

## ENVIRONMENTAL PRODUCT DECLARATION

# LASER PRINTER CS921DE

According to ISO 14025



The Lexmark CS921de delivers high-volume color printing at up to 35 pages per minute (A4/letter) and multi-format output up to SRA3/12x18 with optional finishing. Thoughtful engineering drives endurance and minimizes interruptions to keep the work moving, from high-capacity replacement toner to long-life fusers and developers. Professional color tools and customizable solution apps complement a 4.3-inch touch screen and full accessibility features to maximize ease of use. Comprehensive connectivity options and integration with the full portfolio of Lexmark-exclusive features and services makes it ideal for standalone duty and complements existing A4/letter fleets..



Lexmark hardware, software and services combine to help our customers securely and efficiently capture, manage and print information. Our solutions connect unstructured printed and digital information to the applications, processes and people that need it most, improving customer service, driving financial performance and ensuring flexibility for the future.

As part of the commitment to our customers, Lexmark is undertaking the task of performing Life Cycle Analysis on the set of products announced after October 2012. The results of the LCA analysis will assist Lexmark in reducing the environmental impact of the hardware, software and services offered to our customers.



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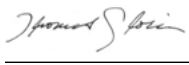
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This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do 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, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Lexmark
DECLARATION NUMBER	4788109831.101.1
DECLARED PRODUCT	Laser Printer CS921de
REFERENCE PCR	ULE (2012) Product Category Rules for preparing an environmental product declaration (EPD) for printers and multi-function printing units (v1.0). UL Environment
DATE OF ISSUE	October 24, 2017
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications
The PCR review was conducted by:	UL Environment Review Panel
	Lise Laurin (Chairperson) 31 Leach Road; Kittery, Maine 03904; lise@earthshift.com
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL	
	Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	
	Thomas Gloria, Indust. Ecology Consultants

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## Product Description

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<b>Product Type</b>	Color Laser Printer
<b>Printer Model</b>	CS921de
<b>Maximum Print Speed</b>	35 pages per minute
<b>Intended use</b>	primarily office
<b>Range of applications</b>	scan, copy, and print images or text in color onto paper or paper-like media
<b>Product Lifetime</b>	5 years
<b>Introduction Date</b>	08/22/2017
<b>Product Specifications</b>	<a href="http://www.lexmark.com/en_US/products/series/printer-and-multifunction/finder.shtml">http://www.lexmark.com/en_US/products/series/printer-and-multifunction/finder.shtml</a>
<b>Functional Unit</b>	The functional unit has been defined as a 1,000 page simplex job in accordance with the Energy Star Typical Energy Consumption test procedure and the reference Product Category Rule (PCR).
<b>Scope of Validity / Applicability</b>	The EPD is representative for the printer model CS921de sold as a stand-alone unit. This EPD and the reference PCR are applicable for printer sale and use in the North American market. Lexmark cannot guarantee that comparisons with EPDs of competitive products will be valid.
<b>Product Characterization</b>	A solutions-capable, network-ready color laser printer with standard 2-sided printing, an 1.2 GHz quad-core processor, and up to 3GB of memory that prints up to 35 ppm color. The printer fuses to a medium (such as paper) to create hard copy images from electronic or hard copy originals. The printer product delivered to the customer consists of the printer, a power cord, printed setup instructions, a CD/DVD that includes the User Guide and Printer Drivers and an initial set of product supplies. The printer is delivered in packaging that can be recycled locally and is not needed for product operation. Product supplies include toner cartridges, imaging kits and the fusing mechanism. The power supply is internal to the product and the imaging kit and fusing mechanism are installed at the factory. Only the toner cartridges must be installed by the customer. The printer can be setup by the customer without outside assistance.

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## System Boundary

The study considers all phases of the life cycle, as shown below.

