SLOAN®
Water Connects Us®

VERIFIED by SCS GLOBAL SERVICES
ENVIRONMENTAL PRODUCT DECLARATION
BASED ON LCA

Declaration Owner
Sloan Valve Company
10500 Seymour Avenue, Franklin Park, IL 60131
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Product
Optima® EBF Sensor Faucets

Functional Unit
Sensor faucets are intended for use in public lavatories as the dispensing unit for the water supplied, primarily for hand washing or simple rinsing. These fixtures are primarily installed in the commercial environment including commercial buildings, airports, stadiums, healthcare, hospitality sectors, etc. The functional unit is defined as "10 years of use of a faucet in an average US public lavatory environment". The lifespan of 10 years is an industry accepted average lifetime that is based on the economic lifespan of a product. However, the faucet lifespan may well greatly exceed 10 years with proper maintenance.

The scope of this EPD is Cradle-to-Grave.

EPD Number and Period of Validity
SCS-EPD-05196
EPD Valid October 24, 2018 through October 23, 2023
Version: October 19, 2021

Product Category Rule
Part A: LCA Calculation Rules and Report Requirements v2018; Sustainable Minds (March 2018).

Part B: Product Group Definition | Public Lavatory Faucets; Sustainable Minds (July 3, 2018).

Program Operator
SCS Global Services
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SCSglobal SERVICES

Declaration Owner:	Sloan Valve Company
Address:	10500 Seymour Avenue, Franklin Park, IL 60131
Declaration Number:	SCS-EPD-05196
Declaration Validity Period:	EPD Valid October 24, 2018 through October 23, 2023
Version Date:	October 19, 2021
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Aditi Suresh, SCS Global Services
LCA Software:	SimaPro v8.3
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Tom Gloria, Ph.D., Industrial Ecology Consultants
Part A Product Category Rule:	LCA Calculation Rules and Report Requirements v2018; Sustainable Minds (March 2018).
Part A PCR Review conducted by:	Part A PCR review conducted by the SM TAB, tab@sustainableminds.com
Part B Product Category Rule:	Product Group Definition | Product Group Definition | Public Lavatory Faucets; Sustainable Minds (July 3, 2018).
Part B PCR Review conducted by:	Part B PCR review conducted by the SM TAB, tab@sustainableminds.com
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Tom Gloria, Ph.D., Industrial Ecology Consultants

Declaration Contents:

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, and ISO 21930.*

Scope of Results Reported: *The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.*

Accuracy of Results: *Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.*

Comparability: *The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.*

PRODUCT

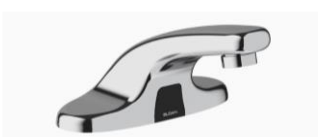
The following Optima® EBF sensor faucets are represented by this EPD:

Model #	Flow Rate	Model #	Flow Rate
EBF650	(0.35 gpm/ 1.3 lpm)	EBF 415	(0.5 gpm/1.9 lpm)
EBF650	(0.5 gpm/1.9 lpm)	ETF 410	(0.35 gpm/ 1.3 lpm)
EBF425	(0.35 gpm/ 1.3 lpm)	ETF 410	(0.5 gpm/1.9 lpm)
EBF425	(0.5 gpm/1.9 lpm)	ETF420	(0.35 gpm/ 1.3 lpm)
EBF655	(0.35 gpm/ 1.3 lpm)	ETF420	(0.5 gpm/1.9 lpm)
EBF655	(0.5 gpm/1.9 lpm)	ETF600	(0.35 gpm/ 1.3 lpm)
EBF 415	(0.35 gpm/ 1.3 lpm)	ETF600	(0.5 gpm/1.9 lpm)

PRODUCT DESCRIPTION

Sensor-activated faucets are designed to deliver a preset volume of water into a lavatory. Sloan's line of Optima® faucets have a reputation for reliability and proven engineering expertise and a wide range of design and feature options. This line of hygienic, touch-free electronic operation faucets are vandal resistant that stand up to the harshest commercial environments.

Optima® EBF 650
Battery- Powered Deck-Mounted Low Integrated Base Body Faucet



Optima® EBF 655
Battery- Powered Deck-Mounted Low Integrated Base Body BAA Complaint Faucet

Optima® ETF 600
Hardwired-Powered Deck-Mounted Low Integrated Base Body Faucet

The Optima® EBF 415, EBF 425, EBF 650 and EBF 655 are Battery-Powered Deck-Mounted Low Integrated Base Body Faucets with 0.35 gpm/1.3 Lpm or 0.5 gpm/1.9 Lpm flow rates. Optima® ETF 410, ETF 420, and ETF 600 sensor faucets are Hardwired-Powered Deck-Mounted Low Integrated Base Body Faucets with 0.35 gpm/1.3 Lpm or 0.5 gpm/1.9 Lpm flow rates. These sensor faucets feature a cast brass spout, quick connect fittings and integrated water shut-off.

Optima® EBF 415, EBF 425, EBF 650, ETF 410, ETF 420, and ETF 600 sensor faucets meet the following certifications: Americans with Disabilities Act (ADA), California Energy Commission (CEC), CalGreen Code, GPC 0.25 or less, UL Certified, UPC Low Lead, LEED v4 (with 0.35 gpm spray option) and NSF 372.

Optima® EBF 655 sensor faucets meet the following certifications: Americans with Disabilities Act (ADA), California Energy Commission (CEC), CalGreen Code, GPC 0.25 or less, UL Certified, UPC Low Lead, Buy American Act (BAA), LEED v4 (with 0.35 gpm spray option) and NSF 372.

