
A4	1.16E+00	1.62E+00	9.09E-09	8.49E-08
A5	1.28E-02	1.01E-02	1.61E-10	1.62E-09
B1	0	0	0	0
B2	2.23E+01	3.85E+00	1.60E-07	1.58E-06
B3	0	0	0	0
B4	8.56E+03	1.08E+04	2.98E-04	4.99E-03
B5	0	0	0	0
B6-B7	1.19E+03	6.82E+02	4.07E-05	1.68E-04
C1	0	0	0	0
C2	0.0823	0.115	6.44E-10	6.01E-09
C3	3.19E-01	3.58E-02	1.41E-09	6.27E-09
C4	5.12E-02	6.80E-02	4.60E-10	5.52E-09
Total	9.84E+03	1.21E+04	3.42E-04	5.48E-03

5.5 Commercial flush valve: TEU1UA(R)

Cradle-to-gate

Figure 18 shows the results per functional unit for the finished products. Bronze and zinc parts, together with the printed wiring board have significant material contributions to the results. The stainless steel material is relevant to the carcinogenics category. The electroplating process is a major contributor to the ozone depletion category while the die casting process is relevant to the ecotoxicity and non-carcinogenics categories. Furthermore, polishing and turning have somewhat significant processing contribution to the results. Because these products are manufactured in Vietnam but sold in the US market, the transportation via oceanic freighter appears as a relevant contributor to the fossil fuel depletion and smog categories. The other parts and processes contribute between 2% and 13% of the overall impacts in the remaining categories.

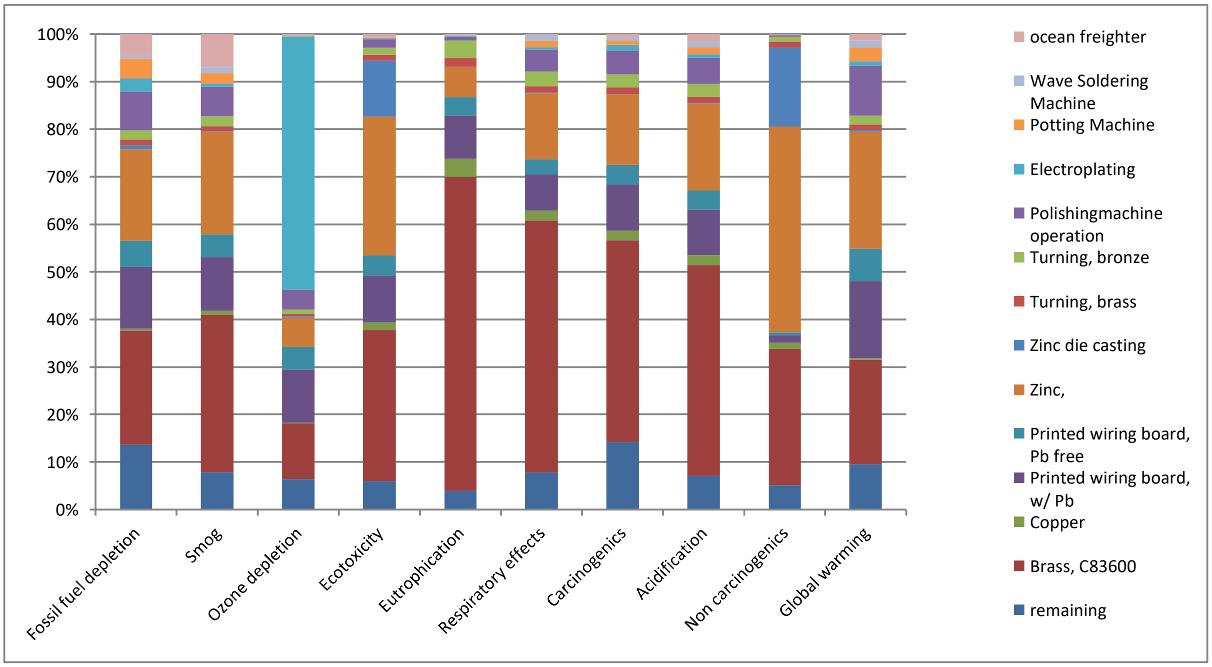


Figure 18. Cradle-to-gate impacts for TEU1UA(R)– relative results

Full life cycle

Figure 19 and Table 5.5a show the results for the full life cycle of the product. While the product itself [A1-A3] is significant in all impact categories, it is the impacts associated with the use phase [B1-B7] which dominate all categories. The magnitude of the use phase impacts primarily results from the contributions of the 6.5 replacement flush valves [B4] required to meet the estimated service life of the building (ESL), the reporting of which include all life-cycle impacts associated with the production, transport, use and disposal of the replacements. Although impacts from the rest are rather insignificant (compared with [B4]), it can be noted that results show that the production [A1-A3] dominates all impact categories and is most significant as a contributor to eutrophication (mostly defined by emissions from copper mining), non-carcinogens (emissions from the production of coal, copper and zinc) and ecotoxicity (mostly from disposal of steel slags and bottom ashes from coal fired power plants, and barium emissions to water from the extraction process of natural gas). The impacts for the production of the product itself [A1-A3] are discussed above in the cradle-to-gate section. The use phase [B1-B7] is relevant to some impact categories, especially fossil fuel depletion, ozone depletion, carcinogens, and global warming. This is mostly due to the embedded electricity used for the water supply and the water consumed during use. It does not appear that the use phase is significant to ecotoxicity, eutrophication, or non-carcinogens. The transportation to the installation site [A4], the construction/installation of the product and the processes for dismantling [A5], and the final waste treatment of the product [C1-C4] do not have a significant impact according to these results. This is an ultra-high efficiency urinal flush valve with 0.125 gallon per flush consumption but the significant impact of the water use in the use module [B6-B7] in all categories is noted, ranging from 9 to 13%.

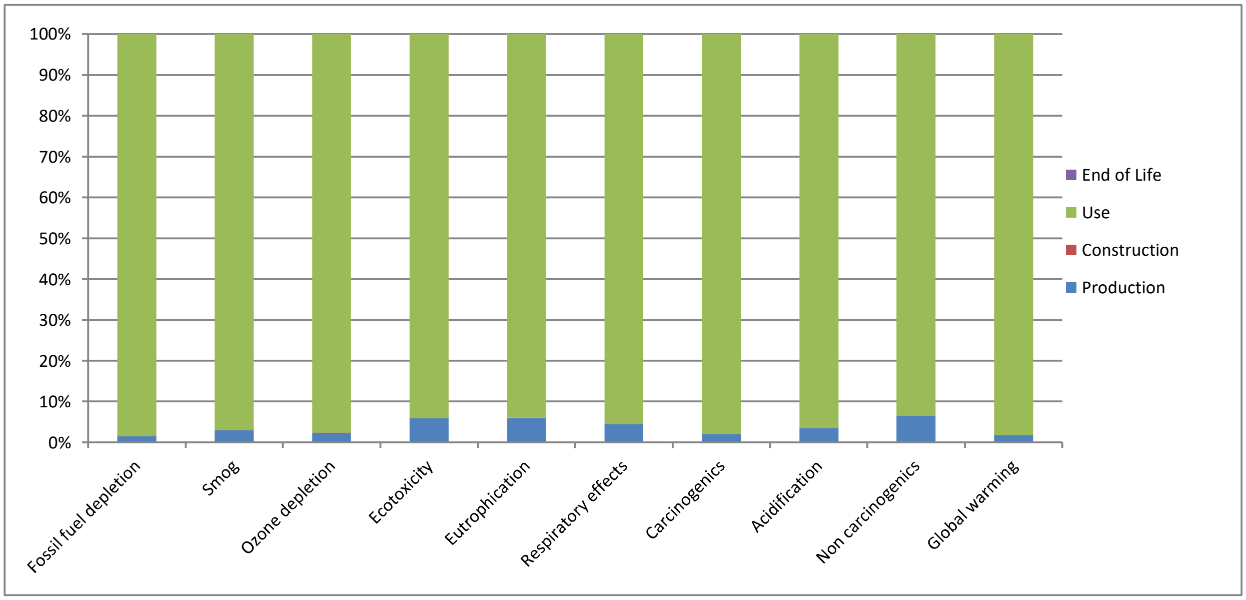


Figure 19. LCIA results for TEU1UA(R) – relative results

Table 5.5a LCIA results for TEU1UA(R)

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	1.15E+01	6.77E-06	9.02E-01	1.62E+00	2.05E-01	9.51E+01
A4	1.23E-01	1.21E-09	2.71E-04	4.18E-03	6.67E-05	6.86E-01
A5	1.33E-03	1.80E-09	5.94E-04	1.03E-04	8.53E-06	3.63E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.95E-01	5.06E-07	5.07E-03	4.57E-02	3.85E-03	8.08E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	2.87E+02	2.30E-04	1.32E+01	3.63E+01	3.55E+00	4.40E+03
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	2.36E+01	2.24E-05	2.84E-01	2.58E+00	1.74E-01	4.95E+02
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	6.57E-03	7.27E-11	1.48E-05	2.28E-04	3.56E-06	4.12E-02
C3	4.71E-02	3.65E-08	2.99E-04	2.10E-03	2.81E-04	2.69E-01
C4	3.82E-03	4.77E-09	4.83E-05	3.00E-04	2.34E-05	4.79E-02
Total	3.23E+02	2.59E-04	1.44E+01	4.06E+01	3.93E+00	5.00E+03

SM results

The SM millipoint scores by life cycle phase for this product are presented below (Table 5.5b). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.5b SM millipoint scores for TEU1UA(R) by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	726	34.4	0.0695	692	0.0450

Additional LCIA impact categories are reported as additional environmental information.

Table 5.5c: Additional Environmental Information: TEU1UA(R)

Parameter	**Fossil fuel depletion**	**Ecotoxicity**	**Carcinogenics**	**Non carcinogenics**
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	5.32E+01	5.12E+02	2.43E-06	3.35E-04
A4	1.21E+00	1.69E+00	9.48E-09	8.84E-08
A5	1.78E-02	2.45E-02	2.02E-10	1.94E-09
B1	0	0	0	0
B2	2.23E+01	3.85E+00	1.60E-07	1.58E-06
B3	0	0	0	0
B4	2.70E+03	7.42E+03	9.61E-05	4.38E-03
B5	0	0	0	0
B6-B7	2.98E+02	1.71E+02	1.02E-05	4.19E-05
C1	0	0	0	0
C2	0.0728	0.101	5.7E-10	5.32E-09
C3	3.91E-01	3.61E-01	5.01E-09	2.55E-07
C4	4.88E-02	6.68E-02	4.48E-10	5.46E-09
Total	3.07E+03	8.11E+03	1.09E-04	4.76E-03

5.6 Commercial flush valve: TEU2LA(R)

Cradle-to-gate

Figure 20 shows the results per functional unit for the finished products. The brass and stainless steel SUS304 parts, together with the printed wiring board, have significant material contributions, and other manufacturing processes such as polishing and potting have significant processing contributions to the results.

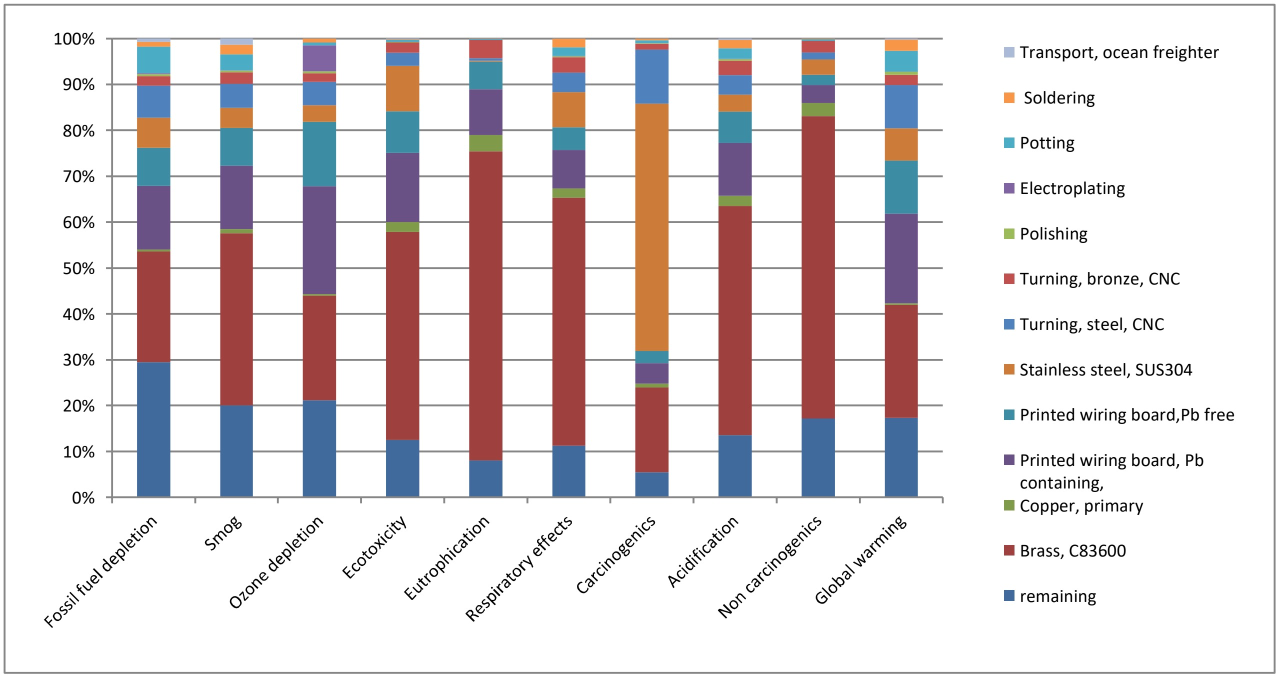


Figure 20. Cradle-to-gate impacts for TEU2LA(R) – relative results

Full life cycle

Figure 21 and Table 5.6a show the results for the full life cycle of the product. While the product itself [A1-A3] is significant in all impact categories, it is the impacts associated with the use phase [B1-B7] which dominate all categories. The magnitude of the use phase impacts primarily results from the contributions of the 6.5 replacement flush valves [B4] required to meet the estimated service life of the building (ESL), the reporting of which include all life-cycle impacts associated with the production, transport, use and disposal of the replacements. Although impacts from the rest are rather insignificant (compared with [B4]), it can be noted that results show that the production [A1-A3] dominates all impact categories and is most significant as a contributor to eutrophication (mostly defined by emissions from copper mining), non-carcinogens (emissions from the production of coal, copper and zinc) and ecotoxicity (mostly from disposal of steel slags and bottom ashes from coal fired power plants, and barium emissions to water from the extraction process of natural gas). The impacts for the production of the product itself [A1-A3] are discussed above in the cradle-to-gate section. The use phase [B1-B7] is relevant to some impact categories, especially fossil fuel depletion, ozone depletion, carcinogens, and global warming. This is mostly due to the embedded electricity used for the water supply and the water consumed during use. It does not appear that the use phase is significant to ecotoxicity, eutrophication, or non-carcinogens. The transportation to the installation site [A4], the construction/installation of the product and the processes for dismantling [A5], and the final waste treatment of the product [C1-C4] do not have a significant impact according to these results. The significant impact of water use in the use module [B6-B7] in all categories is noted, ranging from 9 to 13%.

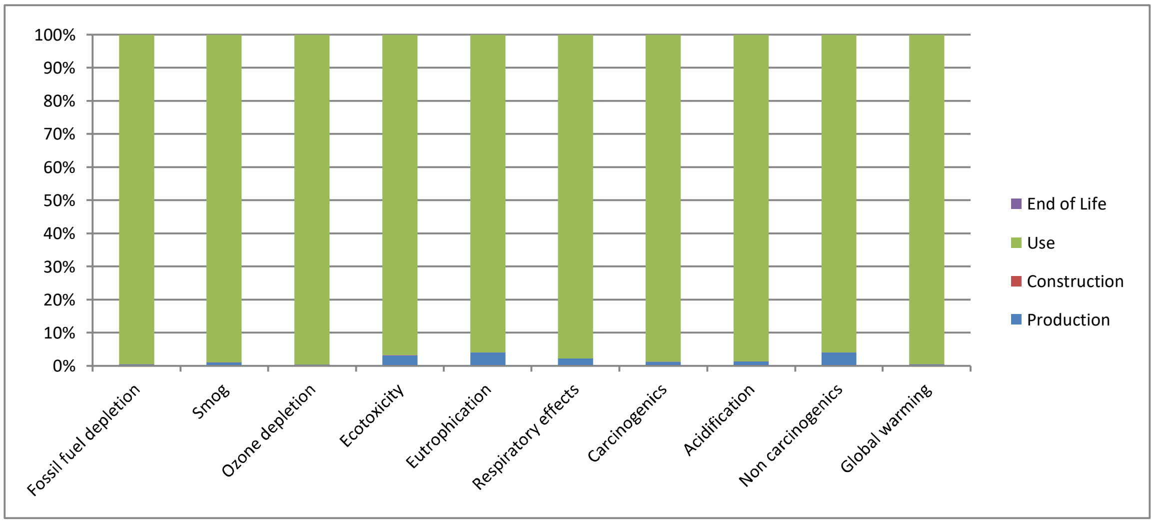


Figure 21. LCIA results for TEU2LA(R) – relative results

Table 5.6a LCIA results for TEU2LA(R)

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	9.42E+00	3.25E-06	8.29E-01	1.34E+00	1.88E-01	7.92E+01
A4	1.15E-01	1.13E-09	2.54E-04	3.92E-03	6.25E-05	6.43E-01
A5	8.94E-04	1.16E-09	4.79E-04	8.09E-05	6.37E-06	3.10E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.95E-01	5.06E-07	5.07E-03	4.57E-02	3.85E-03	8.08E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	7.31E+02	6.24E-04	1.80E+01	8.39E+01	6.80E+00	1.39E+04
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	9.44E+01	8.97E-05	1.14E+00	1.03E+01	6.95E-01	1.98E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	7.85E-03	8.69E-11	1.77E-05	2.73E-04	4.25E-06	4.93E-02
C3	3.58E-02	3.03E-08	2.61E-04	1.71E-03	2.31E-04	2.30E-01
C4	3.26E-03	4.60E-09	6.39E-05	2.68E-04	2.18E-05	6.09E-02
Total	8.36E+02	7.17E-04	1.99E+01	9.56E+01	7.69E+00	1.59E+04

SM results

The SM millipoint score by life cycle phase for this product is presented below (Table 5.6b). They confirm the trends in the results using the impact assessment results prior to normalization and weighting.

Table 5.6b SM millipoint scores for T TEU2LA(R) by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	1410	26.3	0.0642	1383	0.0425

Additional LCIA impact categories are reported as additional environmental information.

