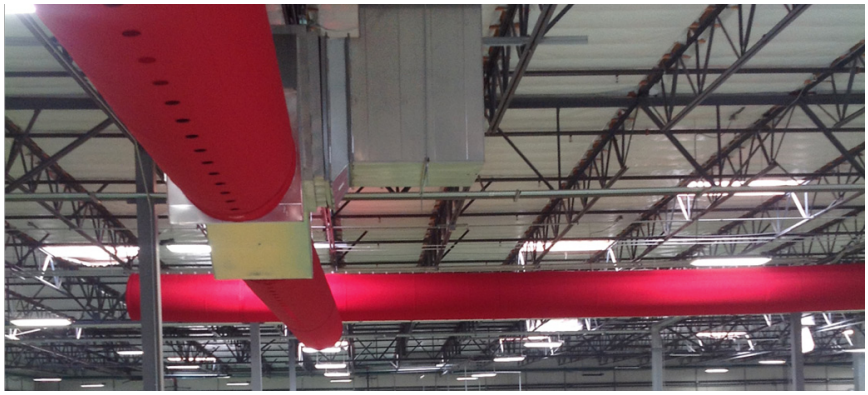
ENVIRONMENTAL PRODUCT DECLARATION

TRADITIONAL ROUNDED

AIR DISPERSION SYSTEM



Installed Traditional Rounded Air Dispersion System (inflated)

DUCTSOX®
Redefining Air Dispersion

Leading the industry through innovation, quality, and service since 1980. DuctSox Corporation, headquartered in Dubuque, Iowa, is a manufacturer of commercial and industrial air dispersion products for open ceiling architecture, critical environments, and under floor applications. Our systems are an innovative and cost-effective alternative to traditional metal ductwork providing precise and efficient heating, cooling, or ventilating for virtually any building application. DuctSox is a leader in the HVAC industry with products accepted in key industry organizations such as ASHRAE, Underwriters Laboratories (U.S. & Canada), International Code Council, and many building authorities throughout the world.

DuctSox Corporation is a subsidiary of Rite-Hite Corporation, Milwaukee, WI.

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

Environmental Product Declaration

DUCTSOX®
Redefining Air Dispersion

Traditional Rounded
Fabric Air Ducts

According to ISO 14025, EN 15804+A2, and ISO 21930:2017

EPD Program and Program Operator Name, Address, Logo, and Website	UL Environment 333 Pfingsten Road Northbrook, IL 60611 https://www.ul.com https://www.spot.ul.com
General Program Instructions and Version Number	General Program Instructions v2.5 March 2020
Manufacturer Name and Address	DuctSox Inc. 4343 Chavenelle Drive Dubuque, IA 52002
Declaration Number	4790059096.103.1
Declared Product & Functional Unit or Declared Unit	1 m^2 of substantial material used to produce the duct surface area of any single duct section of the ductwork
Reference PCR and Version Number	PCR 2019:14 Construction Products v1.11 C-PCR-011 Substantial Material for Air Ducts
Description of Product Application/Use	Air duct for ventilation and air-conditioning of buildings
Product RSL Description (if Appl.)	n/a
Markets of Applicability	North America
Date of Issue	10/1/2021
Period of Validity	5 Years
EPD Type	Product-specific
Range of Dataset Variability	n/a
EPD Scope	Cradle-to-gate with options (A1-A3, A4, C2-C4)
Year(s) of Reported Primary Data	2020
LCA Software & Version Number	GaBi 10.0.0.20
LCI Database(s) & Version Number	GaBi Database Version 2021.1
LCIA Methodology & Version Number	EN15804+A2 and TRACI 2.1

The PCR review was conducted by:	PCR Review Committee info@environdec.com Moderator: a.temporin@p3italy.it
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Thomas P. Gloria, Industrial Ecology Consultants
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by Underwriters Laboratories	Maggie Wildnauer, WAP Sustainability
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Indusrial Ecology Consultants

Limitations

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact. An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at https://spot.ul.com/.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared. EPDs of construction products may not be comparable if they do not comply with EN 15804+A2:2019.