The Optima® sensor faucets are available with the following features:

- Isolated Latching Solenoid Operator, isolates magnetic components from water contact
- Sensor Range Adjustment Screw
- Low Battery LED Indicator Light
- User friendly Variable Time Out Settings
- Serviceable Filtered Solenoid Valve
- Bak-Chek® Tee for Hot/Cold Supply
- Spray Head with Pressure Compensating Flow Control
- Metal Jacketed Wire Protection for Sensor Lead

MATERIAL RESOURCES

The material composition and availability of raw material resources of the Optima® EBF sensor faucets are shown in Table 1 and Table 2. Information on product packaging is shown in Table 3.

Table 1. *Material composition (in % of mass) of Optima® EBF650 and Optima® EBF655 sensor faucets.*

Material	% Mass	Availability			
		Renewable	Non-Renewable	Pre-Consumer Recycled Content	Post-Consumer Recycled Content
Brass	59%		Yes	0%	0%
ABS	15%		Yes	0%	0%
Stainless Steel	9.4%		Yes	0%	0%
Polypropylene	7.3%		Yes	0%	0%
Rubber	4.0%	Yes		0%	0%
PCB	3.5%		Yes	0%	0%
Battery	0.9%		Yes	0%	0%
EPDM	0.33%		Yes	0%	0%
HDPE	0.19%		Yes	0%	0%
Acetal	0.05%		Yes	0%	0%
Adhesive	0.009%		Yes	0%	0%
TOTAL	**100%**				

Table 2. *Material composition (in % of mass) of Optima® ETF600 sensor faucets.*

Material	% Mass	Availability			
		Renewable	Non-Renewable	Pre-Consumer Recycled Content	Post-Consumer Recycled Content
Brass	76%		Yes	0%	0%
ABS	17%		Yes	0%	0%
Stainless Steel	4.4%		Yes	0%	0%
Polypropylene	0.94%		Yes	0%	0%
Rubber	0.57%	Yes		0%	0%
HDPE	0.19%		Yes	0%	0%
EPDM	0.05%		Yes	0%	0%
Acetal	0.05%		Yes	0%	0%
TOTAL	**100%**				

Table 3. *Material composition (in % of mass) of Optima® ETF420 and EBF425 sensor faucets.*

Material	% Mass	Availability			
		Renewable	Non-Renewable	Pre-Consumer Recycled Content	Post-Consumer Recycled Content
Brass	61.1%		Yes	0%	0%
Stainless Steel	11.1%		Yes	0%	0%
Copper	10.9%		Yes	0%	0%
PPA	5.9%		Yes	0%	0%
Battery	4%		Yes	0%	0%
Sensor	2.7%		Yes	0%	0%
Aerator	1.9%		Yes	0%	0%
EPDM	1.6%		Yes	0%	0%
Aluminum	1.12%		Yes	0%	0%
Santoprene	0.07%		Yes	0%	0%
Vinyl	0.05%		Yes	0%	0%
ABS	0.006%		Yes	0%	0%
Magnet	0.005%		Yes	0%	0%
TOTAL	**100%**				

Table 4. *Material composition (in % of mass) of packaging for Optima® EBF415, EBF425, EBF650, EBF655, ETF410, ETF420, and ETF600 sensor faucets*

Material	% Mass	Availability			
		Renewable	Non-Renewable	Pre-Consumer Recycled Content	Post-Consumer Recycled Content
Cardboard	87%	Yes		3%	5%
Paper	2.3%	Yes		0%	0%
LDPE film	9.1%		Yes	0%	0%
Plastic label	1.8%		Yes	0%	0%
TOTAL	**100%**				

ADDITIONAL ENVIRONMENTAL INFORMATION

Sloan is a proud member of the United States Green Building Council (USGBC) and through the use of the Leadership in Energy and Environmental Design (LEED) Green Building Rating System, Sloan recognizes and validates the importance of best-in-class building strategies and practices of high performing green buildings. Sloan's Optima® EBF faucets within this EPD can be used to help achieve water efficiency goals as well as gaining USGBC LEED v4 points and/or complying with CAL Green and other building code requirements.

LIFE CYCLE ASSESSMENT OVERVIEW

The system boundary is cradle-to-grave and includes resource extraction and processing, product manufacture and assembly, distribution/transport, use and maintenance, and end-of-life. The diagram below illustrates the life cycle stages included in this EPD.

Product			Construction Process		Use							End-of-Life				Benefits & Loads Beyond the System Boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw Material Extraction and Processing	Transport to the Manufacturer	Manufacturing	Transport	Construction – Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse, recovery, and/or recycling potential
X	X	X	X	X	NR	X	X	NR	NR	NR	X	X	X	X	X	MND

X = Included | MND = module not declared | NR = not relevant

The following provides a brief overview of the Modules included in the product system for Optima® EBF sensor faucets.

Module A1 Raw material extraction and processing, processing of secondary material inputs for sensor faucets

This module includes the potential environmental impacts associated with the extraction and processing of raw materials for various component parts in the sensor faucet. The brass components are one of the primary materials, comprising of at least 59% of the faucet product composition.