Table 5.6c: Additional Environmental Information: TEU2LA(R)

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	4.90E+01	3.36E+02	5.29E-06	1.36E-04
A4	1.14E+00	1.58E+00	8.88E-09	8.29E-08
A5	1.16E-02	7.59E-03	1.48E-10	1.52E-09
B1	0	0	0	0
B2	2.23E+01	3.85E+00	1.60E-07	1.58E-06
B3	0	0	0	0
B4	8.48E+03	8.51E+03	3.23E-04	2.70E-03
B5	0	0	0	0
B6-B7	1.19E+03	6.82E+02	4.07E-05	1.68E-04
C1	0	0	0	0
C2	0.087	0.121	6.81E-10	6.36E-09
C3	3.17E-01	3.51E-01	4.70E-09	2.51E-07
C4	4.52E-02	2.95E-02	3.74E-10	3.60E-09
Total	9.74E+03	9.53E+03	3.70E-04	3.00E-03

5.7 Commercial flush valve: TEU2UA(R)

This section includes the weighted averaged results based on production volumes.

Cradle-to-gate

Figure 22 shows the results for the finished product. It shows that the brass and stainless steel, SUS304, parts, together with the printed wiring board have significant material contributions and that other manufacturing processes such as polishing and potting have significant processing contributions to the results.

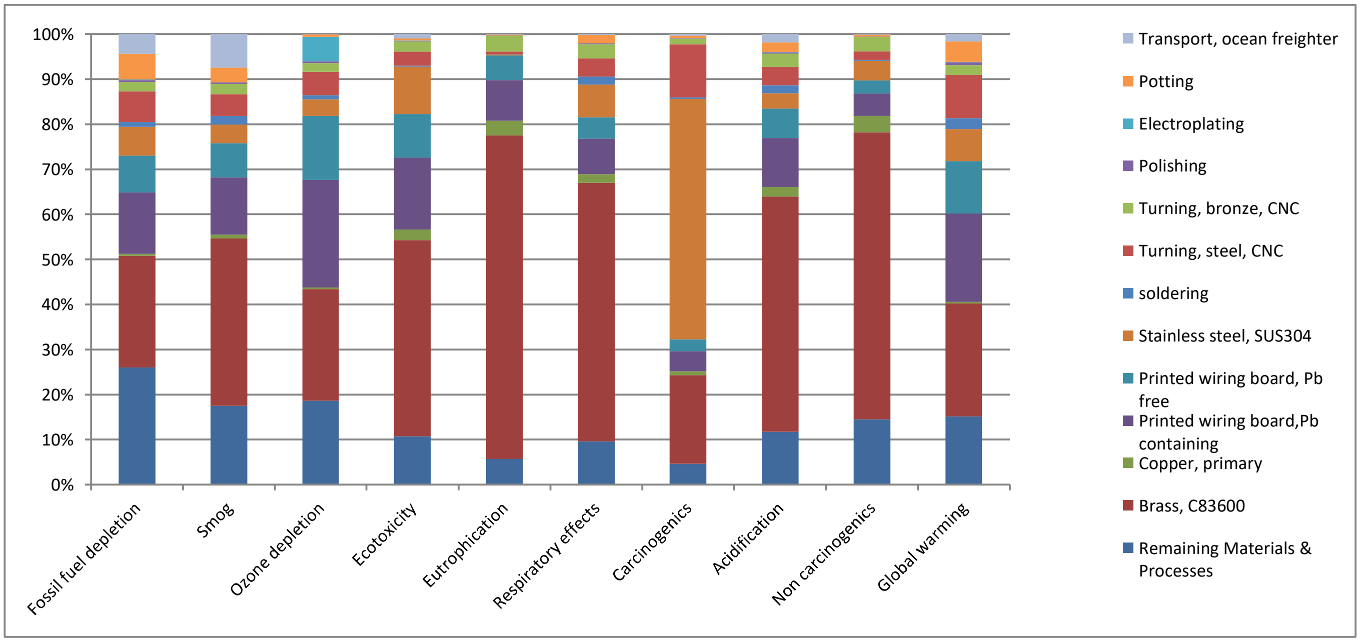


Figure 22. Cradle-to-gate impacts for TEU2UA(R) – relative results

Full life cycle

Figure 23 and Table 5.7a show the results per functional unit for the finished products product. While the product itself [A1-A3] is significant in all impact categories, it is the impacts associated with the use phase [B1-B7] which dominate all categories. The magnitude of the use phase impacts primarily results from the contributions of the 6.5 replacement flush valves [B4] required to meet the estimated service life of the building (ESL), the reporting of which include all life-cycle impacts associated with the production, transport, use and disposal of the replacements. Although impacts from the rest are rather insignificant (compared with [B4]), it can be noted that results show the significant contributions from [A1-A3]. It has the most significant contributions to eutrophication (mostly defined by emissions from copper and gold mining), non carcinogenics (emissions from the production of copper, zinc and lead) and ecotoxicity (mostly from emissions during mining of copper, ferrochromium (steel) and gold). The impacts for the product itself [A1-A3] are discussed above in the cradle-to-gate section. Transportation to site [A4] for the delivery, [A5] for the construction and the processes for dismantling and final waste treatment [C1-C4] of the product do not have a significant impact. The significant impact of water use in the use module [B6-B7] in all categories is noted, ranging from 9 to 13%. This is mostly due to the electricity used for the water supply and operation of the product

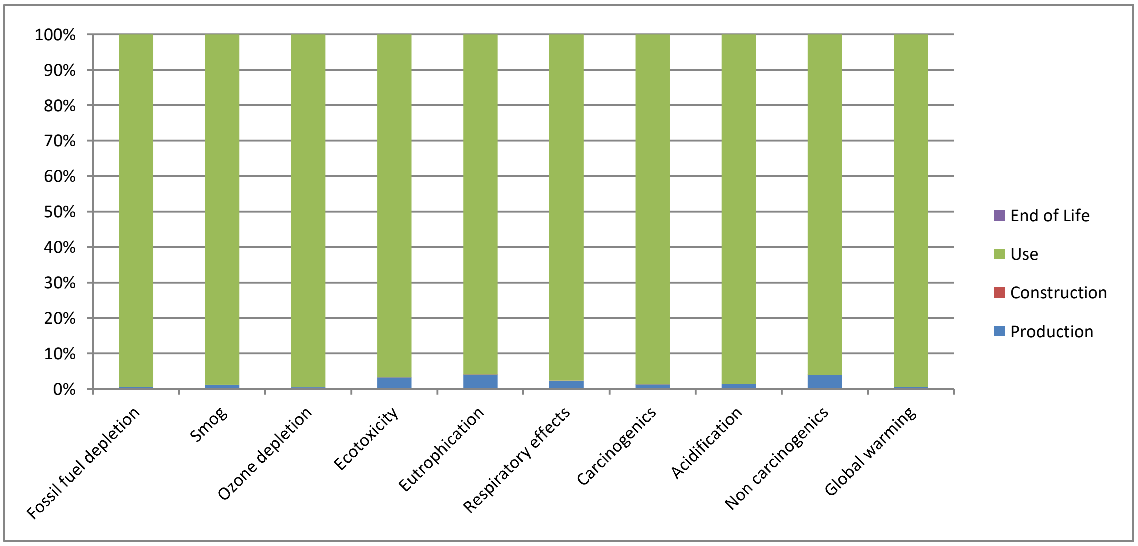


Figure 23. LCIA results for TEU2UA(R) – relative results

Table 5.7a LCIA results for TEU2UA(R)

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	9.69E+00	3.26E-06	9.25E-01	1.42E+00	2.02E-01	7.90E+01
A1-A3	1.09E-01	1.07E-09	2.41E-04	3.72E-03	5.93E-05	6.09E-01
A4	8.94E-04	1.16E-09	4.79E-04	8.09E-05	6.37E-06	3.10E-01
A5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	3.95E-01	5.06E-07	5.07E-03	4.57E-02	3.85E-03	8.08E+00
B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B3	2.74E+02	1.87E-04	1.37E+01	3.45E+01	3.57E+00	4.22E+03
B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	2.36E+01	2.24E-05	2.84E-01	2.58E+00	1.74E-01	4.95E+02
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	7.38E-03	7.48E-10	1.57E-05	2.70E-04	4.81E-06	4.56E-02
C2	3.81E-02	3.10E-08	2.66E-04	1.78E-03	2.41E-04	2.33E-01
C3	3.11E-03	4.26E-09	6.00E-05	2.62E-04	2.13E-05	5.79E-02
C4	3.08E+02	2.13E-04	1.49E+01	3.86E+01	3.95E+00	4.80E+03
Total	9.69E+00	3.26E-06	9.25E-01	1.42E+00	2.02E-01	7.90E+01

SM results

The SM millipoint score by life cycle phase for this product is presented below (Table 5.7b). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.7b Averaged SM millipoint scores for TEU2UA(R) by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	589	25.2	0.0612	563	0.0423

Additional LCIA impact categories are reported as additional environmental information.

Table 5.7c: Additional Environmental Information: TEU2UA(R)

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	4.93E+01	3.18E+02	5.37E-06	1.09E-04
A4	1.08E+00	1.50E+00	8.42E-09	7.86E-08
A5	1.16E-02	7.59E-03	1.48E-10	1.52E-09
B1	0	0	0	0
B2	2.23E+01	3.85E+00	1.60E-07	1.58E-06
B3	0	0	0	0
B4	2.67E+03	4.93E+03	1.26E-04	1.51E-03
B5	0	0	0	0
B6-B7	2.98E+02	1.71E+02	1.02E-05	4.19E-05
C1	0	0	0	0
C2	0.0817	0.115	6.24E-10	5.95E-09
C3	3.28E-01	3.50E-01	4.68E-09	2.51E-07
C4	4.22E-02	2.83E-02	3.62E-10	3.53E-09
Total	3.04E+03	5.42E+03	1.42E-04	1.67E-03

5.8 Commercial flush valve: TET1(6)UB(X)

Cradle-to-gate

Figure 24 shows the results per functional unit for the finished products. Bronze and zinc parts, together with the printed wiring board have significant material contributions to the results. The stainless steel material is relevant to the carcinogenics category. The electroplating process is a major contributor to the ozone depletion category while the die casting process is relevant to the ecotoxicity and non-carcinogenics categories. Furthermore, polishing and potting have somewhat significant processing contribution to the results. Because these products are manufactured in Vietnam but sold in the US market, the transportation via oceanic freighter appears as a relevant contributor to the fossil fuel depletion and smog categories. The other parts and processes contribute between 3% and 15% of the overall impacts in the remaining categories.

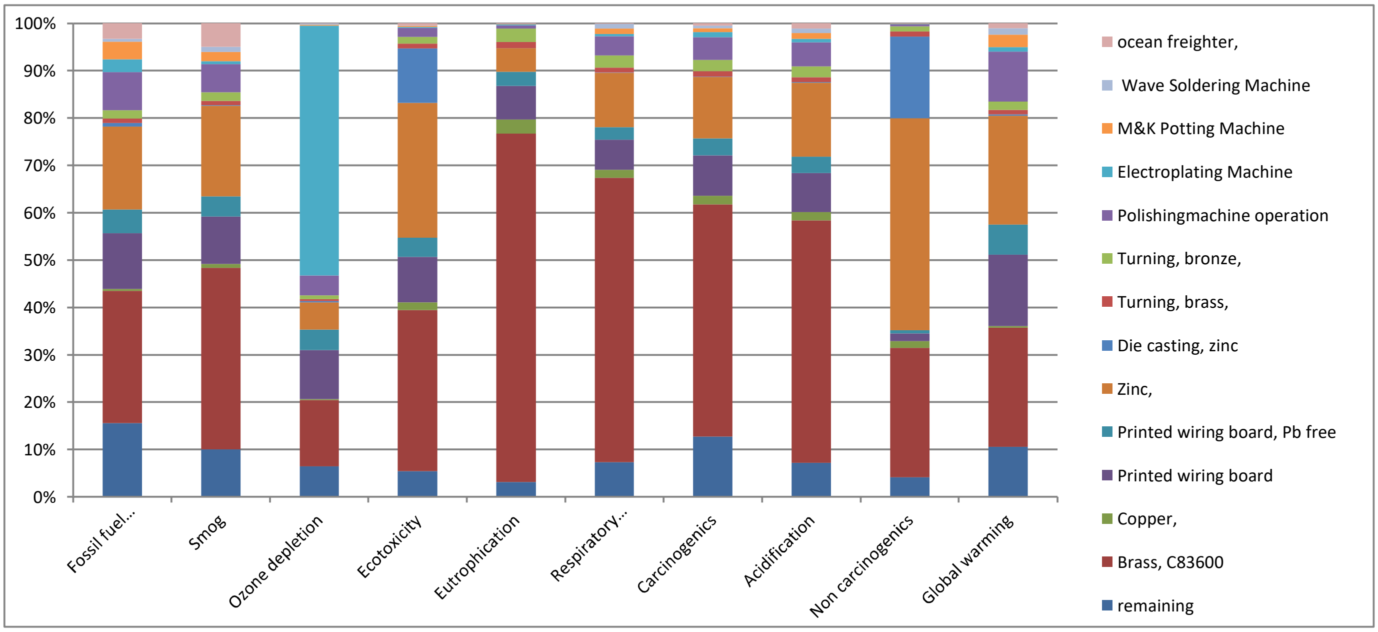


Figure 24. Cradle-to-gate impacts for TET1(6)UB(X) – relative results

Full life cycle

Figure 25 and Table 5.8a show the results per functional unit for the full life cycle of the product. While the product itself [A1-A3] is significant in all impact categories, it is the impacts associated with the use phase [B1-B7] which dominate all categories. The magnitude of the use phase impacts primarily results from the contributions of the 6.5 replacement flush valves [B4] required to meet the estimated service life of the building (ESL), the reporting of which include all life-cycle impacts associated with the production, transport, use and disposal of the replacements. Although impacts from the rest are rather insignificant (compared with [B4]), it can be noted that results show that the use phase dominates all impact categories, with the exception of non carcinogenics. The use phase [B1-B7] is highly significant for global warming, fossil fuel depletion, carcinogenics, and ozone depletion. This is mostly due to the embedded electricity used for the water supply and the water consumed during use. The production phase [A1-A3] has a significant contribution to eutrophication (mostly defined by emissions from copper mining), non-carcinogenics (emissions from the production of coal, copper and zinc) and ecotoxicity (mostly from disposal of steel slags and bottom ashes from coal fired power plants, and barium emissions to water from the extraction process of natural gas). The impacts for the production of the product itself [A1-A3] are discussed above in the cradle-to-gate section. The transportation to the installation site [A4], the construction/installation of the product and the processes for dismantling [A5], and the final waste treatment of the product [C1-C4] do not have a significant impact according to these results. The significant impact of water use in the use module [B6-B7] in all categories is noted, ranging from 9 to 13%. This is mostly due to the electricity used for the water supply and operation of the product

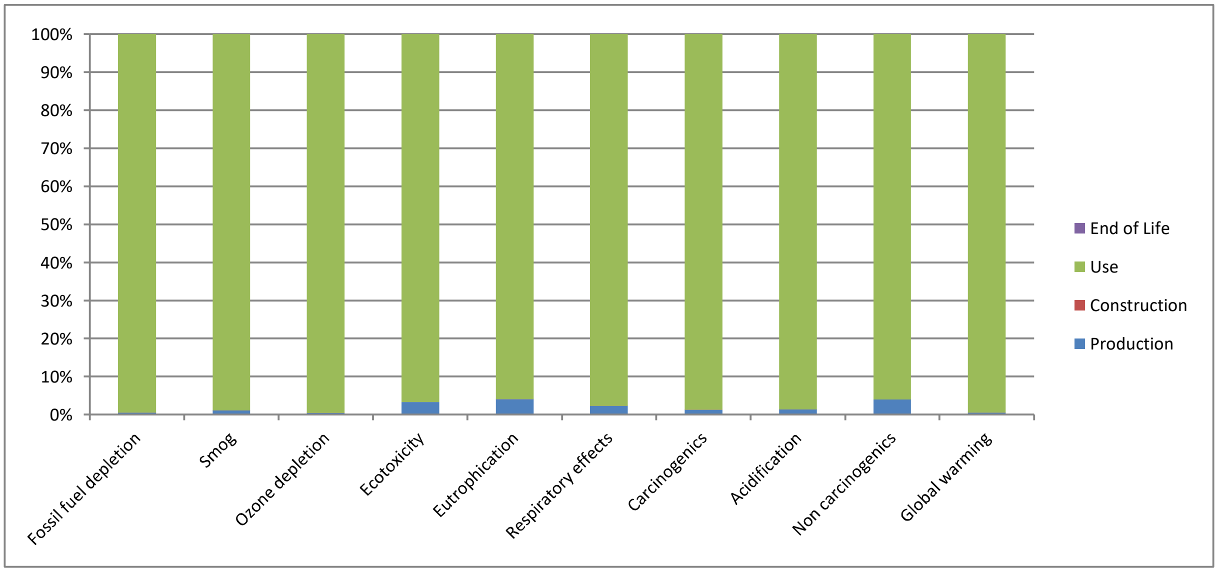


Figure 25. LCIA results for TET1(6)UB(X) – relative results

Table 5.8a LCIA results for TET1(6)UB(X)

Parameter	**Smog**	**Ozone depletion**	**Eutrophication**	**Acidification**	**Respiratory effects**	**Global warming**
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	1.30E+01	7.34E-06	1.16E+00	1.89E+00	2.47E-01	1.02E+02
A4	1.18E-01	1.16E-09	2.60E-04	4.01E-03	6.40E-05	6.58E-01
A5	9.83E-04	1.28E-09	5.15E-04	8.55E-05	6.83E-06	3.24E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.95E-01	5.06E-07	5.07E-03	4.57E-02	3.85E-03	8.08E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	1.99E+03	1.84E-03	3.67E+01	2.24E+02	1.65E+01	3.98E+04
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	2.83E+02	2.69E-04	3.41E+00	3.09E+01	2.09E+00	5.94E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	7.43E-03	8.22E-11	1.68E-05	2.58E-04	4.02E-06	4.66E-02
C3	4.67E-02	2.71E-08	1.58E-04	1.61E-03	2.04E-04	1.72E-01
C4	4.07E-03	5.00E-09	5.37E-05	3.08E-04	2.45E-05	5.15E-02
Total	2.29E+03	2.12E-03	4.13E+01	2.57E+02	1.88E+01	4.59E+04

SM results

The SM millipoint scores per functional unit by life cycle phase for this product are presented below (Table 5.8b). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.8b SM millipoint scores for TET1(6)UB(X) by life cycle phase – absolute results

Impact category	**Unit**	**Total**	**PRODUCTION (A1-A3)**	**CONSTRUCTION (A4-A5)**	**USE (B1-B7)**	**END OF LIFE (C1-C4)**
SM single figure score	mPts	3687	35.8	0.0659	3652	0.0192

Additional LCIA impact categories are reported as additional environmental information.