DUCTSOX
Redefining Air Dispersion

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Fabric Air Ducts

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

According to ISO 14025, EN 15804+A2 and ISO 21930:2017

1. Product Definition and Information

1.1. Product Description

The traditional rounded air dispersion system has zero internal tensioning or hoops. The system is 100% deflated with the air off with a single row hanging system or 45% deflated with a 2 row system.

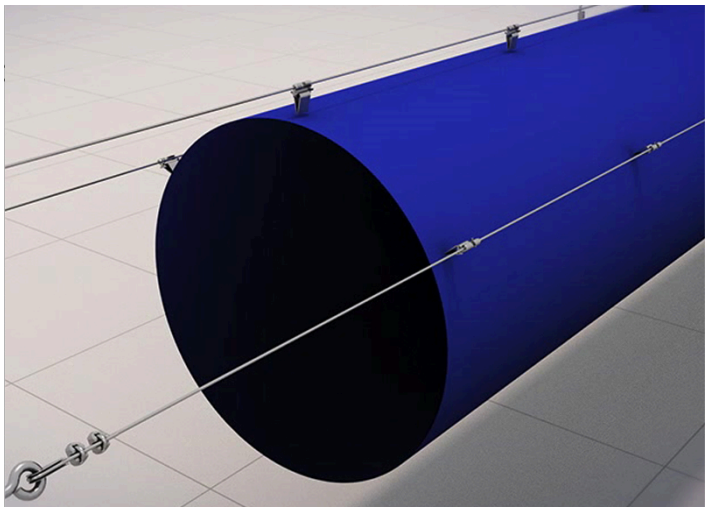

Figure 1: Cross-section of product

1.2. Application

Traditional rounded air dispersion systems are designed to be used in commercial and industrial applications.

1.3. Declaration of Methodological Framework

The underlying LCA follows an an attributional approach.

1.4. Technical Requirements

The product is categorized under UN CPC 36950. The following technical data describe the product under study.

Table 1: Product Specification

	Relevant Standard	Values
Exercise Temperatures	UL 2518	265ºF
Thermal Resistance [m^2K/W]	n/a	-
Reaction to Fire	UL 2518, UL 181, UL 723	25/50, Flame/Smoke
Flexural Rigidity [Nmm^2]	n/a	-
Microbial Growth	UL 2518, UL 181	60 day
Fibrous Material Outflow	UL 2518, UL 181	2.5x Velocity

1.5. Material Composition

The materials that make up the product are indicated in Table 2.

Table 2: Material Composition

MATERIAL	MASS [%]
Fabric [PET]	71.8
Hardware [Aluminum]	21.2
Hardware [Cold rolled powder coated steel]	5.4
Zippers [Acetal]	1.5
Biogenic Carbon Content of Product [kg C]	*0*

No hazardous or dangerous substances, per Resource Conservation and Recovery Act (RCRA), Subtitle 3, contained or released by this product.

1.6. Manufacturing

DuctSox operates two facilities to produce their traditional rounded air dispersion systems. The facility in Mexico receives the fabric, cuts and sews it to the correct dimensions, and attaches the zippers. The Dubuque, Iowa facility manufactures all hardware components.

1.7. Packaging

Packaging utilized in the shipment of the product is described in Table 3.

Table 3: Packaging

MATERIAL	AMOUNT (KG)
Cardboard [kg]	0.050
Steel [kg]	0.026
Nylon [kg]	3.64E-04
PP [kg]	5.05E-04
PVC [kg]	0.005
Paper [kg]	5.05E-04
Foam [kg]	3.07E-04
PET [kg]	0.008
Wood Pallets [kg]	0.058
Biogenic Carbon Content of All Packaging [kg C]	*0.056*

1.8. Transportation

It is assumed that all raw materials are distributed by truck or ship, based on global region.