Module A2: Transportation

This module includes the transportation of all raw material components (such as brass, plastics, stainless steel, synthetic rubber, etc.) for Optima® EBF 650 and Optima® ETF 600 sensor faucets from the suppliers to the manufacturing facility in China. In case of Optima® EBF 655 sensor faucets, this module includes transportation of raw material components to the manufacturing facility in the U.S.

Module A3: Manufacture of Sensor faucet

This module includes the manufacturing, assembly and packaging of the final Optima® EBF 650 and Optima® ETF 600 sensor faucets at the manufacturing facility in China. Optima® EBF 655 sensor faucets are assembled and packaged in the U.S.

Module A4: Transportation & Delivery to the site

This module includes the impacts associated with transportation of finished sensor faucets to the U.S. based distribution center and the subsequent delivery to the installation site.

Module A5: Construction & Installation

The installation of sensor faucets is performed with hand tools and does not require any ancillary material input. This module considers the impacts associated with waste processing and disposal of product packaging waste generated during the installation process.

Module B1: Normal use of the product

This module includes environmental impacts arising through normal anticipated use of the product. This module is not applicable because the anticipated use of the faucet is accounted for in Module B7: Operational water use.

Module B2: Maintenance

This module considers the impacts associated with cleaning and maintenance of the product over a 10-year period. Cleaning of the faucet is assumed to occur daily using 10ml of 1% sodium lauryl sulfate solution. The faucets are cleaned daily for a period of 10 years, corresponding to the functional unit for the assessment. Additionally, waste processing and disposal related to these maintenance activities are included in this module.

Module B3: Repair

This module includes any anticipated repair events during the reference service of the faucets. Based on the manufacturer's recommendation, alkaline batteries need to be replaced thrice over a 10-year period. This module considers the impacts associated with the production and transportation of components required for product repair.

Module B4-B5: Replacement and refurbishment

These modules include anticipated replacement or refurbishment events during the reference service life associated with replacing a whole product (Module B4) and restoration of parts to a condition in which the products can perform its required function (Module B5). These modules are not applicable to sensor faucets as these products are not expected to be replaced as a whole product over a 10 year period. The replacement of certain worn out parts are considered as repair in Module B3.

Module B6: Operational Energy Use

This module includes energy use during the operation of the product, together with its associated environmental aspects and impacts including processing and transportation of any waste generated on-site due to the use of energy. This module is not applicable to Optima® EBF 650 and Optima® EBF 655 because sensor faucets are battery operated and/or equipped with a solar panel to capture and store power. There is no primary energy consumption associated with these products. This module is only applicable to Optima® ETF 600, which is powered by hardwired mount.

Module B7: Operational Water Use

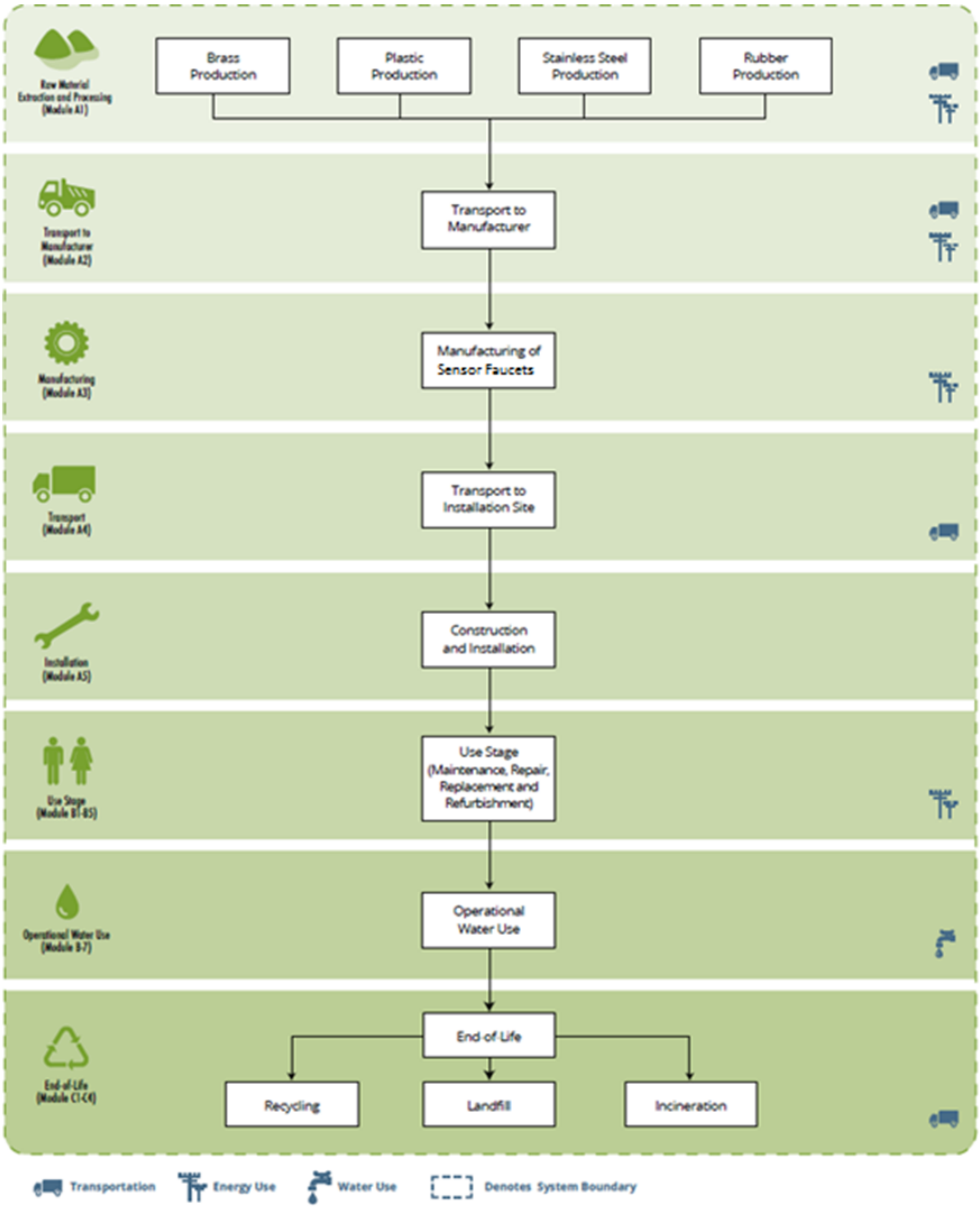
This module includes water use during the operation of the product (assumes a mix of 70% hot water and 30% cold water), together with its associated environmental aspects and impacts considering the life cycle of water which includes production, transportation and wastewater treatment. Impacts were calculated depending on the water use (gallons per minute) specifications of sensor faucets.