Table 5.8c: Additional Environmental Information: TET1(6)UB(X)

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	5.85E+01	5.25E+02	2.77E-06	3.24E-04
A4	1.16E+00	1.62E+00	9.09E-09	8.49E-08
A5	1.28E-02	1.01E-02	1.61E-10	1.62E-09
B1	0	0	0	0
B2	2.23E+01	3.85E+00	1.60E-07	1.58E-06
B3	0	0	0	0
B4	2.41E+04	1.97E+04	8.27E-04	7.17E-03
B5	0	0	0	0
B6-B7	3.58E+03	2.05E+03	1.22E-04	5.03E-04
C1	0	0	0	0
C2	0.0823	0.115	6.44E-10	6.01E-09
C3	3.19E-01	3.58E-02	1.41E-09	6.27E-09
C4	5.12E-02	6.80E-02	4.60E-10	5.52E-09
Total	2.77E+04	2.23E+04	9.52E-04	8.00E-03

5.9 Commercial flush valve: TET1(6)LB(X)

Cradle-to-gate

Figure 26 shows the results for the finished product. Bronze and zinc parts, together with the printed wiring board have significant material contributions to the results. The stainless steel material is relevant to the carcinogenics category. The electroplating process is a major contributor to the ozone depletion category while the die casting process is relevant to the ecotoxicity and non-carcinogenics categories. Furthermore, polishing and potting have somewhat significant processing contribution to the results. Because these products are manufactured in Vietnam but sold in the US market, the transportation via oceanic freighter appears as a relevant contributor to the fossil fuel depletion and smog categories. The other parts and processes contribute between 3% and 15% of the overall impacts in the remaining categories.

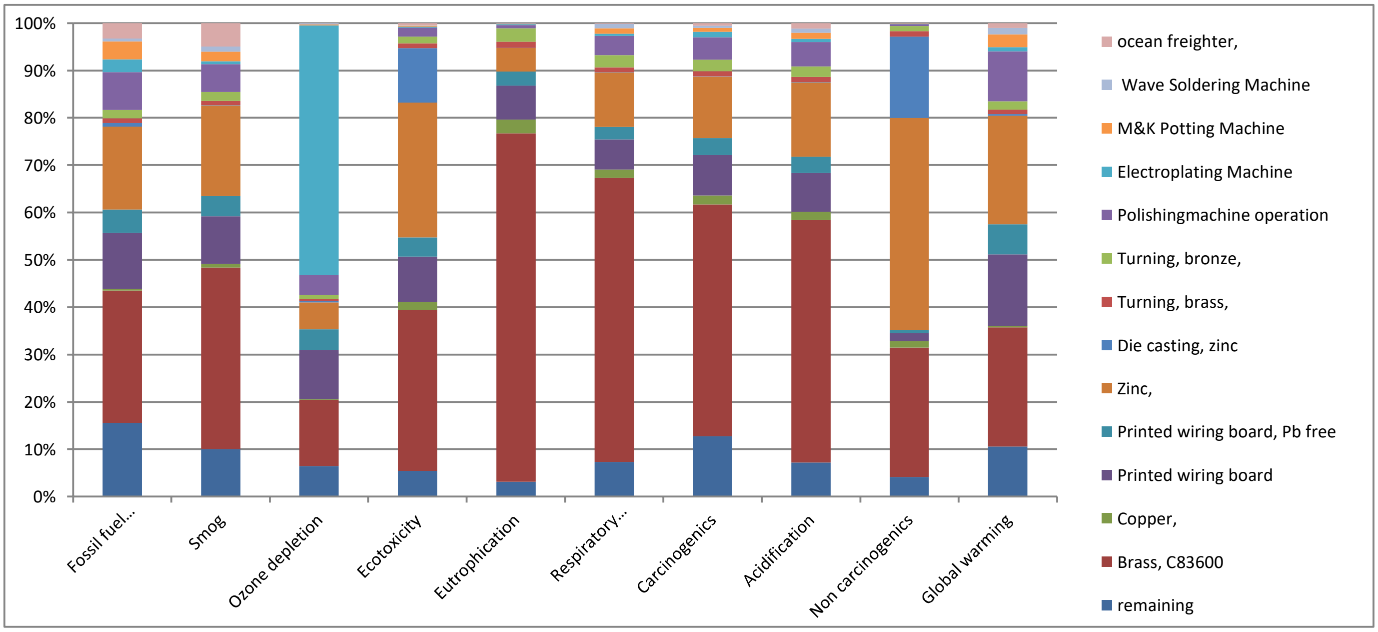


Figure 26. Cradle-to-gate impacts for TET1(6)LB(X) – relative results

Full life cycle

Figure 27 and Table 5.9a show the results for the full life cycle of the product. While the product itself [A1-A3] is significant in all impact categories, it is the impacts associated with the use phase [B1-B7] which dominate all categories. The magnitude of the use phase impacts primarily results from the contributions of the 6.5 replacement flush valves [B4] required to meet the estimated service life of the building (ESL), the reporting of which include all life-cycle impacts associated with the production, transport, use and disposal of the replacements. Although impacts from the rest are rather insignificant (compared with [B4]), it can be noted that results show that the use phase dominates all impact categories, with the exception of non carcinogenics. The use phase [B1-B7] is highly significant for global warming, fossil fuel depletion, carcinogenics, and ozone depletion. This is mostly due to the embedded electricity used for the water supply and the water consumed during use. The production phase [A1-A3] has a significant contribution to eutrophication (mostly defined by emissions from copper mining), non carcinogenics (emissions from the production of coal, copper and zinc) and ecotoxicity (mostly from disposal of steel slags and bottom ashes from coal fired power plants, and barium emissions to water from the extraction process of natural gas). The impacts for the production of the product itself [A1-A3] are discussed above in the cradle-to-gate section. The transportation to the installation site [A4], the construction/installation of the product and the processes for dismantling [A5], and the final waste treatment of the product [C1-C4] do not have a significant impact according to these results. The significant impact of water use in the use module [B6-B7] in all categories is noted, ranging from 9 to 13%. This is mostly due to the electricity used for the water supply and operation of the product

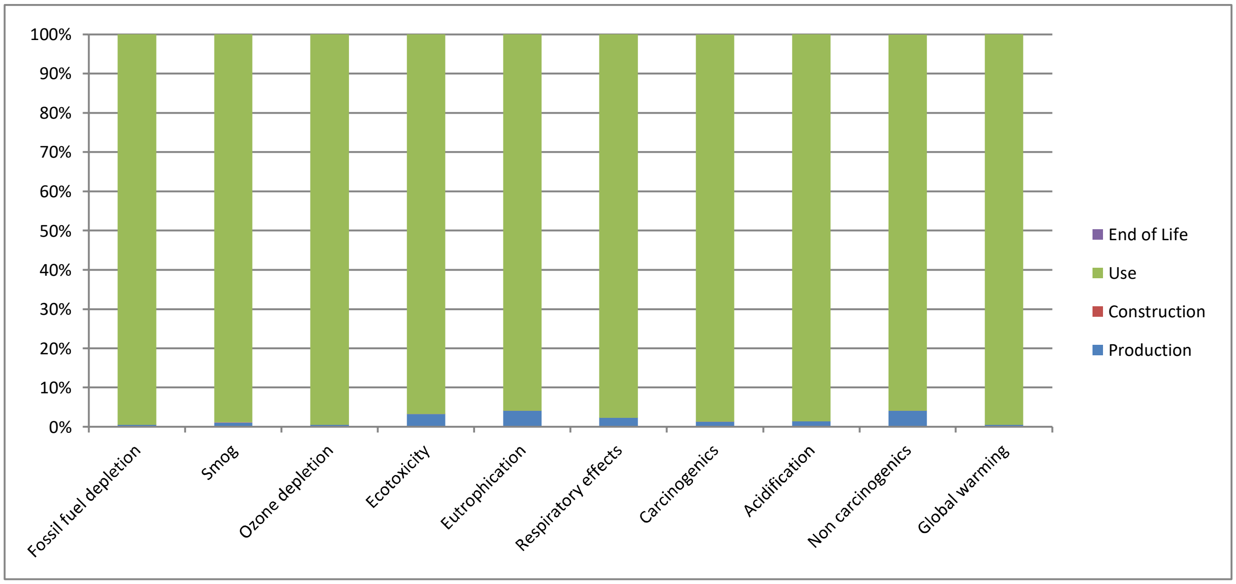


Figure 27. LCIA results for TET1(6)LB(X) – relative results

Table 5.9a LCIA results for TET1(6)LB(X)

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	1.30E+01	7.34E-06	1.16E+00	1.89E+00	2.47E-01	1.02E+02
A1-A3	1.18E-01	1.16E-09	2.60E-04	4.01E-03	6.40E-05	6.58E-01
A4	9.83E-04	1.28E-09	5.15E-04	8.55E-05	6.83E-06	3.24E-01
A5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B1	3.95E-01	5.06E-07	5.07E-03	4.57E-02	3.85E-03	8.08E+00
B2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B3	2.51E+03	2.33E-03	4.29E+01	2.80E+02	2.03E+01	5.06E+04
B4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B5	3.62E+02	3.44E-04	4.36E+00	3.96E+01	2.67E+00	7.60E+03
B6-B7	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C1	7.43E-03	8.22E-11	1.68E-05	2.58E-04	4.02E-06	4.66E-02
C2	4.67E-02	2.71E-08	1.58E-04	1.61E-03	2.04E-04	1.72E-01
C3	4.07E-03	5.00E-09	5.37E-05	3.08E-04	2.45E-05	5.15E-02
C4	2.88E+03	2.68E-03	4.84E+01	3.22E+02	2.32E+01	5.84E+04
Total	1.30E+01	7.34E-06	1.16E+00	1.89E+00	2.47E-01	1.02E+02

SM results

The SM millipoint scores by life cycle phase for this product are presented below (Table 5.9b). They confirm the trends in the results using the impact assessment results before normalization and weighting.

Table 5.9b SM millipoint scores for TET1(6)LB(X) by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure	mPts	4589	35.8	0.0659	4553	0.0192

score						

Additional LCIA impact categories are reported as additional environmental information.

Table 5.9c: Additional Environmental Information: TET1(6)LB(X)

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	5.85E+01	5.25E+02	2.77E-06	3.24E-04
A4	1.16E+00	1.62E+00	9.09E-09	8.49E-08
A5	1.28E-02	1.01E-02	1.61E-10	1.62E-09
B1	0	0	0	0
B2	2.23E+01	3.85E+00	1.60E-07	1.58E-06
B3	0	0	0	0
B4	3.06E+04	2.34E+04	1.05E-03	8.08E-03
B5	0	0	0	0
B6-B7	4.58E+03	2.62E+03	1.56E-04	6.44E-04
C1	0	0	0	0
C2	0.0823	0.115	6.44E-10	6.01E-09
C3	3.19E-01	3.58E-02	1.41E-09	6.27E-09
C4	5.12E-02	6.80E-02	4.60E-10	5.52E-09
Total	3.52E+04	2.66E+04	1.21E-03	9.05E-03

5.10 Commercial flush valve: TET2UB(X)

Cradle-to-gate

Figure 28 shows the results for the finished product. The brass and stainless steel SUS304 parts, together with the printed wiring board, have significant material contributions, and other manufacturing processes such as polishing and potting have significant processing contributions to the results.

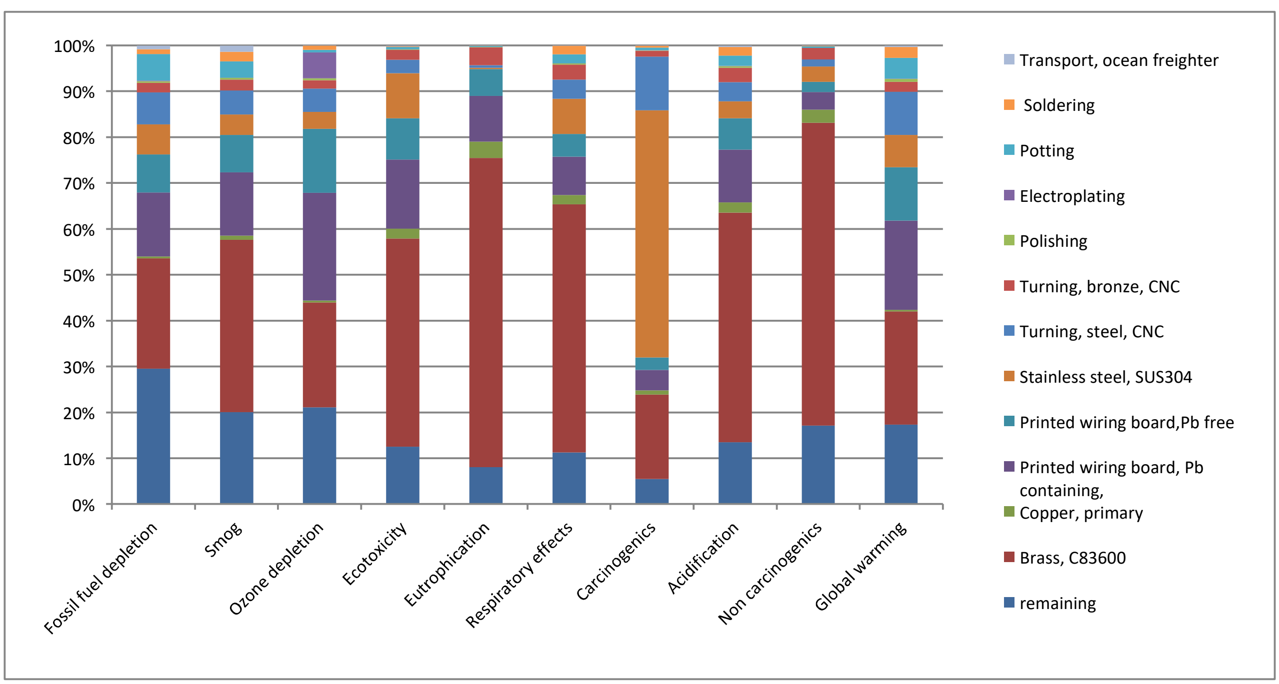


Figure 28. Cradle-to-gate impacts for TET2UB(X) – relative results

Full life cycle

Figure 29 and Table 5.10a show the results per functional unit for the finished products. While the product itself [A1-A3] is significant in all impact categories, it is the impacts associated with the use phase [B1-B7] which dominate all categories. The magnitude of the use phase impacts primarily results from the contributions of the 6.5 replacement flush valves [B4] required to meet the estimated service life of the building (ESL), the reporting of which include all life-cycle impacts associated with the production, transport, use and disposal of the replacements. Although impacts from the rest are rather insignificant (compared with [B4]), it can be noted that results show that The production phase [A1-A3] has a significant contribution to eutrophication (mostly defined by emissions from copper mining), non carcinogenics (emissions from the production of coal, copper and zinc) and ecotoxicity (mostly from disposal of steel slags and bottom ashes from coal fired power plants and barium emissions to water from the extraction process of natural gas). The impacts for the product itself [A1-A3] are discussed above in the cradle-to-gate section. Transportation to site [A4] for the delivery, [A5] for the construction and the processes for dismantling and final waste treatment [C1-C4] of the product do not have a significant impact. The significant impact of water use in the use module [B6-B7] in all categories is noted, ranging from 9 to 13%. This is mostly due to the electricity used for the water supply and operation of the product

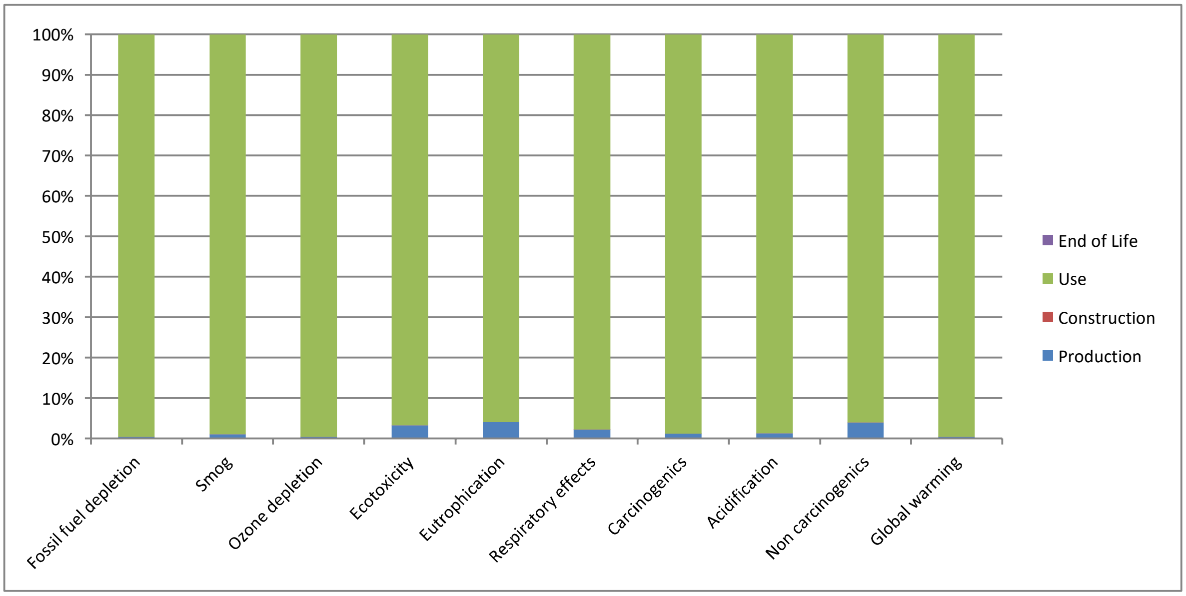


Figure 29. LCIA results for TET2UB(X) – relative results

Table 5.10a LCIA results for TET2UB(X)

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	9.42E+00	3.25E-06	8.29E-01	1.34E+00	1.88E-01	7.92E+01
A4	1.15E-01	1.13E-09	2.54E-04	3.92E-03	6.25E-05	6.43E-01
A5	8.94E-04	1.16E-09	4.79E-04	8.09E-05	6.37E-06	3.10E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.95E-01	5.06E-07	5.07E-03	4.57E-02	3.85E-03	8.08E+00

B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	1.96E+03	1.79E-03	3.27E+01	2.18E+02	1.58E+01	3.96E+04
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	2.83E+02	2.69E-04	3.41E+00	3.09E+01	2.09E+00	5.94E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	7.85E-03	8.69E-11	1.77E-05	2.73E-04	4.25E-06	4.93E-02
C3	3.58E-02	3.03E-08	2.61E-04	1.71E-03	2.31E-04	2.30E-01
C4	3.26E-03	4.60E-09	6.39E-05	2.68E-04	2.18E-05	6.09E-02
Total	2.25E+03	2.06E-03	3.70E+01	2.50E+02	1.81E+01	4.56E+04

SM results

The SM millipoint score by life cycle phase for this product is presented below (Table 5.10b). They confirm the trends in the results using the impact assessment results prior to normalization and weighting.