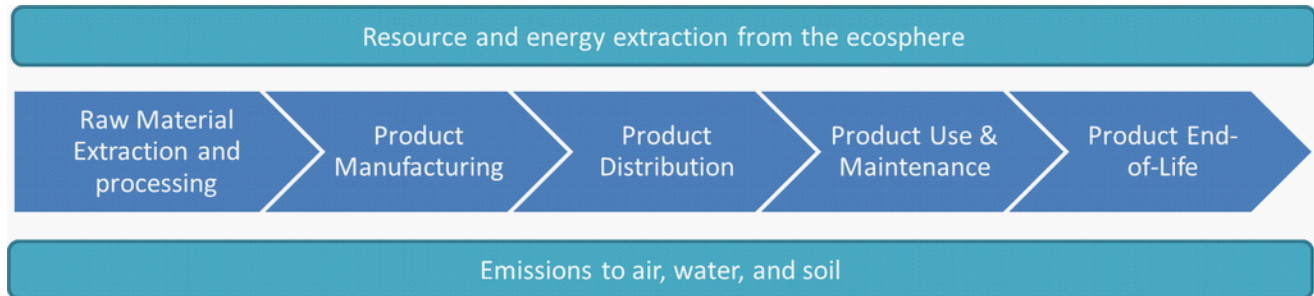


Figure 1: System Boundaries

## Declaration of Basic Materials

The printer consist of mechanical, electromechanical, and electronic components. Its material composition can be described using the basic material fractions given below. Please note that the category 'Electronics' also includes all wiring.

Material	Mass (kg)
<b>Plastics (recyclable)</b>	26.9
<b>Plastics (non-recyclable)</b>	6
<b>Ferrous Metals</b>	44.3
<b>Aluminum</b>	1.42
<b>Copper</b>	0
<b>Glass</b>	0.937
<b>Electronics</b>	8.2
<b>Other Materials</b>	0.128

Table 1: Basic Material Declaration

## Product Supply Chain

The printer is manufactured and assembled in Southeast China. The cartridges for the North American market are manufactured and assembled in Juarez, Mexico.

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## Life Cycle Assessment Results

The following sections describe the printer's potential environmental impacts over the full printer life cycle. These represent the typical impacts for an average system sold in the North American market. All impacts are presented per functional unit of printing 1,000 images of the reference standard.

### Manufacturing Material and Resources Inventory

Table 2 displays the use of material resources (kg) and of non-renewable as well as renewable primary energy demand necessary for printer manufacturing, but excludes other life cycle stages of the printer (cradle-to-gate). Likewise, material and energy consumption associated with printer packaging, cartridges, and paper is excluded here.

Use of Material Resources [kg]	
Non-Renewable	3.86E003
Renewable (excl. water)	1.01E004
Water	8.44E005
Use of Non-Renewable Primary Energy [MJ]	
Crude Oil	2.21E003
Hard Coal	5.41E003
Lignite	390
Natural Gas	2.9E003
Uranium	683
Use of Renewable Primary Energy [MJ]	
Biomass	1.41
Geothermal	9.82
Solar	445
Wind	228
Hydropower	514

Table 2: Use of Material and Energy Resources for Printer Manufacturing (Cradle-to-Gate)

### Energy Consumption During Utilization

Based on the EnergyStar Typical Energy Consumption (TEC) test methodology, the printer is expected to have the following power consumption for an assumed average job load.

	Per 1,000 page	Per product lifetime
Energy Consumption During Utilization [kWh]	0.757	598

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Table 3: At-wall power consumption during utilization

## Life Cycle Impact Assessment

The following provides an overview of the potential printer life cycle impacts with emissions classified and characterized to standard environmental impact metrics using the Recipe 2008 Hierarchist (H) midpoint characterization factors (v1.08).

Note that the mineral resource depletion results do not include any contributions from the paper life cycle as the AF&PA report does not allow for the conversion to ReCiPe 2008.

Ecotoxicity and human health are not included in this study, as per the PCR, due to their respective uncertainties.

LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Global Warming Potential [kg CO <sub>2</sub> -Equiv.]	9.87E00	3.49E00	7.80E03	2.76E03
Ozone Depletion Potential [kg CFC-11 eq]	2.46E-07	4.42E-09	1.94E-04	3.49E-06
Acidification Potential [kg SO <sub>2</sub> eq]	5.49E-02	1.27E-02	4.34E01	1.00E01
Eutrophication Potential [kg P eq]	1.62E-03	2.47E-05	1.28E00	1.95E-02
Fossil Fuel Depletion Potential [kg oil eq]	1.90E00	1.15E00	1.50E03	9.06E02
Mineral Resource Depletion Potential [kg Fe eq]	8.92E-01	8.92E-01	7.05E02	7.05E02

Table 3: Summary of Life Cycle Impact Assessment Results

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## Interpretation of Results

### Dominance Analysis

Due to the 5 year lifetime and the number of pages printed per day as established by the Energy Star Typical Energy Consumption test procedure, the use phase heavily dominates the life cycle impacts. The below tables and charts display the results of the dominance analysis for each impact category addressed in Table 3.

#### Global Warming Potential

	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	1.08E 00	1.08E 00	8.54E 02	8.54E 02
Lexmark use phase <LC>	8.79E 00	2.41E 00	6.94E 03	1.90E 03
E oL phase <LC>	7.73E -03	7.73E -03	6.11E 00	6.11E 00

Table 4: GWP dominance analysis [kg CO2 equiv]

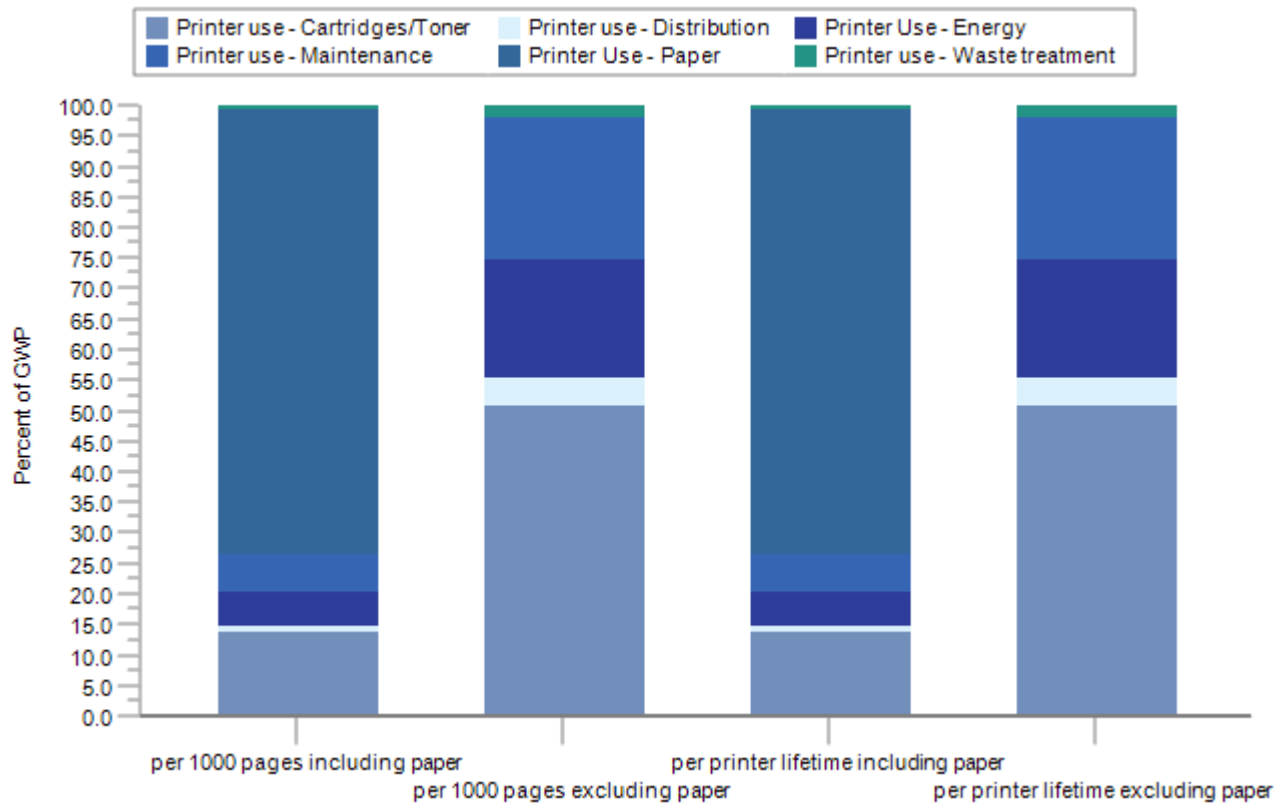


Figure 1: GWP dominance analysis of the use phase

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## Ozone Depletion Potential