Module C1-C4: End-of-Life

The end-of-life stage of the product starts when it is replaced, dismantled or deconstructed from the building. Impacts for deconstruction and dismantling processes were not modeled in the LCA as it is a manual process with hand tools, and does not require any energy input for removal of the product. The impacts associated with transportation of waste materials to processing facilities, waste processing of material components and waste disposal of the product are included in these modules.

PROCESS FLOW DIAGRAM

The diagram below is a representation of the most significant contributions to the production for Optima® EBF sensor faucets. The following life cycle stages are included: production (Modules A1-A3); construction & installation (Module A4-A5); product use (Modules B1-B7); and end-of-life (Modules C1-C4).



LIFE CYCLE IMPACT ASSESSMENT

Life cycle impact assessment is the process of converting the life cycle inventory results into a representation of potential environmental and human health impacts. For example, emissions of carbon dioxide, methane, and nitrous oxide (inventory data) together contribute to climate change (impact assessment). The impact assessment for the EPD is conducted in accordance with the requirements of the Product Category Rule (PCR). Impact category indicators were estimated using TRACI v2.1 characterization method, including Global Warming Potential (100 year time horizon), Acidification Potential, Eutrophication Potential, Smog formation, Ozone Depletion Potential, and Fossil Fuel Depletion Potential.

Table 5. *Results for 10 years of use of Optima® EBF415, EBF425, and EBF650 sensor faucets.*

Impact Category	Production			Construction & Installation		Use			End-of-Life			
	Raw Material Extraction/ Processing	Transport to the Manufacturer	Manufacturing	Transportation	Installation	Maintenance	Repair	Operational Water Use	Demolition	Transportation	Waste Processing	Disposal
	A1	A2	A3	A4	A5	B2	B3	B7	C1	C2	C3	C4
Ecological Indicators												
Acidification (kg SO_2 eq)	0.70	2.0×10^{-3}	1.7×10^{-3}	1.4×10^{-2}	1.8×10^{-5}	5.1×10^{-2}	9.2×10^{-2}	See Table 8	0.0	1.8×10^{-5}	1.3×10^{-3}	5.6×10^{-4}
Eutrophication (kg N eq)	1.7	3.0×10^{-4}	1.1×10^{-3}	2.5×10^{-3}	6.0×10^{-4}	2.1×10^{-2}	1.2×10^{-2}		0.0	4.2×10^{-6}	1.1×10^{-3}	2.5×10^{-3}
Global Warming (kg CO_2 eq)	35	0.24	0.37	2.2	0.07	8.3	1.6		0.0	3.8×10^{-3}	0.35	0.38
Ozone Depletion (kg CFC-11 eq)	2.3×10^{-6}	4.5×10^{-8}	1.8×10^{-9}	4.1×10^{-7}	2.3×10^{-10}	8.2×10^{-7}	7.8×10^{-6}		0.0	7.4×10^{-10}	1.6×10^{-8}	1.4×10^{-8}
Human Health Indicators												
Smog (kg O_3 eq)	3.8	3.7×10^{-2}	1.9×10^{-2}	0.28	3.4×10^{-4}	0.50	9.9×10^{-2}	See Table 8	0.0	4.1×10^{-4}	1.5×10^{-2}	7.7×10^{-3}
Resource Depletion												
Fossil Fuel Depletion (MJ surplus)	36	0.53	5.1×10^{-2}	4.8	3.0×10^{-3}	29	1.8	See Table 8	0.0	8.7×10^{-3}	0.24	0.16