Table 5.10b SM millipoint scores for TET2UB(X) by life cycle phase – absolute results

Impact category	**Unit**	**Total**	**PRODUCTION (A1-A3)**	**CONSTRUCTION (A4-A5)**	**USE (B1-B7)**	**END OF LIFE (C1-C4)**
SM single figure score	mPts	3553	26.3	0.0642	3527	0.0425

Additional LCIA impact categories are reported as additional environmental information.

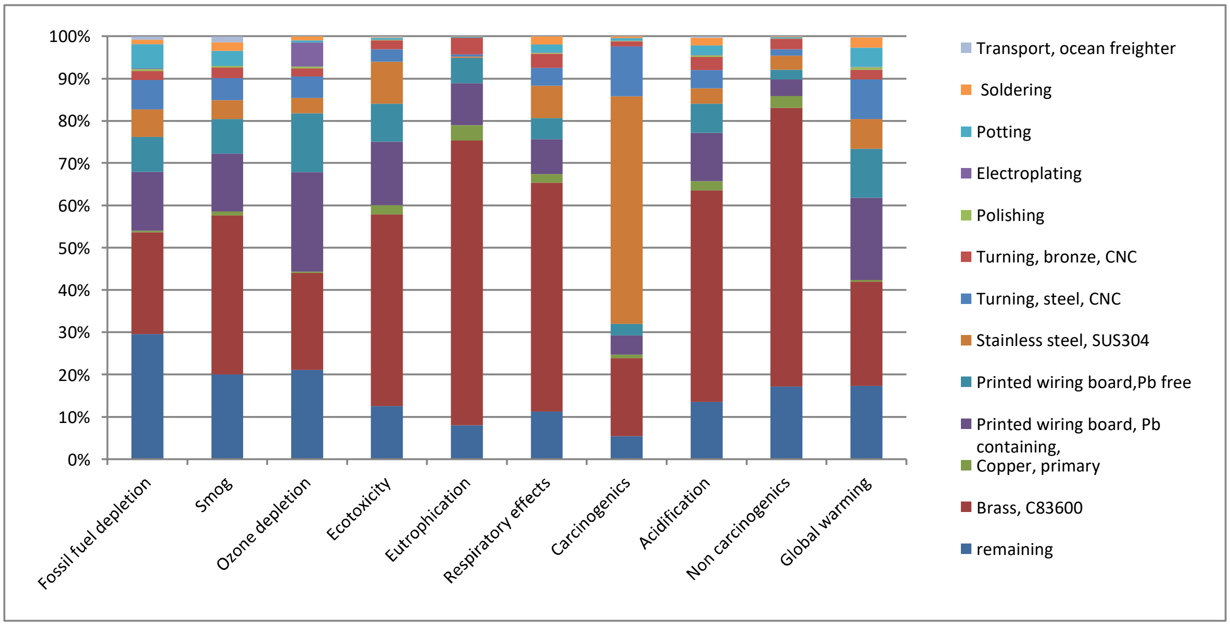
Table 5.10c: Additional Environmental Information: TET1(6)LB(X)

Parameter	**Fossil fuel depletion**	**Ecotoxicity**	**Carcinogenics**	**Non carcinogenics**
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	4.90E+01	3.36E+02	5.29E-06	1.36E-04
A4	1.14E+00	1.58E+00	8.88E-09	8.29E-08
A5	1.16E-02	7.59E-03	1.48E-10	1.52E-09
B1	0	0	0	0
B2	2.23E+01	3.85E+00	1.60E-07	1.58E-06
B3	0	0	0	0
B4	2.40E+04	1.74E+04	8.52E-04	4.88E-03
B5	0	0	0	0
B6-B7	3.58E+03	2.05E+03	1.22E-04	5.03E-04
C1	0	0	0	0
C2	0.087	0.121	6.81E-10	6.36E-09
C3	3.17E-01	3.51E-01	4.70E-09	2.51E-07
C4	4.52E-02	2.95E-02	3.74E-10	3.60E-09
Total	2.76E+04	1.98E+04	9.80E-04	5.52E-03

5.11 Commercial flush valve: TET2LB(X)

Cradle-to-gate

Figure 30 shows the results for the finished product. The brass and stainless steel SUS304 parts, together with the printed wiring board, have significant material contributions, and other manufacturing processes such as polishing and potting have



significant processing contributions to the results.

Figure 30. Cradle-to-gate impacts for TET2LB(X) – relative results

Full life cycle

Figure 31 and Table 5.11a show the results per functional unit for the finished products. While the product itself [A1-A3] is significant in all impact categories, it is the impacts associated with the use phase [B1-B7] which dominate all categories. The magnitude of the use phase impacts primarily results from the contributions of the 6.5 replacement flush valves [B4] required to meet the estimated service life of the building (ESL), the reporting of which include all life-cycle impacts associated with the production, transport, use and disposal of the replacements. Although impacts from the rest are rather insignificant (compared with [B4]), it can be noted that results show that the production phase [A1-A3] has a significant contribution to eutrophication (mostly defined by emissions from copper mining), non carcinogenics (emissions from the production of coal, copper and zinc) and ecotoxicity (mostly from disposal of steel slags and bottom ashes from coal fired power plants and barium emissions to water from the extraction process of natural gas). The impacts for the product itself [A1-A3] are discussed above in the cradle-to-gate section. Transportation to site [A4] for the delivery, [A5] for the construction and the processes for dismantling and final waste treatment [C1-C4] of the product do not have a significant impact. The significant impact of water use in the use module [B6-B7] in all categories is noted, ranging from 9 to 13%. This is mostly due to the electricity used for the water supply and operation of the product

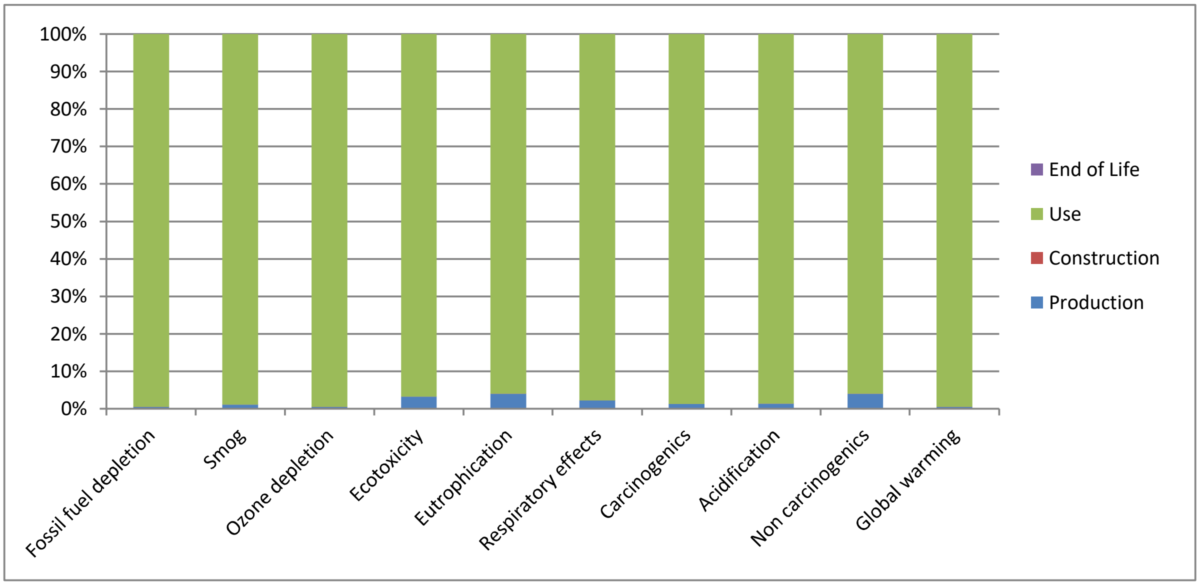


Figure 31. LCIA results for TET2LB(X) – relative results

Table 5.12b LCIA results for TET2LB(X)

Parameter	Smog	Ozone depletion	Eutrophication	Acidification	Respiratory effects	Global warming
Unit	kg O3 eq	kg CFC-11 eq	kg N eq	kg SO2 eq	kg PM2.5 eq	kg CO2 eq
A1-A3	9.42E+00	3.25E-06	8.29E-01	1.34E+00	1.88E-01	7.92E+01
A4	1.15E-01	1.13E-09	2.54E-04	3.92E-03	6.25E-05	6.43E-01
A5	8.94E-04	1.16E-09	4.79E-04	8.09E-05	6.37E-06	3.10E-01
B1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B2	3.95E-01	5.06E-07	5.07E-03	4.57E-02	3.85E-03	8.08E+00
B3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B4	2.47E+03	2.28E-03	3.89E+01	2.74E+02	1.96E+01	5.04E+04
B5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B6-B7	3.62E+02	3.44E-04	4.36E+00	3.96E+01	2.67E+00	7.60E+03
C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C2	7.85E-03	8.69E-11	1.77E-05	2.73E-04	4.25E-06	4.93E-02
C3	3.58E-02	3.03E-08	2.61E-04	1.71E-03	2.31E-04	2.30E-01
C4	3.26E-03	4.60E-09	6.39E-05	2.68E-04	2.18E-05	6.09E-02
Total	2.85E+03	2.63E-03	4.41E+01	3.15E+02	2.25E+01	5.81E+04

SM results

The SM millipoint score by life cycle phase for this product is presented below (Table 5.11b). They confirm the trends in the results using the impact assessment results prior to normalization and weighting.

Table 5.11b SM millipoint scores for TET2LB(X) by life cycle phase – absolute results

Impact category	Unit	Total	PRODUCTION (A1-A3)	CONSTRUCTION (A4-A5)	USE (B1-B7)	END OF LIFE (C1-C4)
SM single figure score	mPts	4445	26.3	0.0642	4418	0.0425

Additional LCIA impact categories are reported as additional environmental information.

Table 5.11c: Additional Environmental Information: TET2LB(X)

Parameter	Fossil fuel depletion	Ecotoxicity	Carcinogenics	Non carcinogenics
Unit	MJ surplus	CTUe	CTUh	CTUh
A1-A3	4.90E+01	3.36E+02	5.29E-06	1.36E-04
A4	1.14E+00	1.58E+00	8.88E-09	8.29E-08
A5	1.16E-02	7.59E-03	1.48E-10	1.52E-09
B1	0	0	0	0
B2	2.23E+01	3.85E+00	1.60E-07	1.58E-06
B3	0	0	0	0
B4	3.05E+04	2.11E+04	1.07E-03	5.79E-03
B5	0	0	0	0
B6-B7	4.58E+03	2.62E+03	1.56E-04	6.44E-04
C1	0	0	0	0
C2	0.087	0.121	6.81E-10	6.36E-09
C3	3.17E-01	3.51E-01	4.70E-09	2.51E-07
C4	4.52E-02	2.95E-02	3.74E-10	3.60E-09
Total	3.51E+04	2.41E+04	1.24E-03	6.57E-03

5.12 Sensitivity analysis

Part A mandates that a sensitivity analysis must be performed using the highest and lowest values for the most important choices and assumptions to check the robustness of the results of the LCA. However, given that this study adheres strictly to the system boundary and scoping requirements as set forth in the PCR, no additional sensitivity analysis of the system boundary is justified.

5.13 Data quality

5.13.1 Data quality requirements

Secondary datasets utilized in the model are disclosed in Appendix A along with data quality indicators related to the geographic, temporal, and technological coverage of the dataset. Additionally, details on proxies are provided, if applicable.

Geographic Coverage

The geographical scope of the manufacturing portion of the life cycle is in Table 5.12.

Table 5.12: Products and their manufacturing locations

	Product Names	Product Numbers	Plant	Location
1	Residential toilet: Drake® II 1.28gpf	CST454CEFG	Lakewood (tank)	Lakewood, GA
			Morrow (bowl)	Morrow, GA
			Thailand (bowl)	Saraburi, Thailand
2	Residential toilet: Drake® II 1G®	CST454CUFG	Lakewood (tank)	Lakewood, GA
			Morrow (bowl)	Morrow, GA
			Thailand (bowl)	Saraburi, Thailand
3	Residential toilet: Eco Ultramax® 1.28gpf	MS854114E	TMX	Monterrey, Mexico
4	Residential toilet: Ultramax II 1G®	MS604124CUFG	Morrow	Morrow, GA
			Thailand	Saraburi, Thailand
5	Residential toilet: Ultramax® II 1.28gpf	MS604124CEFG	Morrow	Morrow, GA
			Thailand	Saraburi, Thailand
6	Commercial faucet: Standard-R Faucet Series	T28S32E, T28S32EM & T28S32ET	TVN	Hanoi, Vietnam
7	Commercial faucet: Standard-S Faucet Series	T27S32E, T27S32EM & T27S32ET		
8	Commercial flush valve: EcoPower HE Urinal EFV	TEU1LAR	TVN	Hanoi, Vietnam
9	Commercial flush valve: EcoPower Ultra Urinal EFV	TEU1UAR	TVN	
10	Commercial flush valve: EcoPower® Urinal Flush Valve	TEU2LAR	TVN	
11	Commercial flush valve: EcoPower® Urinal Flush Valve	TEU2UAR	TVN	
12	Commercial flush valve: EcoPower® Toilet Flush Valve	TET1UB(X)	TVN	Hanoi, Vietnam
13	Commercial flush valve: EcoPower® Toilet Flush Valve	TET1LB(X)	TVN	
14	Commercial flush valve: EcoPower® Toilet Flush Valve	TET2UB(X)	TVN	
15	Commercial flush valve: EcoPower® Toilet Flush Valve	TET2LB(X)	TVN	

All primary data was collected from the manufacturers. The geographic coverage of primary data is considered excellent. The geographical scope of the raw material acquisition is international.

In selecting secondary data (i.e., components data from suppliers), priority was given to the accuracy and representativeness of the data. When available and deemed of significant quality, country-specific data was used. However, priority was given to technological relevance and accuracy in selecting secondary data. This often led to the substitution of regional and/or global data for country-specific data. The geographical coverage of secondary datasets can be referenced in the dataset references table in Appendix A. Overall geographic data quality is considered good.

Time Coverage

Primary data was provided by the manufacturer and represents all information for calendar year 2023. Using this data meets the PCR requirements. Time coverage of this primary data is considered excellent. Data necessary to model cradle-to-grave unit processes were sourced from SimaPro v9.5. Time coverage of the datasets varies from approximately 2022 to present. One exception is a dataset from 2016, but the overall contribution of that dataset to results is negligible. All datasets rely on at least one 1-year average data. Overall time coverage of the datasets is considered good and meets the requirement of the PCR that all data be updated within a 10-year period. The specific time coverage of secondary datasets can be found in Table 5.13.

Technological Coverage

Primary data provided by the manufacturers is specific to the technology the company uses in manufacturing their product. It is site-specific and considered good quality. It is worth noting that the energy and water used in manufacturing the product includes overhead energy such as lighting, heating, and sanitary use of water. Sub-metering was not available to extract process-only energy and water use from the total energy use. Sub-metering would improve the technological coverage of data quality. Data necessary to model cradle-to-grave unit processes were sourced from SimaPro. Technological coverage of the datasets is considered good relative to the actual supply chain of the manufacturer. While improved life cycle data from suppliers would improve technological coverage, the use of lower-quality generic datasets does meet the goal of this LCA.

Treatment of Missing Data

Primary data were used for all manufacturing processes. Whenever available, supplier data was used for raw materials used in the production process. When primary data did not exist, secondary data for raw material production were obtained from the SimaPro database, as shown in Table 5.13. Any proxies used for raw materials have also been detailed in Table 5.13.

Data Quality Assessment

Appendix A shows an assessment for the data quality of all secondary processes included in the model. The following sections provide details on the data quality of the model itself.

Precision

The precision of the data is considered high. Product engineers provided detailed bills of materials, and facility managers provided utility information for the manufacturing facilities. The raw material transportation distances were calculated based on the raw material manufacturers' addresses, extracted from the relevant SDSs. Proxy datasets were utilized in the LCA model when secondary data were not available, as shown in Table 5.13. Precision can be increased via sub-metering individual manufacturing processes to better account for manufacturing processes rather than including overhead utility information.

Adjustments to the background data used in the model were made to improve the accuracy of the data sets. Tap water consumption was modified to reflect the average electricity usage per gallon of water consumed during production as per the PCR. For some data sets, US data was used where possible to represent production in the US.

The Indonesia electricity data set was used as a proxy for toilet tank production in Thailand, since a country-specific electricity data set was not available. The geographical and technological representativeness of the Thailand data set used to represent electricity use in Indonesia is considered to be high.

Completeness

The data included is considered complete. The LCA model included all known material and energy flows. As pointed out in that section, no known flows above 1% were excluded and the sum of all excluded flows totals less than 5%, whether evaluated by mass, energy, or potential environmental impact.

Consistency

The consistency of the model is considered high. The bills of materials provided by the product engineers were developed for multiple internal departments' use and are maintained regularly. The LCA practitioner also cross-referenced the installation documents and other relevant information to ensure consistency. Furthermore, modeling assumptions were consistent across the model, with preference given towards SimaPro data, where available.

Reproducibility

This study is considered reproducible. Descriptions of the data and assumptions through this report would allow a practitioner to utilize the LCA tool to generate results for the products.

Uncertainty

Uncertainty for the secondary datasets is discussed in the documentation published by Ecoinvent for the SimaPro LCI database. The uncertainty of the primary data comes from the utility data allocated to each product. The yearly total energy use changes over time due to more efficient operations, warmer or cooler seasons and other factors. Because energy data comes directly from utility bills, the uncertainty is mainly based on the accuracy of the utility meters. The allowable error for a water meter remaining in service can be varied from 4% to 7% in the manufacturing countries. For watthour meters and gas meters, the allowable error can be varied from 2% to 6%.