	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	2.68E-09	2.68E-09	2.12E-06	2.12E-06
Lexmark use phase <LC>	2.43E-07	1.74E-09	1.92E-04	1.38E-06
EoL phase <LC>	7.30E-14	7.30E-14	5.77E-11	5.77E-11

Table 5: ODP dominance analysis [kg CFC-11 equiv]

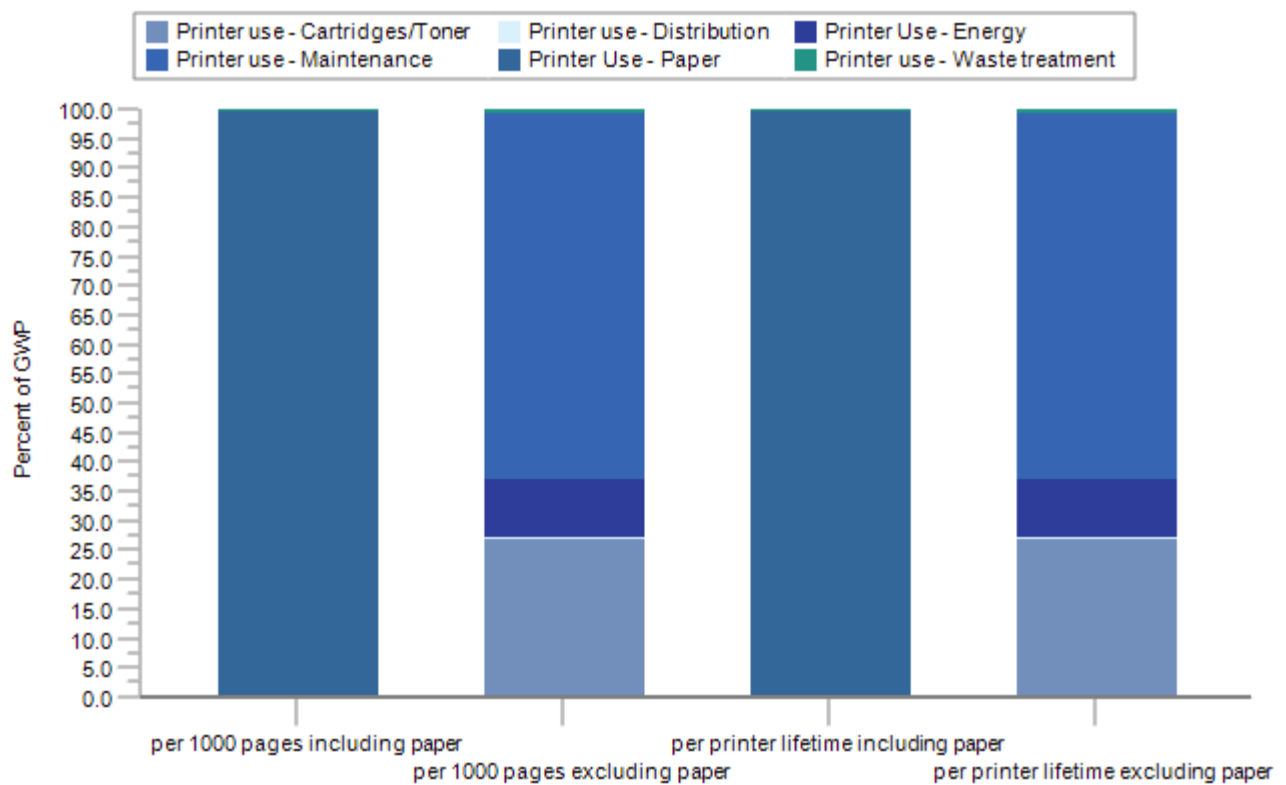


Figure 2: ODP dominance analysis of the use phase



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## Acidification Potential

	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	4.38E-03	4.38E-03	3.46E00	3.46E00
Lexmark use phase <LC>	5.05E-02	8.28E-03	3.99E01	6.54E00
EoL phase <LC>	2.95E-05	2.95E-05	2.33E-02	2.33E-02