Table 6. *Results for 10 years of use of Optima® EBF655 sensor faucet.*

Impact Category	Production			Construction & Installation		Use			End-of-Life			
	Raw Material Extraction/ Processing	Transport to the Manufacturer	Manufacturing	Transportation	Installation	Maintenance	Repair	Operational Water Use	Demolition	Transportation	Waste Processing	Disposal
	A1	A2	A3	A4	A5	B2	B3	B7	C1	C2	C3	C4
Ecological Indicators												
Acidification (kg SO_2 eq)	0.70	2.0×10^{-3}	8.9×10^{-4}	1.4×10^{-2}	1.8×10^{-5}	5.1×10^{-2}	9.2×10^{-2}	See Table 8	0.0	1.8×10^{-5}	1.3×10^{-3}	5.6×10^{-4}
Eutrophication (kg N eq)	1.7	3.0×10^{-4}	9.7×10^{-5}	2.5×10^{-3}	6.0×10^{-4}	2.1×10^{-2}	1.2×10^{-2}		0.0	4.2×10^{-6}	1.1×10^{-3}	2.5×10^{-3}
Global Warming (kg CO_2 eq)	35	0.24	0.12	2.2	0.07	8.3	1.6		0.0	3.8×10^{-3}	0.35	0.38
Ozone Depletion (kg CFC-11 eq)	2.3×10^{-6}	4.5×10^{-8}	7.3×10^{-9}	4.1×10^{-7}	2.3×10^{-10}	8.2×10^{-7}	7.8×10^{-6}		0.0	7.4×10^{-10}	1.6×10^{-8}	1.4×10^{-8}
Human Health Indicators												
Smog (kg O_3 eq)	3.8	3.7×10^{-2}	2.0×10^{-3}	0.28	3.4×10^{-4}	0.50	9.9×10^{-2}	See Table 8	0.0	4.1×10^{-4}	1.5×10^{-2}	7.7×10^{-3}
Resource Depletion												
Fossil Fuel Depletion (MJ surplus)	36	0.53	0.28	4.8	3.0×10^{-3}	29	1.8	See Table 8	0.0	8.7×10^{-3}	0.24	0.16

Table 7. *Results for 10 years of use of Optima® ETF410, ETF420, and ETF600 sensor faucets.*

Impact Category	Production			Construction & Installation		Use				End-of-Life			
	Raw Material Extraction/ Processing	Transport to the Manufacturer	Manufacturing	Transportation	Installation	Maintenance	Repair	Operational Energy Use	Operational Water Use	Demolition	Transportation	Waste Processing	Disposal
	A1	A2	A3	A4	A5	B2	B3	B6	B7	C1	C2	C3	C4
Ecological Indicators													
Acidification (kg SO_2 eq)	0.59	2.0×10^{-3}	1.7×10^{-3}	1.4×10^{-2}	1.4×10^{-5}	5.1×10^{-2}	0.0	2.8×10^{-2}	See Table 7	0.0	1.7×10^{-5}	1.7×10^{-3}	2.2×10^{-3}
Eutrophication (kg N eq)	1.1	3.0×10^{-4}	1.1×10^{-3}	2.5×10^{-3}	6.1×10^{-4}	2.1×10^{-2}	0.0	6.1×10^{-2}		0.0	4.1×10^{-6}	1.4×10^{-3}	8.0×10^{-3}
Global Warming (kg CO_2 eq)	14	0.24	0.37	2.1	0.063	8.3	0.0	7.4		0.0	3.8×10^{-3}	0.44	1.6
Ozone Depletion (kg CFC-11 eq)	7.2×10^{-7}	4.5×10^{-8}	1.8×10^{-9}	4.1×10^{-7}	2.0×10^{-10}	8.2×10^{-7}	0.0	6.1×10^{-7}		0.0	7.4×10^{-10}	2.0×10^{-8}	5.3×10^{-8}
Human Health Indicators													
Smog (kg O_3 eq)	2.2	3.7×10^{-2}	1.9×10^{-2}	0.28	3.0×10^{-4}	0.50	0.0	0.20	See Table 7	0.0	4.1×10^{-4}	2.0×10^{-2}	3.0×10^{-2}
Resource Depletion													
Fossil Fuel Depletion (MJ surplus)	17	0.53	5.0×10^{-2}	4.8	2.7×10^{-3}	29	0.0	5.7	See Table 7	0.0	8.6×10^{-3}	0.30	0.65

The operational water use phase considers the volume of water required per minute (assumes a mix of 70% hot water and 30% cold water), the embedded energy required for water supply, distribution and wastewater treatment, and the number of uses over a 10-year period. The volume of water required per use (expressed in terms of gallons per minute) varies depending on the design specification of the sensor faucet.

Table 8. *Results for Module B7: Operational Water Use scenarios for Optima® sensor faucets (90 uses per day over 10 year period).*

Impact Category	USE SCENARIO FOR B7: Operational Water Use	
	Optima® Sensor Faucets (90 uses per day over 10 years)	
	0.35 gpm	0.5 gpm
Ecological Indicators		
Acidification (kg SO_2 eq)	4.0	5.7
Eutrophication (kg N eq)	6.0	8.5
Global Warming (kg CO_2 eq)	800	1,100
Ozone Depletion (kg CFC-11 eq)	1.0×10^{-4}	1.4×10^{-4}
Human Health Indicators		
Smog (kg O_3 eq)	22	31
Resource Depletion		
Fossil Fuel Depletion (MJ surplus)	1,900	2,600

ADDITIONAL ENVIRONMENTAL PARAMETERS

ISO 21930 requires that several parameters be reported in the EPD, including resource use, waste categories and output flows, and other environmental information. The results for these parameters are shown in Table 8, Table 9, Table 10 and Table 11.