Table 5.13 Key datasets used in inventory analysis

Dataset	**Source**	**Year of Last Update**	**Time Coverage**	**Geographical Coverage**	**Technological Coverage**	**Overall Representatives**	**Relevant Module**	**Description**
Stainless steel, SUS303 (austenitic) 9% Ni 18% Cr US-EI China	Ecoinvent	2021	within 10-year period	**China**	Appropriate technology	very good	A1-A3	Raw materials
Zinc, primary, at regional	Ecoinvent	2021	within 10-year period	Vietnam	Appropriate technology	very good	A1-A3	Raw materials

storage/US- US-EI U								
Injection moulding/US- US-EI U	USLCI	2020	within 10-year period	Vietnam	Appropriate technology	good	A1-A3	Raw materials
Sheet rolling, steel/US- US-EI U	USLCI	2021	within 10-year period	Vietnam	Appropriate technology	good	A1-A3	Raw materials
Die casting, zinc US-EI China *Modified to include US electricity*	Ecoinvent	2021	within 10-year period	China	Appropriate technology	very good	A1-A3	Raw materials
Slack wax, at plant, US SE NREL/US U	Ecoinvent	2021	within 10-year period	US	Appropriate technology	very good	A5	Ancillary materials
China clay, Kaolin KTcast A/F US-EI 2.2	Ecoinvent	2021	within 10-year period	US	Appropriate technology	very good	A1-A3	Raw materials
Brass, at plant/US* US-EI U	Ecoinvent	2021	within 10-year period	US	Appropriate technology	very good	A1-A3	Raw materials
Synthetic rubber, at plant/US- US-EI U	Ecoinvent	2021	within 10-year period	US	Appropriate technology	very good	A1-A3	Raw materials
Silica sand, at plant/US** US-EI U	Ecoinvent	2022	within 10-year period	US	Appropriate technology	very good	A1-A3	Raw materials
Feldspar, at plant/RER S	Ecoinvent	2022	within 10-year period	US	Appropriate technology	very good	A1-A3	Raw materials
Limestone, milled, packed, at plant/US* US-EI U	Ecoinvent	2022	within 10-year period	US	Appropriate technology	very good	A1-A3	Raw materials
Corrugated board, fresh fibre, double wall, at plant/RER U US-EI 2.2	Ecoinvent	2012	within 10-year period	US	Appropriate technology	very good	A1-A3	Raw materials
Dolomite, milled, loose US-EI 2.2	USLCI	2012	within 10-year period	US	Appropriate technology	very good	A1-A3	Raw materials
Tap water, at user/US- US-EI U	Ecoinvent	2022	within 10-year period	US	Appropriate technology	Good; technologic proxy	A1-A3	Raw materials
Polypropylene, granulate, at plant/US- US-EI U	USLCI	2012	within 10-year period	US	Appropriate technology	very good	A1-A3	Raw materials
Rubber sealing compound (EN15804 A1-A3)	Ecoinvent	2022	within 10-year period	US	Appropriate technology	very good	A1-A3	Raw materials
Heat, natural gas, at boiler condensing modulating >100kW/RER U	USLCI	2020	within 10-year period	India	Appropriate technology	good	A1-A3	Energy
Electricity, low voltage, at grid, Indonesia FY2016 US-EI 2.2	USLCI	2016	within 10-year period	Indonesia	Appropriate technology	Very good; technologic proxy	A1-A3	Energy
Electricity, low voltage, at grid, Mexico US-EI 2.2	USLCI	2020	within 10-year period	Mexico	Appropriate technology	good	A1-A3	Energy
Electricity mix, eGrid Subregion, SRSO/US U October 2023US-EI 2.2	US EPA	2023	within 10-year period	US	Appropriate technology	good	A1-A3	Energy
Electricity, low voltage, at grid, 2021/US US-EI U	USLCI	2021	within 10-year period	US	Appropriate technology	good	B6-B7	Energy

Heat, natural gas, at boiler condensing modulating >100kW/RER U	USLCI	2020	within 10-year period	Indonesia	Appropriate technology	good	A1-A3	Energy
Electricity, low voltage, at grid, Vietnam FY2016 US-EI 2.2	USLCI	2016	within 10-year period	Vietnam	Appropriate technology	good	A1-A3	Energy
Heat, natural gas, at boiler modulating <100kW/RER S	USLCI	2020	within 10-year period	Vietnam	Appropriate technology	good	A1-A3	Energy
Transport, combination truck, average fuel mix NREL/US U	Ecoinvent	2021	within 10-year period	Vietnam	Appropriate technology	good	A4	Transport
Transport, train, diesel powered NREL/US U	Ecoinvent	2021	within 10-year period	Vietnam	Appropriate technology	very good	A4	Transport
Transport, ocean freighter, average fuel mix NREL/US U	Ecoinvent	2021	within 10-year period	US	Appropriate technology	very good; technologic proxy	A4	Transport
Transport, lorry >16t, fleet average/RER S	Ecoinvent	2021	within 10-year period	India	Appropriate technology	good	A4	Transport
Transport, train, diesel powered NREL/US U	Ecoinvent	2021	within 10-year period	India	Appropriate technology	very good	A4	Transport
Transport, passenger car, diesel, fleet average 2010/RER U	Ecoinvent	2021	within 10-year period	Indonesia	Appropriate technology	very good	A4	Transport
Transport, train, diesel powered NREL/US U	Ecoinvent	2021	within 10-year period	Indonesia	Appropriate technology	very good	A4	Transport

5.13.2 Discussion on data quality

Life cycle assessment (LCA) requires accurate, relevant, and representative data to ensure the credibility of results. The quality of data used in an LCA can significantly influence the outcomes, making it crucial to understand the sources, reliability, and appropriateness of the data employed.

Primary Data: This refers to original data collected directly from the source, specific to the processes or products being assessed, which includes the specific data for the energy intensity of manufacturing or material used for a single process or component.

Secondary Data: These are data obtained from existing sources, such as literature, the USLCI database and the US-ecoinvent database, and previous studies. While they might not be specific to the exact processes or products in question, they can be adjusted and tailored to fit the requirements of the current LCA.

The study faced challenges in accessing primary data for all upstream processes, particularly regarding the specific energy intensity or material used. However, based on a comprehensive materials teardown and other primary product data from the main plant and some suppliers, an accurate and detailed bill of materials (BOM) could be compiled.

In the absence of primary process data, the following steps were taken to ensure the robustness of the LCA model:

1. **Use of secondary datasets**: Secondary datasets were sourced from respected the USLCI database and the US-ecoinvent database. These databases contain aggregated data from multiple studies and are a credible source of industry averages.

2. **Adjustment to fit specifications:** Recognizing that secondary data may not perfectly match the component specifications, adjustments were made to these data sets and documented in detail for the unit processes. Adjustments were based on known relationships, scaling factors, or other relevant parameters to ensure that the data were as close as possible to the specific components. Using secondary data with adjustments offers a pragmatic approach to address data gaps. However, it's important to recognize that:
    - There's an inherent level of uncertainty associated with using adjusted secondary data.
    - The results should be interpreted with caution, especially when making direct comparisons or drawing definitive conclusions.
    - Further studies or updates to this LCA could benefit from more specific primary data, if available in the future.

Data collection and calculation procedure

Depending on availability and relevance, different data collection methods are used to specify the product system and related processes, which is described as a multi-stage process in Figure 32 below.

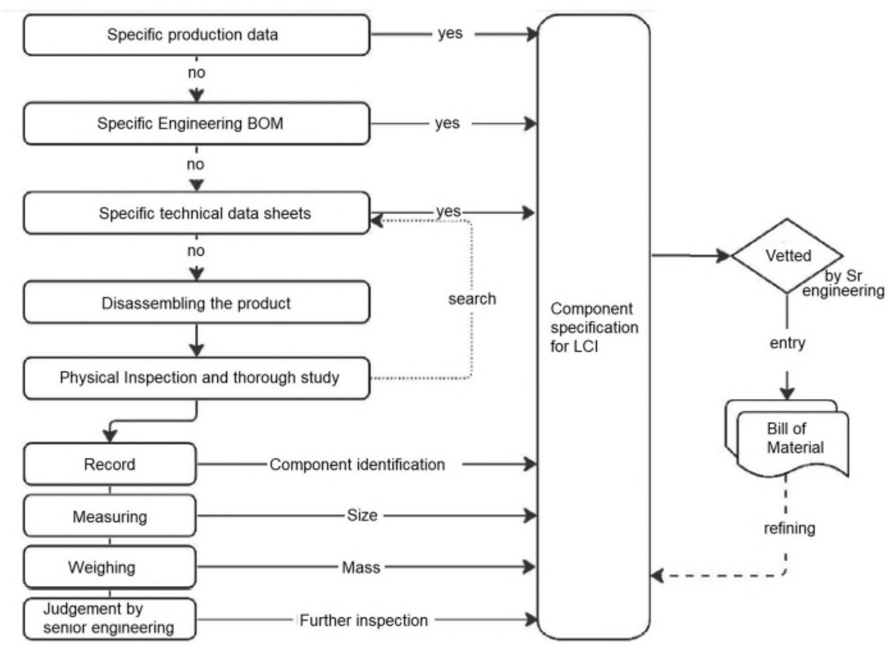


Figure 32. Data collection procedure

The data collection has two main objectives: The first is to describe the product system as completely as possible (e.g. mass, number of components, component types and materials, etc.). The second is to collect as much primary data as possible on the origin and production methods of the various components, or to make plausible approximations that will later allow modelling that is as granular and accurate as possible. As the availability of primary data is relatively scarce or not always accessible to the LCA manager or OEM (i.e. confidentiality, lack of supplier data, etc.), TOTO applies a multi-stage collection procedure which combines already available information (e.g. technical datasheets, BOMs, etc.) with dedicated technical analysis (e.g. disassembling, cutting, measuring, etc.).

All data collection is consolidated into a comprehensive Bill of Material (BOM) for the entire product system (including all components, packaging, etc.), where each data point is given unique identifiers, Source and Type, as can be noted in the Excel data sheet, to ensure seamless documentation and appropriate modelling. The consolidated BOM list as part of the LCA documentation is confidential and will not be published but may be viewed by authorized third parties upon request (submitted during verification to NSF).
The manufacturing phase was modelled on the basis of technical information from TOTO factories and its suppliers and an analysis of the actual components. For some modules, a bill of materials was provided by TOTO factories and the manufacturers of the various components. In addition, a complete disassembling of the product was undertaken to further specify components and fill data gaps. The product was first disassembled into its various modules. Wherever possible, these modules were subsequently disassembled into their different components and material fractions. If possible, all components and materials where specified according to their type, quantity, material, mass, size, finishing and other relevant information (e.g., part numbers or labels).

When visual inspection was unclear or impossible for the LCA manager, expert judgment (i.e., senior engineering team in the US and Japan) and additional literature searches were conducted to gather modeling data.

Discussion of the role of excluded elements
This study followed the completeness criteria stated in Section 2.4.1.1 herein. Small amounts of input materials have not been included based on the mass criteria. These materials were identified and evaluated on the environmental relevance and are deemed to have a negligible impact on the results of the LCA as the main driver of impacts of the modeled products is ceramics.

Discussion of the precision, completeness and representativeness of data
Not all vendors have responded to the level of detail as the request for data entailed. For example, vendors chose to fill their own bills of materials giving little insight to the LCA manager as to how data was calculated. The LCA manager used back calculations and mass balance calculations in order to assure data was plausible, consistent and complete.

Raw materials vendors refused to cooperate with the LCA practitioner because they had strict confidentiality and proprietary policy. This report used literature data where supplier data was not made available based on the USLCI database and the US-ecoinvent database. With future updates and more and more LCA information becoming available, more representative and less generic data should be used for future LCA projects where possible. The impact of this limitation could be relevant as it relates to recycled content, yield and processing energy which are relevant drivers of the LCA results. It is recommended that vendors should be contacted and engaged for future LCA work especially as TOTO moves towards a more integrated People, Planet, Profit strategy. Another example is that no data on the recycled content of the components of the modeled products was provided. The LCA manager made no assumption in that regard and assumed the worst-case scenario in that all materials were primary.

Discussion related to the impact of value judgments
The Sustainable Minds indicator expressed in millipoints is a part of the reporting requirements. It is important to note, however, that the indicator is not only based on scientific impact assessment and normalization, but also on weighting which is based on expert judgment. This last step is a value judgment and can change between different experts and will likely change over time since environmental priorities change over time. This change is not annual but rather it takes a decade. With the limited validation of any LCA and the 5-year validity of a Transparency Report [EPD]™, any changes in these value judgments will be reflected in future updates.

5.14 Recommendations

During the process of compiling this report with the help of many TOTO employees, an insight into the environmental performance of a selection of TOTO products was gained. Additionally, the major contributions and differences were also learned.

Based on these insights we make the following recommendations to TOTO subsidiaries and team members:

- Create a process for LCI data collection for the manufacturing processes onsite and at other manufacturing facilities. This should streamline the data collection for the Morrow facility and others, defining the primary sources for the data, and alignment of the reported data. There is a need for better processing data, like energy consumption and yield. One topic within this is the amount of recycled content which provides an opportunity for environmental performance improvement.
- Evaluate improvement options for the major contributions against required investments to drive down in the impact. Good candidates are the recycled content of the material input, the energy efficiency of the firing kiln, electricity use, sourcing for the manufacturing processes, and product yield.
- Evaluate the use of on-site sourced water or 100% water recycling process. A review of technologies, validated with LCA, can help TOTO USA and her sister subsidiaries have a better positioning in the local and global market as being socially and environmentally responsible beyond using less water to actually eliminate its water sourcing.
- Plan the use of more renewable energy or 100% renewable energy, including, but not limited to, on-site solar panels. Environmental impacts from using coal-based electricity are rather significant, and the use of renewable energy can help reduce the carbon footprints.
- As a general approach, evaluate changes in the manufacturing process or supply chain using LCA technologies to choose the best alternative before making a purchasing or investment decision. This will inform the decision-making process with upfront insight into how it will impact the LCA.

6 SOURCES

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ACRONYMS

EPD	Environmental Product Declaration
ISO	International Standardization Organization
LCA	life cycle assessment
LCI	life cycle inventory
LCIA	life cycle impact analysis
LHV	Low Heating Value
PCR	Product Category Rule document
TTL	TOTO Thailand
TVN	TOTO Vietnam
TMX	TOTO Mexico

GLOSSARY

For the purposes of this report, the terms and definitions given in ISO 14020, ISO 14025, ISO 14040, ISO 14041, ISO 14042, ISO 14043, ISO 14044 and ISO 21930 apply. The most important ones are included here:

aggregation	aggregation of data
allocation	partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems
ancillary input	material input that is used by the unit process producing the product, but does not constitute part of the product
capital good	Means, for instance ancillary input needed for activities, and all handling equipment during the life cycle that can be characterized by a relative long lifespan and can be (re)used many times
category endpoint	attribute or aspect of natural environment, human health, or resources, identifying an environmental issue giving cause for concern
characterization factor	factor derived from a characterization model which is applied to convert an assigned life cycle inventory analysis result to the common unit of the category indicator
comparative assertion	environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function
completeness check	process of verifying whether information from the phases of a life cycle assessment is sufficient for reaching conclusions in accordance with the goal and scope definition
consistency check	process of verifying that the assumptions, methods and data are consistently applied throughout the study and are in accordance with the goal and scope definition performed before conclusions are reached
co-product	any of two or more products coming from the same unit process or product system
critical review	process intended to ensure consistency between a life cycle assessment and the principles and requirements of the International Standards on life cycle assessment
cut-off criteria	specification of the amount of material or energy flow or the level of environmental significance associated with unit processes or product system to be excluded from a study

data quality	characteristics of data that relate to their ability to satisfy stated requirements
elementary flow	material or energy entering the system being studied that has been drawn from the environment without previous human transformation, or material or energy leaving the system being studied that is released into the environment without subsequent human transformation
energy flow	input to or output from a unit process or product system, quantified in energy units
environmental aspect	element of an organization's activities, products or services that can interact with the environment
environmental measure	series of certain quantities, based on economic flows and weighing of environmental effects.
environmental mechanism	system of physical, chemical and biological processes for a given impact category, linking the life cycle inventory analysis results to category indicators and to category endpoints
environmental profile	a series of environmental effects
evaluation	element within the life cycle interpretation phase intended to establish confidence in the results of the life cycle assessment
feedstock energy	heat of combustion of a raw material input that is not used as an energy source to a product system, expressed in terms of higher heating value or lower heating value
functional lifespan	the period or time during which a building or a building element fulfils the performance requirements
functional unit	quantified performance of a product system for use as a reference unit
impact category	class representing environmental issues of concern to which life cycle inventory analysis results may be assigned
impact category indicator	quantifiable representation of an impact category
Input	product, material or energy flow that enters a unit process
interested party	individual or group concerned with or affected by the environmental performance of a product system, or by the results of the life cycle assessment
intermediate flow	product, material or energy flow occurring between unit processes of the product system being studied
intermediate product	output from a unit process that is input to other unit processes that require further transformation within the system
life cycle	consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to final disposal
life cycle assessment LCA	compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle
life cycle impact assessment LCIA	phase of life cycle assessment aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system throughout the life cycle of the product
life cycle interpretation	phase of life cycle assessment in which the findings of either the inventory analysis or the impact assessment, or both, are evaluated in relation to the defined goal and scope in order to reach conclusions and recommendations
life cycle inventory analysis LCI	phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle
life cycle inventory analysis result LCI result	outcome of a life cycle inventory analysis that catalogues the flows crossing the system boundary and provides the starting point for life cycle impact assessment
multi-input process	a unit process where more than one flow enters from different product systems for combined processing
multi-output process	a unit process that results in more than one flow used in different product systems
output	product, material or energy flow that leaves a unit process

performance	behavior based on use
primary material	a material produced from raw materials
primary production	a production process that produces primary material
process	set of interrelated or interacting activities that transforms inputs into outputs
process energy	energy input required for operating the process or equipment within a unit process, excluding energy inputs for production and delivery of the energy itself
product	any goods or service
product flow	products entering from or leaving to another product system
product system	collection of unit processes with elementary and product flows, performing one or more defined functions, and which models the life cycle of a product
raw material	primary or secondary material that is used to produce a product
recycling	all processes needed to recycle a material, product or element as a material input
reference flow	measure of the outputs from processes in a given product system required to fulfill the function expressed by the functional unit
releases	emissions to air and discharges to water and soil
return system	a system to collect waste material from the market for the purpose of recycling or reuse
reuse	all processes needed to reuse a material, product or element in the same function
secondary material	material input produced from recycled materials
secondary production	production process that produces secondary material
sensitivity analysis	systematic procedures for estimating the effects of the choices made regarding methods and data on the outcome of a study
system boundary	set of criteria specifying which unit processes are part of a product system
third party	person or body that is independent of the involved parties, and as such recognized
transparency	open, comprehensive and understandable presentation of information
type -III-environmental declaration	quantified environmental data of a product with a predefined set of categories based on the ISO 14040 standards, without excluding the presentation of supplementing relevant environmental data, provided within the scope of a type-III-environmental declaration framework
type -III-environmental declaration framework	voluntary process of an industrial sector or independent body to develop a type- III-environmental declaration, including a framework that defines the essential requirements, the selection of categories or parameters, the level of involvement of third parties and a template for external communication
uncertainty analysis	systematic procedure to quantify the uncertainty introduced in the results of a life cycle inventory analysis due to the cumulative effects of model imprecision, input uncertainty and data variability
unit process	smallest element considered in the life cycle inventory analysis for which input and output data are quantified
waste	substances or objects which the holder intends or is required to dispose of

APPENDIX A. LCI AND OTHER STARTING POINTS FOR THE MANUFACTURING PROCESS

The LCI for the parts are reported in a separate spreadsheet. It includes all parts, processes and other LCI collected to model the products. An overview of the material list for the products as required by Part A is included herein. Also included is an LCI data summary table for the manufacturing processes at the TOTO facilities.