Table 6: AP dominance analysis [kg SO<sub>2</sub> equiv]

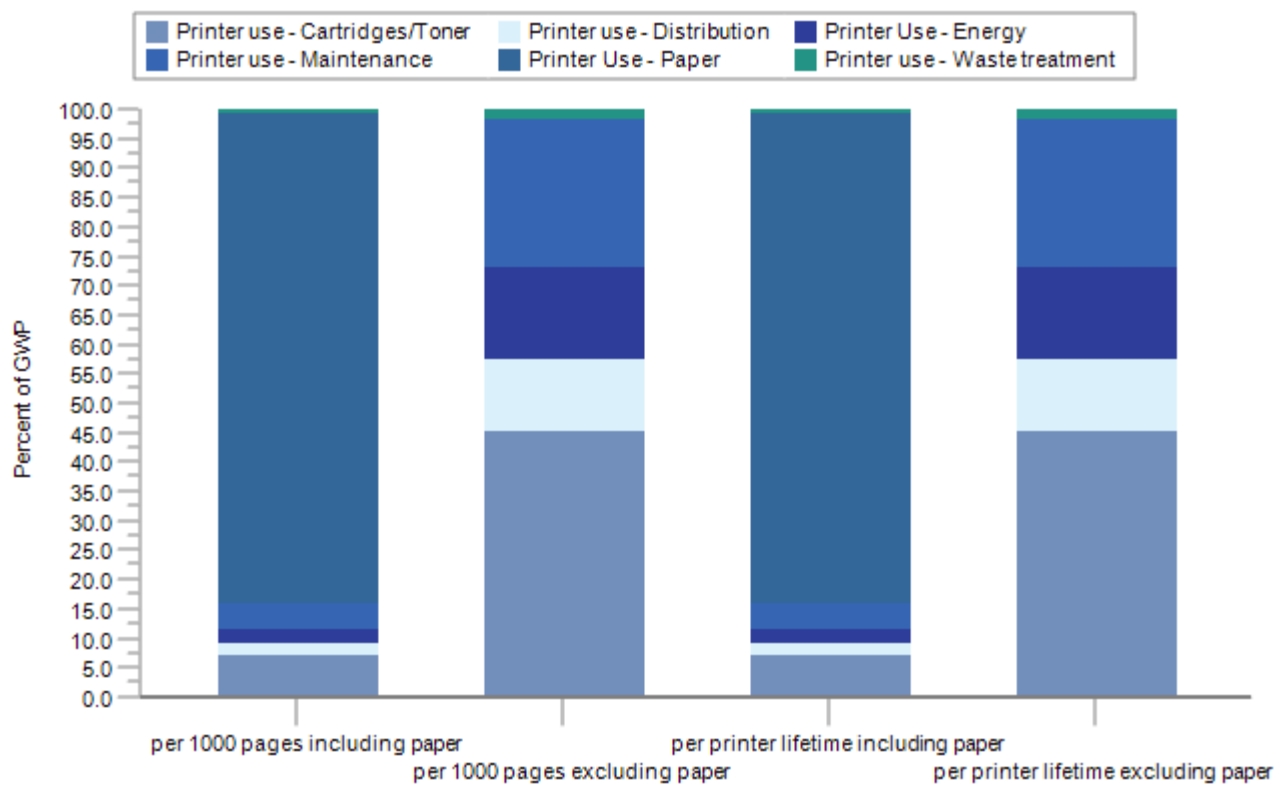


Figure 3: AP dominance analysis of the use phase

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## Eutrophication Potential

	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	1.09E-05	1.09E-05	8.58E-03	8.58E-03
Lexmark use phase <LC>	1.61E-03	1.38E-05	1.27E00	1.09E-02
EoL phase <LC>	3.18E-08	3.18E-08	2.51E-05	2.51E-05