Acronym	Parameter
RPR_E	Renewable primary resources used as an energy carrier (fuel)
RPM_E	Renewable primary resources with energy content used as material
$NRPR_E$	Non- renewable primary resources used as an energy carrier (fuel)
$NRPM_E$	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
NHW	Non-hazardous waste disposed
HW	Hazardous waste disposed
RW	Radioactive waste disposed
CFR	Components for reuse
MFR	Materials for recycling
MER	Materials for energy recovery
EE_I	Exported energy from incineration
EE_L	Exported energy from landfill

Table 9. *Results for 10 years of use of Optima® EBF650 sensor faucet by module. Results representing energy flows are calculated using lower heating (i.e., net calorific) values.*

Environmental Parameter	Production			Construction & Installation		Use			End-of-Life			
	Raw Material Extraction/ Processing	Transport to the Manufacturer	Manufacturing	Transportation	Installation	Maintenance	Repair	Operational Water Use	Demolition	Transportation	Waste Processing	Disposal
	A1	A2	A3	A4	A5	B2	B3	B7	C1	C2	C3	C4
RPR_E (MJ)	54	6.3x10^{-2}	0.27	0.53	1.2x10^{-3}	6.2	1.9	See Table 12	0.0	8.9x10^{-4}	0.3	0.12
RPM_E (MJ)	3.9	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
$NRPR_E$ (MJ)	470	4.0	3.2	36	2.9x10^{-2}	237	19		0.0	0.06	2.8	1.6
$NRPM_E$ (MJ)	20	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
SM (MJ)	0.0	0.0	0.016	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
RSF (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
NRSF (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
RE (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Water Use (m^3)	2.4	3.5x10^{-3}	1.3x10^{-2}	2.9x10^{-2}	5.4x10^{-5}	1.0	0.11		0.0	4.9x10^{-5}	9.6x10^{-3}	4.2x10^{-3}
NHW (kg)	6.6	0.26	0.11	2.6	6.1x10^{-2}	0.48	0.42		0.0	5.2x10^{-3}	9.3x10^{-2}	0.60
HW (kg)	3.7x10^{-3}	2.0x10^{-6}	4.3x10^{-6}	1.8x10^{-5}	3.1x10^{-8}	1.0x10^{-4}	2.7x10^{-5}		0.0	3.2x10^{-8}	8.2x10^{-3}	3.1x10^{-6}
RW (kg)	1.9x10^{-4}	4.3x10^{-6}	2.6x10^{-7}	3.9x10^{-5}	1.1x10^{-8}	3.2x10^{-5}	8.3x10^{-6}		0.0	7.0x10^{-8}	1.5x10^{-6}	1.4x10^{-6}
CFR (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
MFR (kg)	0.0	0.0	0.0	0.0	0.098	0.0	0.0		0.0	0.0	0.96	0.0
MER (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
EE, Total (MJ)	0.0	0.0	0.0	0.0	0.17	0.0	0.0		0.0	0.0	0.0	1.0
EE_I, Electricity (MJ)	0.0	0.0	0.0	0.0	0.038	0.0	0.0		0.0	0.0	0.0	0.33
EE_I Heat (MJ)	0.0	0.0	0.0	0.0	0.076	0.0	0.0		0.0	0.0	0.0	0.67
EE_L, Electricity (MJ)	0.0	0.0	0.0	0.0	0.060	0.0	0.0		0.0	0.0	0.0	0.0
EE_L, Heat (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Biogenic CO_2 (kg CO_2)	-0.17	0.0	-0.33	0.0	0.12	0.0	0.0		0.0	0.0	0.0	0.037

Table 10. *Results for 10 years of use of Optima® EBF655 sensor faucet by module. Results representing energy flows are calculated using lower heating (i.e., net calorific) values.*

Environmental Parameter	Production			Construction & Installation		Use			End-of-Life			
	Raw Material Extraction/ Processing	Transport to the Manufacturer	Manufacturing	Transportation	Installation	Maintenance	Repair	Operational Water Use	Demolition	Transportation	Waste Processing	Disposal
	A1	A2	A3	A4	A5	B2	B3	B7	C1	C2	C3	C4
RPR_E (MJ)	54	$6.3x10^{-2}$	0.27	0.53	$1.2x10^{-3}$	6.2	1.9	See Table 12	0.0	$8.9x10^{-4}$	0.3	0.12
RPM_E (MJ)	3.9	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
$NRPR_E$ (MJ)	470	4.0	3.2	36	$2.9x10^{-2}$	237	19		0.0	0.06	2.8	1.6
$NRPM_E$ (MJ)	20	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
SM (MJ)	0.0	0.0	0.016	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
RSF (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
NRSF (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
RE (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Water Use (m^3)	2.4	$3.5x10^{-3}$	$1.3x10^{-2}$	$2.9x10^{-2}$	$5.4x10^{-5}$	1.0	0.11		0.0	$4.9x10^{-5}$	$9.6x10^{-3}$	$4.2x10^{-3}$
NHW (kg)	6.6	0.26	0.11	2.6	$6.1x10^{-2}$	0.48	0.42		0.0	$5.2x10^{-3}$	$9.3x10^{-2}$	0.60
HW (kg)	$3.7x10^{-3}$	$2.0x10^{-6}$	$4.3x10^{-6}$	$1.8x10^{-5}$	$3.1x10^{-8}$	$1.0x10^{-4}$	$2.7x10^{-5}$		0.0	$3.2x10^{-8}$	$8.2x10^{-3}$	$3.1x10^{-6}$
RW (kg)	$1.9x10^{-4}$	$4.3x10^{-6}$	$2.6x10^{-7}$	$3.9x10^{-5}$	$1.1x10^{-8}$	$3.2x10^{-5}$	$8.3x10^{-6}$		0.0	$7.0x10^{-8}$	$1.5x10^{-6}$	$1.4x10^{-6}$
CFR (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
MFR (kg)	0.0	0.0	0.0	0.0	0.098	0.0	0.0		0.0	0.0	0.96	0.0
MER (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
EE, Total (MJ)	0.0	0.0	0.0	0.0	0.17	0.0	0.0		0.0	0.0	0.0	1.0
EE_I, Electricity (MJ)	0.0	0.0	0.0	0.0	0.038	0.0	0.0		0.0	0.0	0.0	0.33
EE_I Heat (MJ)	0.0	0.0	0.0	0.0	0.076	0.0	0.0		0.0	0.0	0.0	0.67
EE_L, Electricity (MJ)	0.0	0.0	0.0	0.0	0.060	0.0	0.0		0.0	0.0	0.0	0.0
EE_L, Heat (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Biogenic CO_2 (kg CO_2)	-0.17	0.0	-0.33	0.0	0.12	0.0	0.0		0.0	0.0	0.0	0.037