An average shipping distance from the manufacturing location to the customer was estimated to be 1500 miles. The transportation distance for all waste flows is assumed to be 20 miles based on best available data.

1.9. Disposal

Disposal pathways in the EPD are modeled in accordance with disposal routes and waste classification referenced in Sections 2.8.5 and 2.8.6 of *Part A: Life Cycle Assessment Calculation Rules and Report Requirements* from UL Environment. This indicates an end-of-life split amongst landfill, recycling, and incineration pathways. Manual removal is assumed, with metal components recycled at a rate of 85% and all other materials sent to landfill.

2. Life Cycle Assessment Background Information

2.1. Functional or Declared Unit

The declared unit is 1 m^2 of substantial material used to produce the duct surface area of any single duct section of the ductwork, as commonly used by consumers and architects. Fabric thickness is 0.29 mm.

Table 4: Declared Unit

NAME	VALUE	UNIT
Functional Unit	1	m^2
Mass	0.316	kg

2.2. System Boundary

The type of EPD is cradle-to-gate with options. Included stages are summarized in Figure 2.

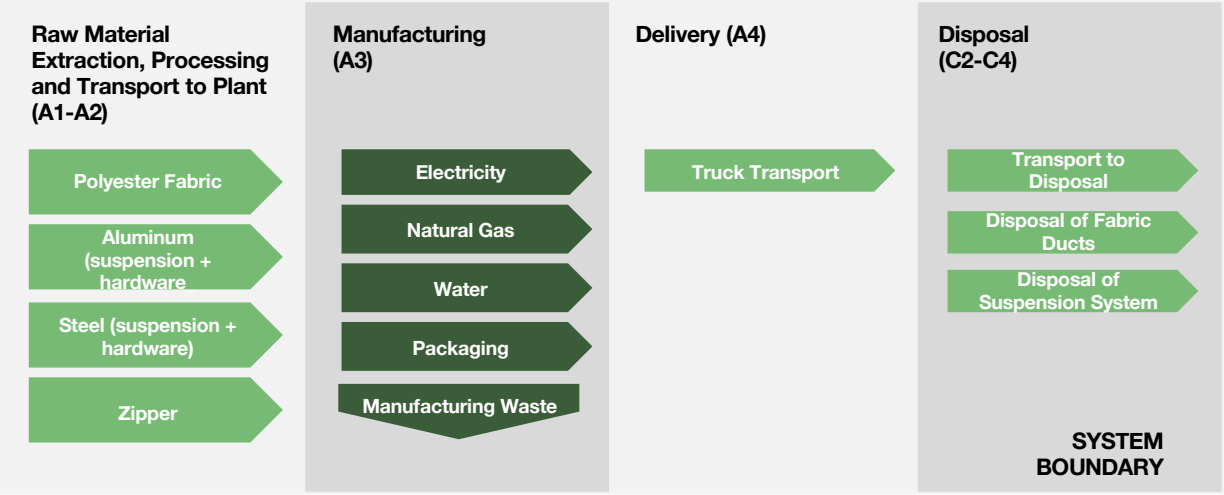

Figure 2: System Boundary

2.3. Estimates and Assumptions

Transport to customer will vary and was therefore assumed to be 1500 miles based on DuctSox's estimate. Overhead energy and water consumption were included in the manufacutring data as they were unable to be separated out. No minimum recycled content is specified for any material, therefore industry average recycled content values were used for North American steel and aluminum.

2.4. Cut-off Criteria

Material inputs greater than 1% (based on total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion and/or the material input was thought to have significant environmental impact. Cumulative excluded material inputs and environmental impacts are less than 5% based on total weight of the functional unit.

2.5. Data Sources

Primary data were collected by facility personnel and from utility bills and was 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 was utilized from the GaBi Database 2021.1.