Table A.1 Raw materials
Refer to Table 2.6 for detailed ceramic production raw materials.

Table A.2 Products BOMs

Table A.2.1 Drake® II 1.28gpf (CST454CEFG) and Drake® II 1G® (CST454CUFG)

		Part Listing	Part #	Materials	Q'ty	Weight per part or material (kg)	DATA			% by wt. (overall)
							Source	TYPE	Year	
1		**Toilet Bowl**	**CW454UFUG#AA**	China	1	25.9	F	M	2023	53.26%
2*		Carton Box	0BU217	corrugated board	1	5.896	F	M	2023	12.12%
3*		c-UPC Sticker	0EU107	paper	1	0.001	F	M	2023	0.00%
4*		Water Consumption Sticker	0EU106	paper	1	0.001	F	M	2023	0.00%
5*		Sanagloss Cleaning Instruction	0GU016-2	paper	1	0.004	F	M	2023	0.01%
6*		Product Label w/ Watersense logo	0EU082	Paper	2	0.004	F	M	2023	0.01%
7		**Toilet Tank Assembly**	**ST454E#XX**							0.00%
	1	TANK BODY AND LID	SW454ZA#AA	China	1	12.8	F	M	2023	26.32%
	2	TANK CARTON BOX	0BU331	Corrugated Board	1	0.9	F	M	2023	1.85%
	3	TANK BOTTOM PAD	0DU619	Corrugated Board	1	0.1	F	M	2023	0.21%
	4*	TANK LID PAD	0DU602	Corrugated Board	1	0.1	F	M	2023	0.21%
	5*	Product Label (w/ WS Logo)	0EU082	Paper	2	0.004	F	M	2023	0.01%
	6*	FILL VALVE (w/ shank gasket)	THU404.30	POM	1	0.001	F	M	2023	0.00%
				EPDM	1	0.005	F	M	2023	0.01%
				PP	1	0.0003	F	M	2023	0.00%
				EPDM	2	0.0002	F	M	2023	0.00%
				POM	1	0.036	F	M	2023	0.07%
				PP	1	0.082	F	M	2023	0.17%
				EPDM	1	0.002	F	M	2023	0.00%
				POM	1	0.005	F	M	2023	0.01%
				POM	1	0.001	F	M	2023	0.00%
				EPDM	1	0.0001	F	M	2023	0.00%
				POM	1	0.008	F	M	2023	0.02%
				FKM	1	0.001	F	M	2023	0.00%
				EPDM	1	0.0003	F	M	2023	0.00%
				POM	1	0.0002	F	M	2023	0.00%
				POM	1	0.007	F	M	2023	0.01%
				EPDM	1	0.0002	F	M	2023	0.00%
				PP	1	0.011	F	M	2023	0.02%
				POM	2	0.006	F	M	2023	0.01%
				POM	1	0.006	F	M	2023	0.01%
				POM	1	0.005	F	M	2023	0.01%
				PP	1	0.013	F	M	2023	0.03%
				ABS	1	0.024	F	M	2023	0.05%

				PP	1	0.001	F	M	2023	0.00%
	7*	FILL VALVE NUT	9AU124	POM	1	0.005	F	M	2023	0.01%
	8*	FILL VALVE	THU186	Stainless steel	1	0.002	F	M	2023	0.00%
				HDPE	1	0.002	F	M	2023	0.00%
				PVC	1	0.008	F	M	2023	0.02%
	9*	TRIP LEVER	THU068#YY	Zinc	1	0.095	F	M	2023	0.20%
				SBR	1	0.003	F	M	2023	0.01%
				PP	1	0.003	F	M	2023	0.01%
				PP	1	0.006	F	M	2023	0.01%
				Brass	1	0.04	F	M	2023	0.08%
	10*	FLUSH VALVE	THU252P	Stainless steel	1	0.001	F	M	2023	0.00%
				Stainless steel	1	0.004	F	M	2023	0.01%
				EPDM	1	0.02	F	M	2023	0.04%
				PVC	1	0.05	F	M	2023	0.10%
				Stainless steel	1	0.001	F	M	2023	0.00%
				PVC	1	0.023	F	M	2023	0.05%
				PP	1	0.148	F	M	2023	0.30%
	11*	FLUSH VALVE NUT	9AU093W	POM	1	0.025	F	M	2023	0.05%
	12*	BOLT CAP W/ WASHER	THU044#ZZ	PP	2	0.006	F	M	2023	0.01%
	13*	CLEAR POLY BAG	0KU013	PE	1	0.002	F	M	2023	0.00%
	14*	BRASS CLOSET BOLT	6CU011	Brass	2	0.027	F	M	2023	0.05%
	15*	BRASS HEX NUT	6DU003	Brass	4	0.004	F	M	2023	0.01%
	16*	STAINLESS STEEL WASHER	7CU012	Stainless steel	4	0.007	F	M	2023	0.01%
	17*	TANK TO BOWL GASKET	9BU024E	EPDM	1	0.06	F	M	2023	0.12%
	18*	PINK POLY BAG	0KU014P	PE	1	0.004	F	M	2023	0.01%
	19*	FLAT RUBBER WASHER	9BU013E	EPDM	2	0.003	F	M	2023	0.01%
	20*	CLEAR POLY BAG	0KU013	PE	1	0.002	F	M	2023	0.00%
	21*	TANK INSTRUCTIONS	0GU048Z-7	paper	1	0.031	F	M	2023	0.06%
	22*	INSTALLATION INSTRUCTION	0GU011Z-4	paper	1	0.031	F	M	2023	0.06%
	23*	WARNING PAPER	0EU017	paper	1	0.004	F	M	2023	0.01%
	24*	REPLACEMENT PART LID STICKER	0EU112	PP	1	0.001	F	M	2023	0.00%
	25*	WATER SENSE LOGO STICKER - CHINA	0EU060-1	PP	1	0.001	F	M	2023	0.00%
8*		SOFT CLOSE SEAT	SS114#XX	PP	1	0.0008	F	M	2023	0.00%
				POM	1	0.0078	F	M	2023	0.02%
				PP	1	0.0124	F	M	2023	0.03%
				PP	1	0.988	F	M	2023	2.03%
				PP	1	0.922	F	M	2023	1.90%
				SUS430	1	0.0406	F	M	2023	0.08%
				PP	1	0.0642	F	M	2023	0.13%
				PVC	1	0.0072	F	M	2023	0.01%
				SUS430	1	0.0468	F	M	2023	0.10%

*Secondary data

Table A.2.2 Eco Ultramax® 1.28gpf (MS854114E), Ultramax II 1G® (MS604124CUFG) and Ultramax® II 1.28gpf (MS604124CEFG)

	Part Listing	Part #	Materials	Q'ty	Weight per part or material (kg)	DATA			% by wt. (overall)	Processes (casting, injection molding, etc.)
						Source	TYPE	Year		
1	CHINA	CW604UUG#AA	China	1	38	F	M	2023	83.97%	-
2*	CARTON BOX	0BU280	Corrugated Board	1	3.2	F	M	2023	7.07%	-
3*	FRONT PAD	0DU484	Corrugated Board	1	0.6	F	M	2023	1.33%	-
4*	RIGHT SIDE PAD	0DU482	Corrugated Board	1	0.2	F	M	2023	0.44%	-

5*	LEFT SIDE PAD	0DU483	Corrugated Board	1	0.2	F	M	2023	0.44%	-
6*	LID WRAP	0DU481	Corrugated Board	1	0.2	F	M	2023	0.44%	-
7*	FLAPPER SUPPORT	0DU415	Corrugated Board	1	0.05				0.11%	-
8*	FLUSH VALVE ASSEMBLY	THU013P	Stainless steel	1	0.0006	F	M	2023	0.00%	-
	with PVC Red Flapper (16+1 rings)		Stainless steel	1	0.0035	F	M	2023	0.01%	-
			EPDM	1	0.0202	F	M	2023	0.04%	-
			PVC	1	0.0498	F	M	2023	0.11%	injection molding
			Stainless steel	1	0.005	F	M	2023	0.01%	-
			PP	1	0.148	F	M	2023	0.33%	injection molding
			Stainless steel	2	0.00606	F	M	2023	0.01%	-
			brass	2	0.031	F	M	2023	0.07%	brass die casting
9*	FILL VALVE (w/ shank gasket)	THU401.30	POM	1	0.0008	F	M	2023	0.00%	-
			EPDM	1	0.0054	F	M	2023	0.01%	-
			PP	1	0.0008	F	M	2023	0.00%	-
			EPDM	1	0.0001	F	M	2023	0.00%	-
			POM	1	0.0354	F	M	2023	0.08%	injection molding
			PP	1	0.0805	F	M	2023	0.18%	injection molding
			EPDM	1	0.0001	F	M	2023	0.00%	-
			POM	1	0.0045	F	M	2023	0.01%	-
			POM	1	0.0009	F	M	2023	0.00%	-
			EPDM	1	0.00005	F	M	2023	0.00%	-
			POM	1	0.008	F	M	2023	0.02%	-
			FKM	1	0.001	F	M	2023	0.00%	-
			EPDM	1	0.0001	F	M	2023	0.00%	-
			POM	1	0.0001	F	M	2023	0.00%	-
			POM	1	0.0065	F	M	2023	0.01%	-
			EPDM	1	0.00005	F	M	2023	0.00%	-
			PP	1	0.0097	F	M	2023	0.02%	-
			POM	1	0.0053	F	M	2023	0.01%	-
			POM	1	0.0061	F	M	2023	0.01%	-
			POM	1	0.004	F	M	2023	0.01%	-
			PP	1	0.013	F	M	2023	0.03%	-
			ABS	1	0.023	F	M	2023	0.05%	-
			PP	1	0.0005	F	M	2023	0.00%	-
10*	FILL VALVE NUT	9AU124	POM	1	0.0052	F	M	2023	0.01%	-
11*	FILL VALVE REFILL TUBE W/CLIP 7.5"	THU185	SUS304	1	0.0016	F	M	2023	0.00%	-
			HDPE	1	0.0017	F	M	2023	0.00%	-
			PVC	1	0.00785	F	M	2023	0.02%	-
12*	PARTS BAG#1	9AU123	PP	1	0.00872	F	M	2023	0.02%	-
13*	PARTS BAG#2	9BU042E	TPE	1	0.00243	F	M	2023	0.01%	-
14*	PARTS BAG#3	THU044#ZZ	PP	2	0.00897	F	M	2023	0.02%	-
15*	PARTS BAG#4	0KU013	PE	1	0.00246	F	M	2023	0.01%	-
16*	TRIP LEVER (CHROME)	THU004#CP	Zinc	1	0.095	F	M	2023	0.21%	zinc die casting
			SBR	1	0.0027	F	M	2023	0.01%	-
			POM	1	0.0034	F	M	2023	0.01%	-
			POM	1	0.0056	F	M	2023	0.01%	-
			Brass	1	0.04	F	M	2023	0.09%	brass, turning
			Stainless steel	1	0.005	F	M	2023	0.01%	-
			Stainless steel	1	0.005	F	M	2023	0.01%	-

17*	INSTALLATION INSTRUCTIONS	0GU013Z-8	paper	1	0.031	F	M	2023	0.07%	-
18*	SANAGLOSS CLEANING INSTRUCTION	0GU016-2	paper	1	0.0044	F	M	2023	0.01%	-
19*	PRODUCT LABEL (w/ Watersense Logo)	0EU082	paper	2	0.0035	F	M	2023	0.01%	-
20*	c-UPC LABEL STICKER	0EU036	paper	1	0.001	F	M	2023	0.00%	-
21*	WATER CONSUMPTION STICKER	0EU054	paper	1	0.002	F	M	2023	0.00%	-
22*	CHINA WATER SENSE STICKER	0EU060-1	paper	1	0.004	F	M	2023	0.01%	-
23*	REPLACEMENT PART LID STICKER	0EU089	plastic	1	0.003	F	M	2023	0.01%	-
24*	SOFT CLOSE SEAT	SS114#XX	PP	1	0.0008	F	M	2023	0.00%	-
			POM	1	0.0078	F	M	2023	0.02%	-
			PP	1	0.0124	F	M	2023	0.03%	-
			PP	1	0.988	F	M	2023	2.18%	injection molding
			PP	1	0.922	F	M	2023	2.04%	injection molding
			SUS430	1	0.0406	F	M	2023	0.09%	steel, turning
			PP	1	0.0642	F	M	2023	0.14%	injection molding
			PVC	1	0.0072	F	M	2023	0.02%	-
			SUS430	1	0.0468	F	M	2023	0.10%	steel, turning

*Secondary data

Table A.3 Raw materials definition of T28S32E and T27S32E

			Availability					
Component	**Material**	**Mass%**	**Renewable**	**Non-renewable**	**Recycled post-industrial**	**Recycled post-consumer**	**Origin of raw materials**	**Supply Distance (miles)**
Spout Assembly	Brass (C360000)	17.29%	No	Yes	0%	0%	Taiwan	10578
	SUS304	6.40%	No	Yes	0%	0%	Taiwan	10578
	Polyacetal	2.17%	No	Yes	0%	0%	Japan	10268
	NBR	2.13%	No	Yes	0%	0%	Japan	10268
	Brass	2.13%	No	Yes	38%	0%	Taiwan	10578
	Brass	6.83%	No	Yes	58%	0%	Taiwan	10578
	SUS303	8.54%	No	Yes	49%	0%	Taiwan	10578
	PVC	6.40%	No	Yes	0%	0%	Taiwan	10578
	Steel	2.13%	No	Yes	0%	0%	Taiwan	10578
	Remaining materials	0.55%	No	Yes	0%	0%	Taiwan	10578
*Sensor	Miscellaneous materials	1.07%	No	Yes	0%	0%	Japan	10268
*Solenoid Assembly	Polyacetal	1.25%	No	Yes	0%	0%	China	928
	Remaining materials	1.49%	No	Yes	0%	0%	China	-
*Generator	PPO	1.64%	No	Yes	0%	0%	China	5
	Copper	2.56%	No	Yes	0%	0%	China	5
	Brass (covalent coating)	1.47%	No	Yes	0%	0%	35%China 65% Australia	5
	Remaining materials	2.32%	No	Yes	0%	0%	China	-
*Controller box parts	Brass, Pb free	5.65%	No	Yes	0%	0%	35%China 65% Australia	5

	ABS	14.93%	No	Yes	0%	0%	China	5
	SUS303	3.36%	No	Yes	0%	0%	China	5
	PP	3.08%	No	Yes	0%	0%	China	5
	Remaining materials	0.52%	No	Yes	0%	0%	China	-
*Controller box (circuit board)	ABS	1.19%	No	Yes	0%	0%	China	5
	Surface mount, Pb containing	1.51%	No	Yes	0%	0%	China	5
	Epoxy resin	1.00%	No	Yes	0%	0%	China	5
	Remaining materials	1.44%	No	Yes	0%	0%	China	-
*Battery	Miscellaneous materials	1.18%	No	Yes	0%	0%	China	-
*Flow regulator	Miscellaneous materials	0.01%	No	Yes	0%	0%	China	-

*Secondary data

Table A.4 Raw materials definition of T28S32ET and T27S32ET

			Availability					
Component	**Material**	**Mass%**	**Renewable**	**Non-renewable**	**Recycled post-industrial**	**Recycled post-consumer**	**Origin of raw materials**	**Supply Distance (miles)**
Spout Assembly	Brass (C360000)	15.11%	No	Yes	0%	0%	Taiwan	10578
	SUS304	5.60%	No	Yes	0%	0%	Taiwan	10578
	Polyacetal	1.90%	No	Yes	0%	0%	Japan	10268
	NBR	1.87%	No	Yes	0%	0%	Japan	10268
	Brass	1.87%	No	Yes	38%	0%	Taiwan	10578
	Brass	5.97%	No	Yes	58%	0%	Taiwan	10578
	SUS303	7.46%	No	Yes	49%	0%	Taiwan	10578
	PVC	5.60%	No	Yes	0%	0%	Taiwan	10578
	Steel	1.87%	No	Yes	0%	0%	Taiwan	10578
	Remaining materials	0.45%	No	Yes	0%	0%	Taiwan	10578
*Sensor	Miscellaneous materials	0.94%	No	Yes	0%	0%	Japan	10268
*Solenoid Assembly	Polyacetal	1.09%	No	Yes	0%	0%	China	928
	Remaining materials	1.31%	No	Yes	0%	0%	China	-
*Generator	PPO	1.42%	No	Yes	0%	0%	China	5
	Copper	2.24%	No	Yes	0%	0%	China	5
	Brass (covalent coating)	1.29%	No	Yes	0%	0%	35%China 65% Australia	5
	Remaining materials	2.04%	No	Yes	0%	0%	China	-
*Controller box parts	Brass, Pb free	4.94%	No	Yes	0%	0%	35%China 65% Australia	5
	ABS	13.04%	No	Yes	0%	0%	China	5
	SUS303	2.93%	No	Yes	0%	0%	China	5

	PP	2.70%					China	
	Remaining materials	0.47%	No	Yes	0%	0%	China	-
*Controller box (circuit board)	ABS	1.04%	No	Yes	0%	0%	China	5
	Surface mount, Pb containing	1.32%	No	Yes	0%	0%	China	5
	Remaining materials	2.13%	No	Yes	0%	0%	China	-
*Battery	Miscellaneous materials	1.03%	No	Yes	0%	0%	China	-
*Flow regulator	Miscellaneous materials	0.01%	No	Yes	0%	0%	China	-
*Thermostatic *Mixing Valve	Brass	10.34%	No	Yes	0%	0%	China	1020
	Remaining materials	2.24%	No	Yes	0%	0%	China	-