Table 11. *Results for 10 years of use of Optima® ETF600 sensor faucet by module. Results representing energy flows are calculated using lower heating (i.e., net calorific) values.*

Environmental Parameter	Production			Construction & Installation		Use				End-of-Life			
	Raw Material Extraction/ Processing	Transport to the Manufacturer	Manufacturing	Transportation	Installation	Maintenance	Repair	Operational Water Use	Operational Water Use	Demolition	Transportation	Waste Processing	Disposal
	A1	A2	A3	A4	A5	B2	B3	B6	B7	C1	C2	C3	C4
RPR_E (MJ)	27	6.3×10^{-2}	0.27	0.53	9.1×10^{-4}	6.2	0.0	11	See Table 12	0.0	8.8×10^{-4}	0.3	0.50
RPM_E (MJ)	0.55	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
$NRPR_E$ (MJ)	190	4.0	2.9	36	2.5×10^{-2}	237	0.0	120		0.0	6.4×10^{-2}	3.1	6.1
$NRPM_E$ (MJ)	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
SM (MJ)	0.0	0.0	0.016	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
RSF (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
NRSF (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
RE (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Water Use (m^3)	0.9	3.5×10^{-3}	1.3×10^{-2}	2.9×10^{-2}	4.6×10^{-5}	1.0	0.0	0.57		0.0	4.9×10^{-5}	1.1×10^{-2}	1.7×10^{-2}
NHW (kg)	4.0	0.26	0.11	2.6	5.6×10^{-2}	0.48	0.0	0.26		0.0	5.2×10^{-3}	0.10	1.9
HW (kg)	2.5×10^{-3}	2.0×10^{-6}	4.3×10^{-6}	1.8×10^{-5}	2.8×10^{-8}	1.0×10^{-4}	0.0	2.1×10^{-4}		0.0	3.2×10^{-8}	9.2×10^{-3}	5.5×10^{-6}
RW (kg)	5.7×10^{-5}	4.3×10^{-6}	2.6×10^{-7}	3.8×10^{-5}	8.3×10^{-9}	3.2×10^{-5}	0.0	8.1×10^{-5}		0.0	6.9×10^{-8}	1.7×10^{-6}	5.2×10^{-6}
CFR (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
MFR (kg)	0.0	0.0	0.0	0.0	0.098	0.0	0.0	0.0		0.0	0.0	1.1	0.0
MER (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
EE, Total (MJ)	0.0	0.0	0.0	0.0	0.17	0.0	0.0	0.0		0.0	0.0	0.0	0.80
EE_I, Electricity (MJ)	0.0	0.0	0.0	0.0	0.038	0.0	0.0	0.0		0.0	0.0	0.0	0.27
EE_I Heat (MJ)	0.0	0.0	0.0	0.0	0.076	0.0	0.0	0.0		0.0	0.0	0.0	0.54
EE_L, Electricity (MJ)	0.0	0.0	0.0	0.0	0.060	0.0	0.0	0.0		0.0	0.0	0.0	0.0
EE_L, Heat (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Biogenic CO_2 (kg CO_2)	-0.023	0.0	-0.33	0.0	0.12	0.0	0.0	0.0		0.0	0.0	0.0	0.01

Table 12. *Results for scenarios for Module B7: Operational Water Use scenarios Optima® EBF sensor faucet (90 uses per day over 10 year period). Results representing energy flows are calculated using lower heating (i.e., net calorific) values.*

Environmental parameter	USE SCENARIO FOR B7: Operational Water Use	
	Optima® Sensor Faucets (90 uses per day over 10 years)	
	0.35 gpm	0.5 gpm
RPR_E (MJ)	1,100	1,500
RPM_E (MJ)	0.0	0.0
$NRPR_E$ (MJ)	20,700	29,600
$NRPM_E$ (MJ)	0.0	0.0
SM (MJ)	0.0	0.0
RSF (MJ)	0.0	0.0
NRSF (MJ)	0.0	0.0
RE (MJ)	0.0	0.0
Water Use (m^3)	56	80
NHW (kg)	28	39
HW (kg)	$2.5x10^{-2}$	$3.6x10^{-2}$
RW (kg)	$8.1x10^{-3}$	$1.2x10^{-2}$
CFR (kg)	0.0	0.0
MFR (kg)	0.0	0.0
MER (kg)	0.0	0.0
EE, Total (MJ)	0.0	0.0
EE_I, Electricity (MJ)	0.0	0.0
EE_I Heat (MJ)	0.0	0.0
EE_L, Electricity (MJ)	0.0	0.0
EE_L, Heat (MJ)	0.0	0.0
Biogenic CO_2 (kg CO_2)	0.0	0.0