2.6. Data Quality

The geographical scope of the manufacturing portion of the life cycle is North America. All primary data were collected from the manufacturer. The geographic coverage of primary data is considered excellent. The geographical scope of the raw material acquisition is North America and Taiwan. Customer distribution and disposal is assumed to be within the United States. Primary data were provided by the manufacturer and represent all information for calendar year 2020. Time coverage of this primary data is considered excellent. Primary data provided by the manufacturer is specific to the technology the company uses in manufacturing their product. It is site-specific and considered of good quality. Supplier-specific data was used if available.

In selecting secondary data (i.e., GaBi Datasets), 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. Overall geographic data quality is considered good. Time coverage of the GaBi datasets varies from approximately 2010 to present. All datasets rely on at least one 1-year average data. Overall time coverage of the datasets is considered good.

2.7. Period under Review

The period under review is calendar year 2020.

2.8. Allocation

General principles of allocation were based on ISO 14040/44. Where possible, allocation was avoided. Total annual operations at the Mexico facility were allocated across products based on mass. At the Dubuque, Iowa facility, operations associated with DuctSox were first allocated by square footage of the facility dedicated to manufacturing, and within that total, allocated across the three products by mass.

Throughout the study, recycled materials were accounted for via the cut-off method.

3. Life Cycle Assessment Scenarios

Table 5. Transport to the building site (A4)

NAME	VALUE	UNIT
Fuel type	Diesel	-
Liters of fuel	42 (5.6)	l/100km (mpg)

NAME	VALUE	UNIT
Vehicle type	Heavy-duty truck / 24,191 kg (53,333 lb) payload - 8b	-
Transport distance	2,414 (1,500)	km (mi)
Capacity utilization (including empty runs, mass based	67	%
Capacity utilization volume factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaging products)	Not applicable	-

Table 6. End of life (C2-C4)

NAME		VALUE	UNIT
Collection process (specified by type)	Collected separately	0.316	kg
	Collected with mixed construction waste	-	kg
Recovery (specified by type)	Reuse	-	kg
	Recycling	0.072	kg
	Incineration with energy recovery	-	kg
Disposal (specified by type)	Product or material for final deposition	0.244	kg
Removals of biogenic carbon (excluding packaging)		-	kg C
Assumptions for scenario development		Distance to all disposal or recovery assumed to be 32 km (20 mi)	

4. Life Cycle Assessment Results

Table 7 lists the modules included in this assessment.

Table 7. Description of the system boundary modules

Production			Construction		Use							End of Life				Benefits & Loads Beyond System Boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw Material Supply	Transport	Manufacturing	Transport to Site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste Processing	Disposal	Reuse, Recovery, Recycling Potential
X	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	X	X	X	ND