*Secondary data

Table A.5 Raw materials definition of T28S32EM and T27S32EM

			Availability					
Component	**Material**	**Mass%**	**Renewable**	**Non-renewable**	**Recycled post-industrial**	**Recycled post-consumer**	**Origin of raw materials**	**Supply Distance (miles)**
Spout Assembly	Brass (C360000)	15.87%	No	Yes	0%	0%	Taiwan	10578
	SUS304	5.88%	No	Yes	0%	0%	Taiwan	10578
	Polyacetal	2.00%	No	Yes	0%	0%	Japan	10268
	NBR	1.96%	No	Yes	0%	0%	Japan	10268
	Brass	1.96%	No	Yes	38%	0%	Taiwan	10578
	Brass	6.27%	No	Yes	58%	0%	Taiwan	10578
	SUS303	7.84%	No	Yes	49%	0%	Taiwan	10578
	PVC	5.88%	No	Yes	0%	0%	Taiwan	10578
	Steel	1.96%	No	Yes	0%	0%	Taiwan	10578
	Remaining materials	0.49%	No	Yes	0%	0%	Taiwan	10578
*Sensor	Miscellaneous materials	0.99%	No	Yes	0%	0%	Japan	10268
*Solenoid Assembly	Polyacetal	1.14%	No	Yes	0%	0%	China	928
	Remaining materials	1.38%	No	Yes	0%	0%	China	-
*Generator	PPO	1.50%	No	Yes	0%	0%	China	5
	Copper	2.34%	No	Yes	0%	0%	China	5
	Brass (covalent coating)	1.35%	No	Yes	0%	0%	35%China 65% Australia	5
	Remaining materials	2.15%	No	Yes	0%	0%	China	-
*Controller box parts	Brass, Pb free	5.18%	No	Yes	0%	0%	35%China 65% Australia	5
	ABS	13.71%	No	Yes	0%	0%	China	5
	SUS303	3.07%	No	Yes	0%	0%	China	5

	PP	2.83%					China	
	Remaining materials	0.50%	No	Yes	0%	0%	China	-
*Controller box (circuit board)	ABS	1.10%	No	Yes	0%	0%	China	5
	Surface mount, Pb containing	1.38%	No	Yes	0%	0%	China	5
	Remaining materials	2.24%	No	Yes	0%	0%	China	-
*Battery	Miscellaneous materials	1.08%	No	Yes	0%	0%	China	-
*Flow regulator	Miscellaneous materials	0.01%	No	Yes	0%	0%	China	-
Thermostatic Mixing Valve	Brass (C49260)	7%	No	Yes	0%	0%	Taiwan	550
	Brass	1%	No	Yes	0%	0%	Taiwan	550
	Remaining materials	1%	No	Yes	0%	0%	Taiwan	550

*Secondary data

Table A.6 Raw materials definition of TEU1LA

			Availability					
Component	**Material**	**Mass %**	**Renewable**	**Non-renewable**	**Recycled post-industrial**	**Recycled post-consumer**	**Origin of raw materials**	**Supply Distance (miles)**
*Metal Housing	Zinc Die cast	18.05%	No	Yes	0%	0%	China	534
	Zinc Die cast	10.39%	No	Yes	0%	0%	China	534
	Zinc Die cast	10.01%	No	Yes	0%	0%	China	534
	Remaining materials	0.31%	No	Yes	0%	0%	China	-
Valve Metal Body	Bronze (C836000)	30.94%	No	Yes	15%	0%	35%China 65% Australia	5
	Brass	1.62%	No	Yes	10%	0%	35%China 65% Australia	5
	Bronze (C836000)	4.29%	No	Yes	15%	0%	35%China 65% Australia	5
	Bronze (C836000)	9.69%	No	Yes	15%	0%	35%China 65% Australia	5
	Remaining materials	0.50%	No	Yes	0%	0%	China	-
*Piston assembly	Miscellaneous materials	1.19%	No	Yes	0%	0%	China	-
*Solenoid Assembly	Miscellaneous materials	1.73%	No	Yes	0%	0%	China	-
Push m*anual Button	Miscellaneous materials	1.34%	No	Yes	0%	0%	China	-
*Generator	Copper	1.36%	No	Yes	0%	0%	China	5
	Remaining materials	3.72%	No	Yes	0%	0%	China	-
*Controller	Miscellaneous materials	2.96%	No	Yes	0%	0%	China	-
*Sensor	Miscellaneous materials	0.61%	No	Yes	0%	0%	China	-
*Battery	AA Li-ion battery	0.68%	No	Yes	0%	0%	China	1,320
Other parts	Miscellaneous materials	15.52%	No	Yes	0%	0%	China	-
	TOTAL	**100%**						

*Secondary Data

Table A.7 Raw materials definition of TEU1UA

			Availability					
Component	**Material**	**Mass %**	**Renewable**	**Non-renewable**	**Recycled post-industrial**	**Recycled post-consumer**	**Origin of raw materials**	**Supply Distance (miles)**
*Metal Housing	Zinc Die cast	16.29%	No	Yes	0%	0%	China	534
	Zinc Die cast	10.32%	No	Yes	0%	0%	China	534
	Zinc Die cast	7.80%	No	Yes	0%	0%	China	534
	Remaining materials	0.26%	No	Yes	0%	0%	China	-
Valve Metal Body	Bronze (C836000)	30.01%	No	Yes	15%	0%	35%China 65% Australia	5
	Brass	1.37%	No	Yes	10%	0%	35%China 65% Australia	5
	Bronze (C836000)	3.62%	No	Yes	15%	0%	35%China 65% Australia	5
	Remaining materials	0.50%	No	Yes	30%	0%	China	-
*Solenoid Assembly	Miscellaneous materials	1.46%	No	Yes	0%	0%	China	-
*Push manual Button	Miscellaneous materials	1.13%	No	Yes	0%	0%	China	-
*Generator	Copper	1.15%	No	Yes	0%	0%	China	5
	Remaining materials	3.49%	No	Yes	0%	0%	China	-
*Controller	Miscellaneous materials	2.51%	No	Yes	0%	0%	China	-
*Sensor	Miscellaneous materials	0.13%	No	Yes	0%	0%	China	-
*Battery	AA Li-ion battery	0.57%	No	Yes	0%	0%	China	1,320
Other parts	Miscellaneous materials	19.38%	No	Yes	0%	0%	China	-
	TOTAL	**100%**						

*Secondary Data

Table A.8 Raw materials definition of TEU2LA

			Availability					
Component	**Material**	**Mass %**	**Renewable**	**Non-renewable**	**Recycled post-industrial**	**Recycled post-consumer**	**Origin of raw materials**	**Supply Distance (miles)**
*coverplate and frame	Stainless Steel	18.79	No	Yes	0%	0%	China	534
	ABS	4.9	No	Yes	0%	0%	China	534
	Remaining materials	0.02	No	Yes	0%	0%	China	-
Valve Metal Body	Bronze (C836000)	40.54	No	Yes	15%	0%	35%China 65% Australia	5
	Brass	1.46	No	Yes	10%	0%	35%China 65% Australia	5
	Bronze (C836000)	0	No	Yes	15%	0%	35%China 65% Australia	5
	Bronze (C836000)	0	No	Yes	15%	0%	35%China 65% Australia	5
	Remaining materials	9.05	No	Yes	0%	0%	China	-

*Piston assembly	Miscellaneous materials		No	Yes	0%	0%	China	-
*Solenoid Assembly	Miscellaneous materials	1.56	No	Yes	0%	0%	China	-
*Push manual Button	Miscellaneous materials	1.21	No	Yes	0%	0%	China	-
*Generator	Copper	1.3	No	Yes	0%	0%	China	5
	Remaining materials	3.29	No	Yes	0%	0%	China	-
*Controller	Miscellaneous materials	2.98	No	Yes	0%	0%	China	-
*Sensor	Miscellaneous materials	0.55	No	Yes	0%	0%	China	-
*Battery	AA Li-ion battery	0.61	No	Yes	0%	0%	China	1,320
Other parts	Miscellaneous materials	13.74	No	Yes	0%	0%	China	-
	TOTAL	**100**					*Secondary Data	

Table A.9 Raw materials definition of TEU2UA

			Availability					
Component	**Material**	**Mass %**	**Renewable**	**Non-renewable**	**Recycled post-industrial**	**Recycled post-consumer**	**Origin of raw materials**	**Supply Distance (miles)**
*coverplate and frame	Stainless Steel	19.83%	No	Yes	0%	0%	China	534
	ABS frame	5.17%	No	Yes	0%	0%	China	534
	Remaining materials	0.02%	No	Yes	0%	0%	China	-
Valve Metal Body	Bronze (C836000)	37.9%	No	Yes	15%	0%	35%China 65% Australia	5
	Brass	1.91%	No	Yes	10%	0%	35%China 65% Australia	5
							65% Australia	
	Remaining materials	0.19%	No	Yes	30%	0%	China	-
*Solenoid Assembly	Miscellaneous materials	1.65%	No	Yes	0%	0%	China	-
*Push manual Button	Miscellaneous materials	1.28%	No	Yes	0%	0%	China	-
*Generator	Copper	1.37%	No	Yes	0%	0%	China	5
	Remaining materials	3.47%	No	Yes	0%	0%	China	-
*Controller	Miscellaneous materials	3.15%	No	Yes	0%	0%	China	-
*Sensor	Miscellaneous materials	0.58%	No	Yes	0%	0%	China	-
*Battery	AA Li-ion battery	0.65%	No	Yes	0%	0%	China	1,320
Other parts	Miscellaneous materials	22.83%	No	Yes	0%	0%	China	-
	TOTAL	**100**%					*Secondary Data	

Table A.10 Raw materials definition of TET1UB(X)

			Availability					
Component	Material	Mass %	Renewable	Non-renewable	Recycled post-industrial	Recycled post-consumer	Origin of raw materials	Supply Distance (miles)
*Metal Housing	Zinc Die cast	18.05%	No	Yes	0%	0%	China	534
	Zinc Die cast	10.39%	No	Yes	0%	0%	China	534
	Zinc Die cast	10.01%	No	Yes	0%	0%	China	534
	Remaining materials	0.31%	No	Yes	0%	0%	China	-
*Valve Metal Body	Bronze (C836000)	30.94%	No	Yes	15%	0%	35%China 65% Australia	5
	Brass	1.62%	No	Yes	10%	0%	35%China 65% Australia	5
	Bronze (C836000)	4.29%	No	Yes	15%	0%	35%China 65% Australia	5
	Bronze (C836000)	9.69%	No	Yes	15%	0%	35%China 65% Australia	5
	Remaining materials	0.50%	No	Yes	0%	0%	China	-
*Piston assembly	Miscellaneous materials	1.19%	No	Yes	0%	0%	China	-
*Solenoid Assembly	Miscellaneous materials	1.73%	No	Yes	0%	0%	China	-
*Push manual Button	Miscellaneous materials	1.34%	No	Yes	0%	0%	China	-
*Generator	Copper	1.36%	No	Yes	0%	0%	China	5
	Remaining materials	3.72%	No	Yes	0%	0%	China	-
*Controller	Miscellaneous materials	2.96%	No	Yes	0%	0%	China	-
*Sensor	Miscellaneous materials	0.61%	No	Yes	0%	0%	China	-
*Battery	AA Li-ion battery	0.68%	No	Yes	0%	0%	China	1,320
Other parts	Miscellaneous materials	15.52%	No	Yes	0%	0%	China	-
	TOTAL	**100%**						

*Secondary Data

Table A.11 Raw materials definition of TET1LB(X)

			Availability					
Component	Material	Mass %	Renewable	Non-renewable	Recycled post-industrial	Recycled post-consumer	Origin of raw materials	Supply Distance (miles)
*Metal Housing	Zinc Die cast	18.05%	No	Yes	0%	0%	China	534
	Zinc Die cast	10.39%	No	Yes	0%	0%	China	534
	Zinc Die cast	10.01%	No	Yes	0%	0%	China	534
	Remaining materials	0.31%	No	Yes	0%	0%	China	-
Valve Metal Body	Bronze (C836000)	30.94%	No	Yes	15%	0%	35%China 65% Australia	5
	Brass	1.62%	No	Yes	10%	0%	35%China 65% Australia	5
	Bronze (C836000)	4.29%	No	Yes	15%	0%	35%China 65% Australia	5

	Bronze (C836000)	9.69%	No	Yes	15%	0%	35%China 65% Australia	5
	Remaining materials	0.50%	No	Yes	0%	0%	China	-
*Piston assembly	Miscellaneous materials	1.19%	No	Yes	0%	0%	China	-
*Solenoid Assembly	Miscellaneous materials	1.73%	No	Yes	0%	0%	China	-
*Push manual Button	Miscellaneous materials	1.34%	No	Yes	0%	0%	China	-
*Generator	Copper	1.36%	No	Yes	0%	0%	China	5
	Remaining materials	3.72%	No	Yes	0%	0%	China	-
*Controller	Miscellaneous materials	2.96%	No	Yes	0%	0%	China	-
*Sensor	Miscellaneous materials	0.61%	No	Yes	0%	0%	China	-
*Battery	AA Li-ion battery	0.68%	No	Yes	0%	0%	China	1,320
Other parts	Miscellaneous materials	15.52%	No	Yes	0%	0%	China	-
	TOTAL	**100%**						

*Secondary Data

Table A.12 Raw materials definition of TET2UB(X)

			Availability					
Component	**Material**	**Mass %**	**Renewable**	**Non-renewable**	**Recycled post-industrial**	**Recycled post-consumer**	**Origin of raw materials**	**Supply Distance (miles)**
*coverplate and frame	Stainless Steel	18.79	No	Yes	0%	0%	China	534
	ABS	4.9	No	Yes	0%	0%	China	534
	Remaining materials	0.02	No	Yes	0%	0%	China	-
Valve Metal Body	Bronze (C836000)	40.54	No	Yes	15%	0%	35%China 65% Australia	5
	Brass	1.46	No	Yes	10%	0%	35%China 65% Australia	5
	Bronze (C836000)	0	No	Yes	15%	0%	35%China 65% Australia	5
	Bronze (C836000)	0	No	Yes	15%	0%	35%China 65% Australia	5
	Remaining materials	9.05	No	Yes	0%	0%	China	-
*Piston assembly	Miscellaneous materials		No	Yes	0%	0%	China	-
*Solenoid Assembly	Miscellaneous materials	1.56	No	Yes	0%	0%	China	-
*Push manual Button	Miscellaneous materials	1.21	No	Yes	0%	0%	China	-
*Generator	Copper	1.3	No	Yes	0%	0%	China	5
	Remaining materials	3.29	No	Yes	0%	0%	China	-
*Controller	Miscellaneous materials	2.98	No	Yes	0%	0%	China	-

*Sensor	Miscellaneous materials	0.55	No	Yes	0%	0%	China	-
*Battery	AA Li-ion battery	0.61	No	Yes	0%	0%	China	1,320
Other parts	Miscellaneous materials	13.74	No	Yes	0%	0%	China	-
	TOTAL	**100**					*Secondary Data	

Table A.13 Raw materials definition of TET2LB(X)

			Availability					
Component	**Material**	**Mass %**	**Renewable**	**Non-renewable**	**Recycled post-industrial**	**Recycled post-consumer**	**Origin of raw materials**	**Supply Distance (miles)**
*coverplate and frame	Stainless Steel	18.79	No	Yes	0%	0%	China	534
	ABS	4.9	No	Yes	0%	0%	China	534
	Remaining materials	0.02	No	Yes	0%	0%	China	-
Valve Metal Body	Bronze (C836000)	40.54	No	Yes	15%	0%	35%China	5
							65% Australia	
	Brass	1.46	No	Yes	10%	0%	35%China	5
							65% Australia	
	Bronze (C836000)	0	No	Yes	15%	0%	35%China	5
							65% Australia	
	Bronze (C836000)		No	Yes	15%	0%	35%China	5
		0					65% Australia	
	Remaining materials	9.05	No	Yes	0%	0%	China	-
*Piston assembly	Miscellaneous materials		No	Yes	0%	0%	China	-
*Solenoid Assembly	Miscellaneous materials	1.56	No	Yes	0%	0%	China	-
*Push manual Button	Miscellaneous materials	1.21	No	Yes	0%	0%	China	-
*Generator	Copper	1.3	No	Yes	0%	0%	China	5
	Remaining materials	3.29	No	Yes	0%	0%	China	-
*Controller	Miscellaneous materials	2.98	No	Yes	0%	0%	China	-
*Sensor	Miscellaneous materials	0.55	No	Yes	0%	0%	China	-
*Battery	AA Li-ion battery	0.61	No	Yes	0%	0%	China	1,320
Other parts	Miscellaneous materials	13.74	No	Yes	0%	0%	China	-
	TOTAL	**100**					*Secondary Data	

Table A.14 LCI data for zinc die casting process

Die casting, zinc	1	kg
Operating temperature is slightly higher than casting of brass and bronze. A small amount of zinc evaporates. The evaporation losses are estimated at 0.1%wt. Adapted from ecoinvent LCI for die casting of brass and bronze. Geographical coverage encompasses the industrialized countries. Data of 2009 LCI data of metals covering average		

technological processes from Switzerland or one of the European regions were adapted using US electricity. Updated 2012.		
Materials/fuels		
Aluminum casting, plant	4.9E-11	p
Electricity, medium voltage, production	0.0205	kWh
Heat, heavy fuel oil, at industrial furnace 1MW	0.2952	MJ
Heat, natural gas, at industrial furnace >100kW	0.369	MJ
Emissions to air		
Heat, waste	0.0708	MJ
Zinc	0.001	kg

Table A.15 LCI data for turning brass CNC process

Turning, brass, CNC, average	1	kg
This dataset encompasses the direct electricity consumption of the machine as well as compressed air and lubricant oil. Furthermore, the metal removed is included. Machine as well as factory infrastructure and operation are considered as well. The disposal of the lubricant oil is also included while the metal removed is assumed to be recycled. Geographical coverage encompasses the industrialized countries based on 2007 LCI data using industry average technology.		
Materials/fuels		
Electricity, low voltage, production	0.992	kWh
Compressed air, average installation, >30kW, 7 bar gauge, at supply network	1.28	m3
Lubricating oil, at plant	0.00382	kg
Metal working machine, unspecified, at plant	0.000174	kg
Metal working factory	2.02E-09	p
Metal working factory operation, average heat energy	4.41	kg
Brass, at plant	1	kg
Emissions to air		
Heat, waste	3.57	MJ
Waste to treatment		
Disposal, used mineral oil, 10% water, to hazardous waste incineration	0.00382	kg