Interpretation of Results

Overall, the sensor faucet production and assembly operations of Optima® EBF 650 and Optima® EBF 655 occurring at the Chinese and U.S. facilities respectively (Module A3) have negligible impacts across all the impact category indicators. The major hotspot in the supply chain lies in the operational water use (Module B7), accounting for 88-98% of total impacts across all impact categories. The raw material extraction and processing (Module A1), which primarily includes the production of brass components has a small contribution across the supply chain of the sensor faucet production. The impacts associated with use phase are mainly because of the energy required to heat water (water use is a mix of 70% hot water/30% cold water) and the embedded energy in water supply, distribution and wastewater treatment. As such, the operational water use data used for Module B7 has a significant influence on the final results depending on the number of assumed uses and the water delivered per use (gallons per minute).

SUPPORTING TECHNICAL INFORMATION

Data Sources. *Data sources used for the LCA. Materials less than 1% of product mass are not listed.*

Material	Dataset	Publication Date
Product		
ABS	Acrylonitrile-butadiene-styrene copolymer {GLO}| market for | Alloc Rec, U[1] Injection moulding {GLO}| market for | Alloc Rec, U[1]	2016
Brass components	Brass {GLO}| market for | Alloc Rec, U[1]	2016
Acetal	Polypropylene, granulate {GLO}| market for | Alloc Rec, U[1] Injection moulding {GLO}| market for | Alloc Rec, U[1]	2016
EPDM	Synthetic rubber {GLO}| market for | Alloc Rec, U[1]	2016
Battery	Battery cell, Li-ion {GLO}| market for | Alloc Rec, U[1]	2016
PCB	Printed wiring board, surface mounted, unspecified, Pb free {GLO}| market for | Alloc Rec, U	2016
HDPE	Polyethylene, high density, granulate {RoW}| production | Alloc Rec, U[1]; Injection moulding {GLO}| market for | Alloc Rec, U[1]	2016
Rubber	Literature[2]	2016
Polypropylene	Polypropylene, granulate {RoW}| production | Alloc Rec, U[1] Injection moulding {GLO}| market for | Alloc Rec, U[1]	2016
Adhesive	Adhesive, for metal {RoW}| production | Alloc Rec, U[1]	2016
Stainless steel	Steel, chromium steel 18/8, hot rolled {GLO}| market for | Alloc Rec, U[1]	2016
Packaging		
Plastic film	Packaging film, low density polyethylene {GLO}| market for | Alloc Def, U[1]	2016
Corrugated box	Corrugated board box {RoW}| production | Alloc Rec, U[1]	2016
Paper	Kraft paper, bleached {RER}| production | Alloc Rec, U[1]	2016
Label	Printing ink, offset, without solvent, in 47.5% solution state {RER}| printing ink production, offset, product in 47.5% solution state | Alloc Rec, U[1] Packaging film, low density polyethylene {GLO}| market for | Alloc Def, U[1]	2016
Maintenance		
Sodium lauryl sulfate	Fatty alcohol sulfate {RoW}| production, petrochemical | Alloc Rec, U[1]	2016
Water	Tap water {RoW}| market for | Alloc Rec, U[1]	2016
Resource Use		
Electricity	Electricity, medium voltage {CN}| market group for | Alloc Rec, U[1] The dataset represents the supply mix of electricity for eGRID power subregion representing the location of manufacturing facilities operated by SLOAN.[3]	2016
Operational water use	Electricity, medium voltage {US}| market group for | Alloc Rec, U[1]	2016
Natural Gas	Heat, district or industrial, natural gas {GLO}| market group for | Alloc Rec, U[1]	2016
Transportation		
Truck	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Rec[1]	2016
Ship	Transport, freight, sea, transoceanic ship {GLO}| market for | Alloc Rec, U[1]	2016

[1]Ecoinvent 3.3 Life Cycle Database; [2]Jawjit, W., et al., (2009); [3]SCS Global Services

Data Quality

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	Manufacturer provided primary data on product manufacturing for the Chinese and U.S. facilities based on annual production for 2017, respectively. Representative datasets (secondary data) used for upstream and background processes are generally less than 10 years old from original publication, but almost all have been updated in the last two years.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The data used in the analysis is considered to be of high quality and provide the best possible representation available with current data. Datasets used in the assessment are representative of the US, Global, and "Rest-of-World" (average for all countries in the world with uncertainty adjusted). Datasets chosen are considered sufficiently similar to actual processes and are of good data quality.
Technology Coverage: Specific technology or technology mix	Data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Data was collected for all key processes including faucet production and assembly, packaging and transportation.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of sensor faucets. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Overall, data used in the assessment represent actual processes for production of sensor faucets. Primary data is used to model manufacture of sensor faucets. Data is considered to be representative of the actual technologies used for faucet production.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used, with a bias towards Ecoinvent data.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	Data representing energy use at the manufacturer's facilities represent an annual average. Primary data were available for all key processes across the supply chain including faucet production and assembly, packaging, transportation for sensor faucets. LCI datasets from Ecoinvent were used to model all unit processes.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to the product materials and packaging is low. The secondary datasets are considered to be representative as primary data was collected from the Sloan production facilities. Uncertainty related to the impact assessment methods used in the study is relatively high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

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