4.1. Life Cycle Impact Assessment Results

Table 8: LCIA Results, per 1 m²

IMPACT CATEGORY	A1-A3	A4	C2	C3	C4
EN15804+A2					
GWP - total [kg CO_2 eq.]	4.18E+00	9.13E-02	8.26E-04	0.00E+00	1.07E-02
GWP, fossil [kg CO_2 eq.]	4.22E+00	9.15E-02	8.27E-04	0.00E+00	1.08E-02
GWP, biogenic [kg CO_2 eq.]	-3.87E-02	-2.09E-04	-1.90E-06	0.00E+00	-1.08E-04
GWP, land use [kg CO_2 eq.]	1.27E-03	8.62E-05	7.84E-07	0.00E+00	7.01E-06
ODP [kg CFC-11 eq.]	2.62E-09	1.34E-17	1.22E-19	0.00E+00	2.69E-17
AP [Mole of H+ eq.]	1.16E-02	4.48E-04	2.50E-06	0.00E+00	5.31E-05
EP, FW [kg P eq.]	2.37E-05	5.68E-07	5.16E-09	0.00E+00	6.71E-06
EP, Marine [kg N eq.]	2.52E-03	2.25E-04	1.22E-06	0.00E+00	1.56E-05
EP, Terr. [Mole of N eq.]	2.73E-02	2.48E-03	1.34E-05	0.00E+00	1.59E-04
POCP [kg NMVOC eq.]	8.17E-03	4.58E-04	2.43E-06	0.00E+00	3.98E-05
ADP-elements [kg Sb eq.][1]	1.55E-06	2.73E-08	2.48E-10	0.00E+00	2.80E-09
ADP-fossil fuel [MJ][1]	7.59E+01	1.18E+00	1.07E-02	0.00E+00	1.60E-01
Water [m^3 world equiv.]	2.34E+00	6.91E-03	6.28E-05	0.00E+00	6.33E-04
EN15804+A1					
GWP [kg CO_2 eq.]	4.05E+00	8.96E-02	8.12E-04	0.00E+00	1.04E-02
TRACI (North America)					
AP [kg SO_2 eq]	1.02E-02	4.18E-04	2.31E-06	0.00E+00	4.85E-05
EP [kg N eq]	7.17E-04	3.98E-05	2.67E-07	0.00E+00	4.94E-05
GWP [kg CO_2 eq]	4.14E+00	8.98E-02	8.14E-04	0.00E+00	1.05E-02
ODP [kg CFC 11 eq]	4.05E+00	8.96E-02	8.12E-04	0.00E+00	1.04E-02
Resources [MJ]	3.51E-09	1.78E-17	1.62E-19	0.00E+00	3.59E-17
POCP [kg O_3 eq]	8.14E+00	1.68E-01	1.52E-03	0.00E+00	2.09E-02

4.2. Life Cycle Inventory Results

Table 9: LCI Results, per m²

IMPACT CATEGORY	A1-A3	A4	C2	C3	C4
Resource Use Indicators					
RPRE [MJ]	6.33E+00	5.21E-02	4.74E-04	0.00E+00	1.37E-02
RPRM [MJ]	1.29E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RPRT [MJ]	7.62E+00	5.21E-02	4.74E-04	0.00E+00	1.37E-02
NRPRE [MJ]	6.96E+01	1.26E+00	1.15E-02	0.00E+00	1.64E-01

[1] The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

IMPACT CATEGORY	A1-A3	A4	C2	C3	C4
NRPRM [MJ]	6.61E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRT [MJ]	7.58E+01	1.26E+00	1.15E-02	0.00E+00	1.64E-01
SM [kg]	5.39E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	6.76E-02	2.23E-04	2.02E-06	0.00E+00	2.26E-05
FW [m^3]	6.33E+00	5.21E-02	4.74E-04	0.00E+00	1.37E-02
Output Flows and Waste Categories					
HWD [kg]	7.38E-05	1.06E-10	9.60E-13	0.00E+00	1.55E-11
NHWD [kg]	3.31E-01	1.16E-04	1.06E-06	0.00E+00	2.44E-01
RWD [kg]	3.42E-03	3.59E-06	3.27E-08	0.00E+00	1.37E-06
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR [kg]	1.71E-02	0.00E+00	0.00E+00	7.17E-02	0.00E+00
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE [MJ]	1.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET [MJ]	5.29E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00

5. LCA Interpretation

Figure 3 shows the relative contribution of each life cycle stage to the TRACI impact categories. A1-A3 represents the vast majority of all impacts. Raw materials are the most significant contributor, namely the fabric with much smaller contributions from aluminum hardware.