Table A.16 LCI data for turning steel CNC process

Turning, steel, CNC, average	1	kg
This dataset encompasses the direct electricity consumption of the machine as well as compressed air and lubricant oil. Furthermore, the metal removed is included. Machine as well as factory infrastructure and operation are considered as well. The disposal of the lubricant oil is also included while the metal removed is assumed to be recycled. Geographical coverage encompasses the industrialized countries based on 2007 LCI data using industry average technology.		
Materials/fuels		
Electricity, low voltage, production	1.78	kWh
Compressed air, average installation, >30kW, 7 bar gauge, at supply network	1.28	m3
Lubricating oil, at plant	0.00382	kg
Metal working machine, unspecified, at plant	0.000174	kg
Metal working factory	2.02E-09	p
Metal working factory operation, average heat energy	4.41	kg
Steel, low-alloyed, at plant	1	kg
Emissions to air		
Heat, waste	6.39	MJ
Waste to treatment		
Disposal, used mineral oil, 10% water, to hazardous waste incineration	0.00382	kg

Table A.17 LCI data for injection molding process

Injection molding	1	kg
This process contains the auxiliaries and energy demand for the mentioned conversion process of plastics. The converted amount of plastics is NOT included into the dataset. Geographical coverage encompasses difference European and Swiss converting companies based on 2003 LCI data using present technologies.		
Resources		
Water, cooling, unspecified natural origin/m3	0.011	m3
Materials/fuels		
Lubricating oil, at plant	0.00303	kg
Solvents, organic, unspecified, at plant	0.0447	kg
Chemicals organic, at plant	0.0128	kg
Titanium dioxide, production mix, at plant	0.00199	kg
Pigments, paper production, unspecified, at plant	0.00756	kg
EUR-flat pallet	0.00146	p
Solid bleached board, SBB, at plant	9.94E-05	kg
Polyethylene, LDPE, granulate, at plant	0.00169	kg
Polypropylene, granulate, at plant	0.00358	kg
Electricity, medium voltage, production	1.48	kWh
Heat, natural gas, at industrial furnace >100kW	4.21	MJ
Heat, heavy fuel oil, at industrial furnace 1MW	0.229	MJ
Packaging box production unit	1.43E-09	p
Transport, lorry 3.5-16t, fleet average	0.142	tkm
Emissions to air		
Heat, waste	5.33	MJ
Emissions to water		
COD, Chemical Oxygen Demand	9.28E-06	kg
Suspended solids, unspecified	6.63E-06	kg
Waste to treatment		
Disposal, plastics, mixture, 15.3% water, to municipal incineration	0.00567	kg
Disposal, hazardous waste, 0% water, to underground deposit	3.31E-05	kg
Disposal, municipal solid waste, 22.9% water, to sanitary landfill	0.000895	kg

Table A.18 LCI data for M&K potting process

M&K Potting	0.5	g
This dataset models an M&K Potting Machine with typical production volume of 150 circuit board per 1 kWh. A circuit board is estimated to consume 0.5g of Epoxy resin. Source: TOTO Shanghai; Data sourced from Shanghai, China; 2013		
Materials/fuels		
Electricity, medium voltage, production	0.006667	kWh
Epoxy resin, liquid, at plant	0.5	g
Emissions to air		
Heat, waste	0.10374	MJ

Table A.19 LCI data for turning bronze CNC process

Turning, bronze, CNC, average	1	kg

This dataset encompasses the direct electricity consumption of the machine as well as compressed air and lubricant oil. Furthermore, the metal removed is included. Machine as well as factory infrastructure and operation are considered as well. The disposal of the lubricant oil is also included while the metal removed is assumed to be recycled. Geographical coverage encompasses the industrialized countries based on 2007 LCI data using industry average technologies.		
Materials/fuels		
Electricity, low voltage, production	0.992	kWh
Compressed air, average installation, >30kW, 7 bar gauge, at supply network	1.28	m3
Lubricating oil, at plant	0.00382	kg
Metal working machine, unspecified, at plant	0.000174	kg
Metal working factory	2.02E-09	p
Metal working factory operation, average heat energy	4.41	kg
Bronze, at plant	1	kg
Emissions to air		
Heat, waste	3.57	MJ
Waste to treatment		
Disposal, used mineral oil, 10% water, to hazardous waste incineration	0.00382	kg

Table A.20 LCI data for polishing process

Polishing	1	kg
This dataset includes the materials, energies and emissions related to the polishing machines used for polishing metal products. This is mainly electricity, compressed air and solvents. Process heat is from average sources. The consumables are polishing discs and abrasive paste. Geographical coverage encompasses the industrialized countries based on 2007 LCI data using industry average technology.		
Materials/fuels		
Solvents, organic, unspecified, at plant	0.0014	kg
Lubricating oil, at plant	0.000867	kg
Compressed air, average installation, >30kW, 7 bar gauge, at supply network	0.291	m3
Light fuel oil, burned in industrial furnace 1MW, non-modulating	2.6	MJ
Heavy fuel oil, burned in industrial furnace 1MW, non-modulating	0.0328	MJ
Natural gas, burned in boiler modulating >100kW	2.03	MJ
Electricity, low voltage, production	1.15	kWh
Textile, woven cotton, at plant	0.0272	kg
Ethylene glycol, at plant	0.002	kg
Emissions to air		
Hydrocarbons, aliphatic, alkanes, unspecified	0.000558	kg
Ethene, tetrachloro-	7.51E-05	kg
Water	1.12	kg
Heat, waste	4.13	MJ
Waste to treatment		
Disposal, used mineral oil, 10% water, to hazardous waste incineration	0.000867	kg

Table A.21 LCI data for TAMURA wave soldering process

TAMURA Wave Soldering	0.1	kg
This dataset models a TAMURA wave soldering machine with typical production volume of 100 circuit board per 1kWh. A circuit board is estimated to consume 100g of lead-free wave bars. Source: TOTO Shanghai; Data sourced from Shanghai, China; 2013		

Materials/fuels		
Electricity, medium voltage, production	4.323	kWh
Soft solder, Sn97Cu3, at plant	0.1	kg
Emissions to air		
Heat, waste	15.561	MJ

Table A.22 LCI data for electroplating process

Electroplating	1	kg
This dataset models an electroplating machine with typical production volume of 90 metal parts per 1 kWh. The consumable are mainly degreasing solvents, activator substances and additive substances. Source: TOTO Shanghai; Data sourced from Shanghai, China; 2013		
Materials/fuels		
Electricity, low voltage, production	0.011	kWh
Natural gas, burned in industrial furnace low-NOx >100kW	0.00863	MJ
Degreasing Solvent (8% Ammonium Metatungstate, 7% Trichloroethylene, 5% DTPA Pentasodium Solution, 3% Sodium Mono Floro Phosphate)	0.089	kg
Additive Substance (6% Ammonium Metatungstate, 5% Trichloroethylene, 3% Fluoboric acid, 5% Sodium Mono Floro Phosphate)	0.342	kg
Activator Substance (5% Nickel Sulfate NiSO4.6H2O, 5% Sodium Acetate, 7% Trichloroethylene, 3% DTPA Pentasodium Solution)	0.089	kg

Table A.23 LCI data for casting bronze process

Casting Bronze	1	kg
This data contains the energy demand for the melting of copper and tin and casting of bronze. Data is based on assumptions and theoretical modeling. Geographical coverage relates to European average; based on 2003 LCI data using present technologies.		
Materials/fuels		
Aluminum casting, plant	4.9E-11	p
Electricity, medium voltage, production	0.02	kWh
Heat, heavy fuel oil, at industrial furnace 1MW	0.288	MJ
Heat, natural gas, at industrial furnace >100kW	0.36	MJ
Emissions to air		
Heat, waste	0.072	MJ
Tin	5.05E-05	kg

Table A.24 LCI data for plastic film extrusion process

Extrusion, Plastic Film	1	kg
This process contains the auxiliaries and energy demand for the mentioned conversion process of plastics. The converted amount of plastics is NOT included in the dataset. Geographical coverage encompasses difference European and Swiss converting companies based on 2005 LCI data using present technologies.		
Resources		
Water, cooling, unspecified natural origin/m3	0.0437	m3
Materials/fuels		
Lubricating oil, at plant	0.000105	kg
EUR-flat pallet	0.00144	p
Particle board, outdoor use, at plant	0.0000215	m3
Solid bleached board, SBB, at plant	0.000976	kg
Core board, at plant	0.00732	kg
Polyvinylchloride, suspension polymerised, at plant	0.0000488	kg
Polyethylene, LDPE, granulate, at plant	0.00215	kg

Polypropylene, granulate, at plant	0.000683	kg
Electricity, medium voltage, production	0.66	kWh
Heat, at hard coal industrial furnace 1-10MW	0.0751	MJ
Heat, natural gas, at industrial furnace >100kW	0.601	MJ
Heat, heavy fuel oil, at industrial furnace 1MW	0.134	MJ
Steam, for chemical processes, at plant	0.058	kg
Packaging box production unit	1.4E-09	p
Transport, lorry 3.5-16t, fleet average	0.0118	tkm
Emissions to air		
Heat, waste	2.38	MJ
Waste to treatment		
Disposal, plastics, mixture, 15.3% water, to municipal incineration	0.0241	kg

Table A.25 LCI for sheet rolling steel

Sheet Rolling, Steel	1	kg
This dataset includes the process steps continuous pickling line, cold rolling, annealing, tempering, inspecting and finishing, packing coils or sheets, roll maintenance. Does not include the material being rolled. This process is to be used only for un- and low-alloyed steel. Data-set is representative for European Union based on 2003 LCI data using industry average technology.		
Resources		
Water, cooling, unspecified natural origin/m3	0.027	m3
Materials/fuels		
Chemicals inorganic, at plant	1.58E-08	kg
Electricity, medium voltage, production	0.223	kWh
Heat, unspecified, in chemical plant	0.171	MJ
Hydrochloric acid, 30% in H2O, at plant	0.000397	kg
Kraft paper, bleached, at plant	1.6E-06	kg
Kraft paper, unbleached, at plant	2.68E-05	kg
Lime, hydrated, loose, at plant	5.42E-05	kg
Lubricating oil, at plant	0.00459	kg
Natural gas, burned in industrial furnace >100kW	0.912	MJ
Packaging film, LDPE, at plant	8.49E-05	kg
Kraft paper, bleached, at plant	1.62E-09	p
Rolling mill	1.85E-06	m3
Sawn timber, softwood, raw, air dried, u=20%, at plant	4.47E-05	kg
Silicon carbide, at plant	0.00015	kg
Sodium dichromate, at plant	0.0855	kg
Steel, converter, unalloyed, at plant	0.000236	kg
Steel, electric, un- and low-alloyed, at plant	0.00418	kg
Sulphuric acid, liquid, at plant	0.0298	tkm
Transport, lorry >16t, fleet average	0.135	kg
Water, deionised, at plant	1.58E-08	kg
Emissions to air		
Aluminium	1.42E-06	kg
BOD5, Biological Oxygen Demand	4.13E-05	kg
Cadmium	1.5E-07	kg
Chloride	1.34E-06	kg
Chromium VI	3E-08	kg

Chromium	5.4E-07	kg
COD, Chemical Oxygen Demand	4.13E-05	kg
Copper	2.9E-07	kg
DOC, Dissolved Organic Carbon	1.33E-05	kg
Hydrocarbons, unspecified	1.89E-06	kg
Iron	4.65E-06	kg
Lead	3E-07	kg
Manganese	6.12E-07	kg
Mercury	3E-08	kg
Nickel	8.49E-07	kg
Suspended solids, unspecified	0.000159	kg
TOC, Total Organic Carbon	1.33E-05	kg
Zinc	2.24E-07	kg
Emissions to soil		
Iron	4.52E-05	kg
Oils, unspecified	3.85E-05	kg
Waste to treatment		
Disposal, basic oxygen furnace wastes, 0% water, to residual material landfill	0.000193	kg
Disposal, municipal solid waste, 22.9% water, to municipal incineration	0.000358	kg
Disposal, sludge from steel rolling, 20% water, to residual material landfill	0.0201	kg
Disposal, steel in car shredder residue, 0% water, to municipal incineration	0.0079	kg
Disposal, used mineral oil, 10% water, to hazardous waste incineration	0.000888	kg

Table A.26 LCI for wire drawing copper

Wire Drawing, Copper	1	kg
This dataset includes the production of wire rod and the further drawing of this to wire. Does not include the material being rolled or drawn; only the amount of scrap lost in waste is balanced as primary copper input. Wire rod production is comparable to sheet rolling leading to another final shape. Further drawing leads to wires with cross sections ranging from 1.6 to 3.5 mm and higher. Dataset is representative for European Union. Data on which assumptions are basing are from 1998		
Resources		
Water, cooling, unspecified natural origin/m3	0.0108	m3
Materials/fuels		
Sawn timber, softwood, raw, air dried, u=20%, at plant	6.12E-07	m3
Sheet rolling, steel	0.001652	kg
Steel, converter, unalloyed, at plant	0.001652	kg
Electricity, medium voltage, production	0.44667	kWh
Lubricating oil, at plant	0.0072	kg
Transport, lorry >16t, fleet average	0.015045	tkm
Packaging film, LDPE, at plant	0.001322	kg
Light fuel oil, burned in industrial furnace 1MW	0.80011	MJ
Rolling mill	1.43E-09	p
Packaging, corrugated board, mixed fibre, single wall, at plant	0.00033	kg
Copper, at regional storage	0.039644	kg
Natural gas, burned in industrial furnace low-NOx >100kW	0.80011	MJ
Emissions to air		
Heat, waste	1.608	MJ

NMVOC, non-methane volatile organic compounds, unspecified origin	0.00072	kg
Emissions to water		
BOD5, Biological Oxygen Demand	0.000079	kg
COD, Chemical Oxygen Demand	0.000079	kg
DOC, Dissolved Organic Carbon	2.06E-05	kg
TOC, Total Organic Carbon	2.06E-05	kg
Waste to treatment		
Disposal, municipal solid waste, 22.9% water, to municipal incineration	0.023192	kg
Disposal, used mineral oil, 10% water, to hazardous waste incineration	0.00432	kg
Disposal, hazardous waste, 0% water, to underground deposit	0.015462	kg

Table A.27 LCI data for injection molding process

Injection molding	1	kg
This process contains the auxiliaries and energy demand for the mentioned conversion process of plastics. The converted amount of plastics is NOT included into the dataset.		
Resources		
Water, cooling, unspecified natural origin/m3	0.011	m3
Materials/fuels		
Lubricating oil, at plant	0.00303	kg
Solvents, organic, unspecified, at plant	0.0447	kg
Chemicals organic, at plant	0.0128	kg
Titanium dioxide, production mix, at plant	0.00199	kg
Pigments, paper production, unspecified, at plant	0.00756	kg
EUR-flat pallet	0.00146	p
Solid bleached board, SBB, at plant	9.94E-05	kg
Polyethylene, LDPE, granulate, at plant	0.00169	kg
Polypropylene, granulate, at plant	0.00358	kg
Electricity, medium voltage, production	1.48	kWh
Heat, natural gas, at industrial furnace >100kW	4.21	MJ
Heat, heavy fuel oil, at industrial furnace 1MW	0.229	MJ
Packaging box production unit	1.43E-09	p
Transport, lorry 3.5-16t, fleet average	0.142	tkm
Emissions to air		
Heat, waste	5.33	MJ
Emissions to water		
COD, Chemical Oxygen Demand	9.28E-06	kg
Suspended solids, unspecified	6.63E-06	kg
Waste to treatment		
Disposal, plastics, mixture, 15.3% water, to municipal incineration	0.00567	kg
Disposal, hazardous waste, 0% water, to underground deposit	3.31E-05	kg
Disposal, municipal solid waste, 22.9% water, to sanitary landfill	0.000895	kg

Table A.28 LCI data for brass die casting process

Die casting, brass	1	kg
Operating temperature is slightly higher than casting of brass. A small amount of Brass evaporates. The evaporation losses are estimated at 0.1%wt. Adapted from EcoInvent LCI for die casting of bronze.		
Materials/fuels		
Aluminum casting, plant	4.9E-11	p
Electricity, medium voltage, production	0.0197	kWh
Heat, heavy fuel oil, at industrial furnace 1MW	0.283	MJ
Heat, natural gas, at industrial furnace >100kW	0.354	MJ
Emissions to air		
Heat, waste	0.0708	MJ
Brass	0.000303	kg

Table A.29 LCI data for cold impact extrusion, steel

Cold impact extrusion, steel	1	kg
This dataset encompasses the electricity consumption of the machine as well as common pre- and post-treatments. Furthermore, machine as well as factory infrastructure and operation are considered as well. Degreasing is not included and has to be added if necessary.		

Materials/fuel	-	-
Deformation stroke, cold impact extrusion, steel	1	kg
Surface treatment, cold impact extrusion, steel	1	kg
Heat treatment, cold impact extrusion, steel	1	kg
Compressed air, average installation, >30kW, 7 bar gauge, at supply network	0.291	m3
Metal working machine, unspecified, at plant	0.0000395	kg
Metal working factory	4.58E-10	p
Metal working factory operation, average heat energy	1	kg

APPENDIX B. ADDITIONAL RESULTS

No additional result views have been reported at this point.

APPENDIX C. IMPACT CATEGORIES

The impact assessment is based on the TRACI 2.1 methodology [8]. The contents of this publication are presented in this appendix. A definition of the impact categories within TRACI 2.1 is available in section 4.1.

APPENDIX D. USED DATASHEETS

To model the LCA different data sources have been used. This appendix includes a list of all datasheets that have been used. The list is included in the separate spreadsheets:

- LCA of TOTO Ceramic Products – Drakes and Ultramax Modeling Data and Results 06-2023.xlsx
- LCA of TOTO Fittings Products – EcoFaucets and EFVs Modeling Data and Results 06-2023.xlsx

APPENDIX E. LCI

The LCI results per functional unit for all products are included in the separate spreadsheets:

- LCA of TOTO Ceramic Products – Drakes and Ultramax Modeling Data and Results 06-2023.xlsx
- LCA of TOTO Fittings Products – EcoFaucets and EFVs Modeling Data and Results 06-2023.xlsx

APPENDIX F. LCIA METHOD

The LCIA characterization factors are included in the separate spreadsheets below:

- LCA of TOTO Ceramic Products – Drakes and Ultramax Modeling Data and Results 06-2023.xlsx
- LCA of TOTO Fittings Products – EcoFaucets and EFVs Modeling Data and Results 06-2023.xlsx

APPENDIX G. PROCESS FLOW DIAGRAMS

Process flow diagrams per functional unit of product are included in the separate spreadsheets mentioned above. The modeled materials and energy flows are presented.