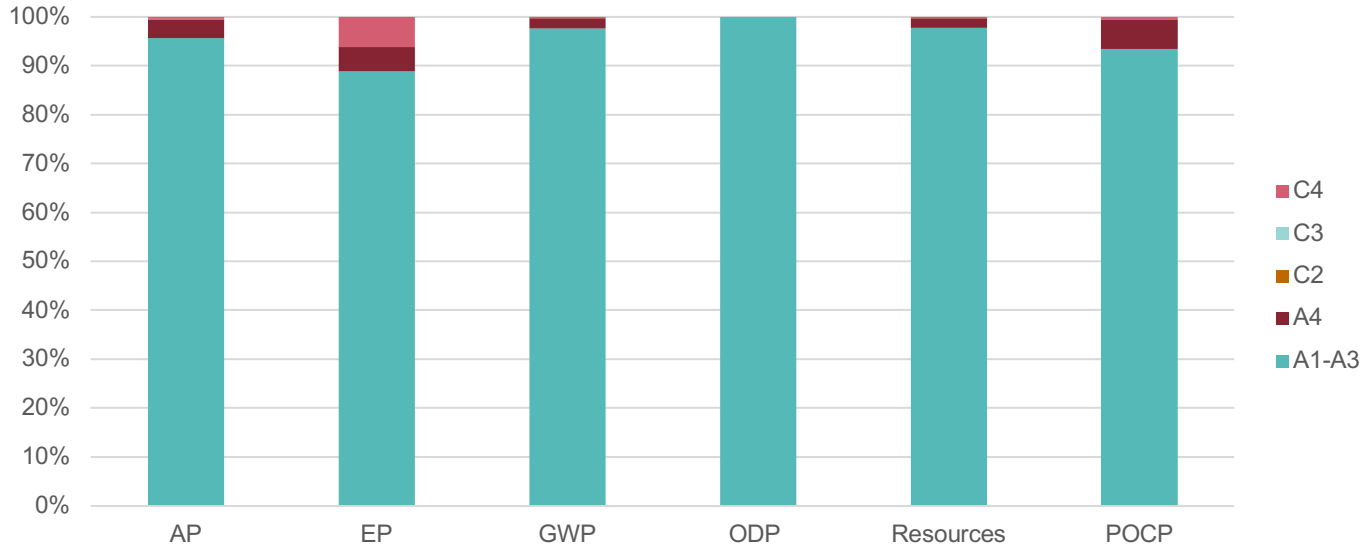

Figure 3: Dominance Analysis [TRACI 2.1]

6. References

- ISO 14040: 2006/Amd 1:2020 Environmental Management - Life cycle assessment – Principles and framework.
- ISO 14044: 2006/Amd 2:2020 Environmental Management - Life cycle assessment - Requirements and Guidelines - Amendment 1.
- ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations - Principles and Procedures.
- ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
- European Standard DIN EN 15804: 2012.04+A1 2013. Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products (includes Amendment A1:2013)
- European Standard DIN EN 15804: 2012.04+A2 2019. Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products (includes Amendment A2:2019)
- CML-IA Characterization Factors. 5 September 2016. https://www.universiteitleiden.nl/en/research/research-output/science/cml-ia-characterisation-factors
- TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts. Version 2.1 - User Guide - https://nepis.epa.gov/Adobe/PDF/P100HN53.pdf.
- Environdec PCR 2019:14 Construction Products v1.11
- Environdec C-PCR-011 (to PCR 2019:14) Substantial Materials for Air Ducts, v.2021-07-09
- UL Environment (2018). Part A: Life Cycle Assessment Calculation Rules and Report Requirements (UL 10010), Version 3.2.

7. Contact Information

7.1. Study Commissioner

DUCTSOX Redefining Air Dispersion

DuctSox Inc.
4343 Chavenelle Drive
Dubuque, IA 52002
Ph: 866-563-7729

7.2. LCA Practitioner

WAP SUSTAINABILITY CONSULTING

WAP Sustainability Consulting
1701 Market Street
Chattanooga, TN 37408
info@WAPSustainability.com

7.3 PCR

Environdec
PCR Review Committee
info@environdec.com
Moderator:a.temporin@p3italy.it
www.environdec.com