Table 8: EP dominance analysis [kg P equiv]

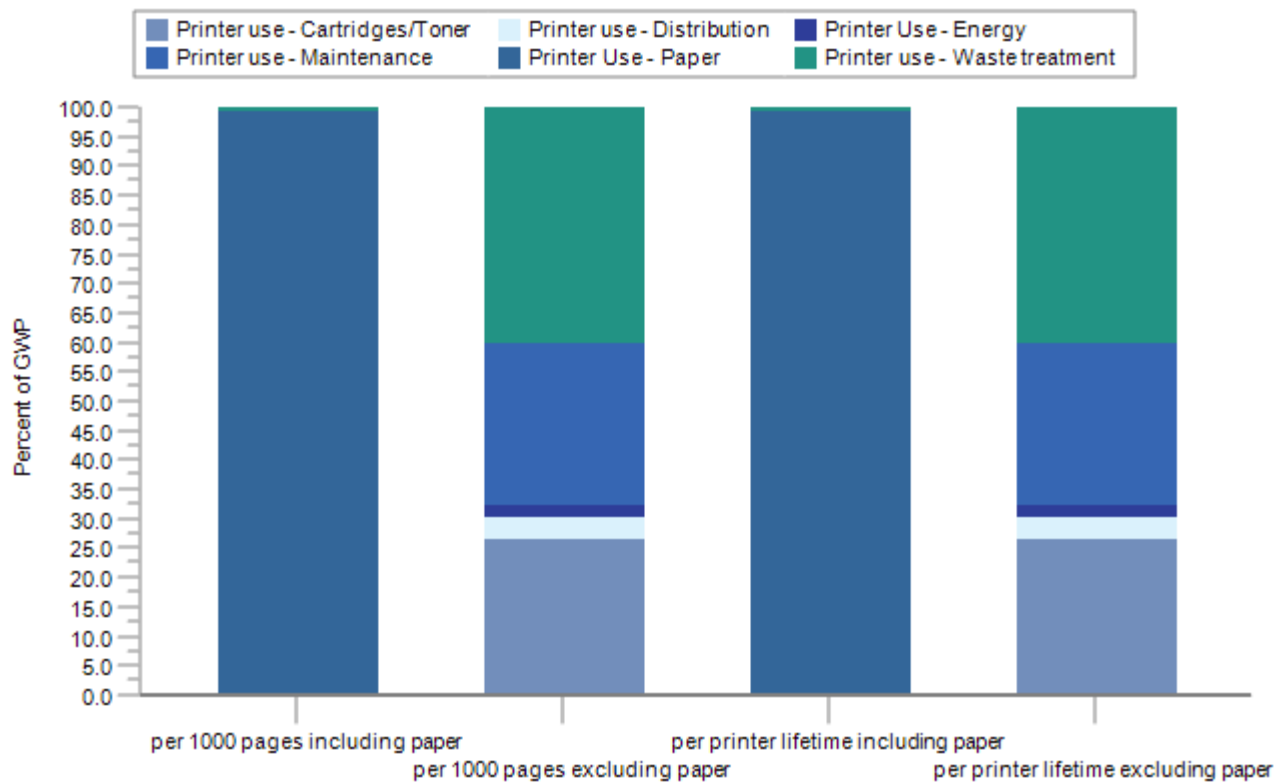


Figure 4: EP dominance analysis of the use phase

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## Fossil Fuel Depletion Potential

	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	3.29E-01	3.29E-01	2.60E02	2.60E02
Lexmark use phase <LC>	1.57E00	8.15E-01	1.24E03	6.44E02
EoL phase <LC>	2.62E-03	2.62E-03	2.07E00	2.07E00

Table 9: FDP dominance analysis [kg oil equiv]

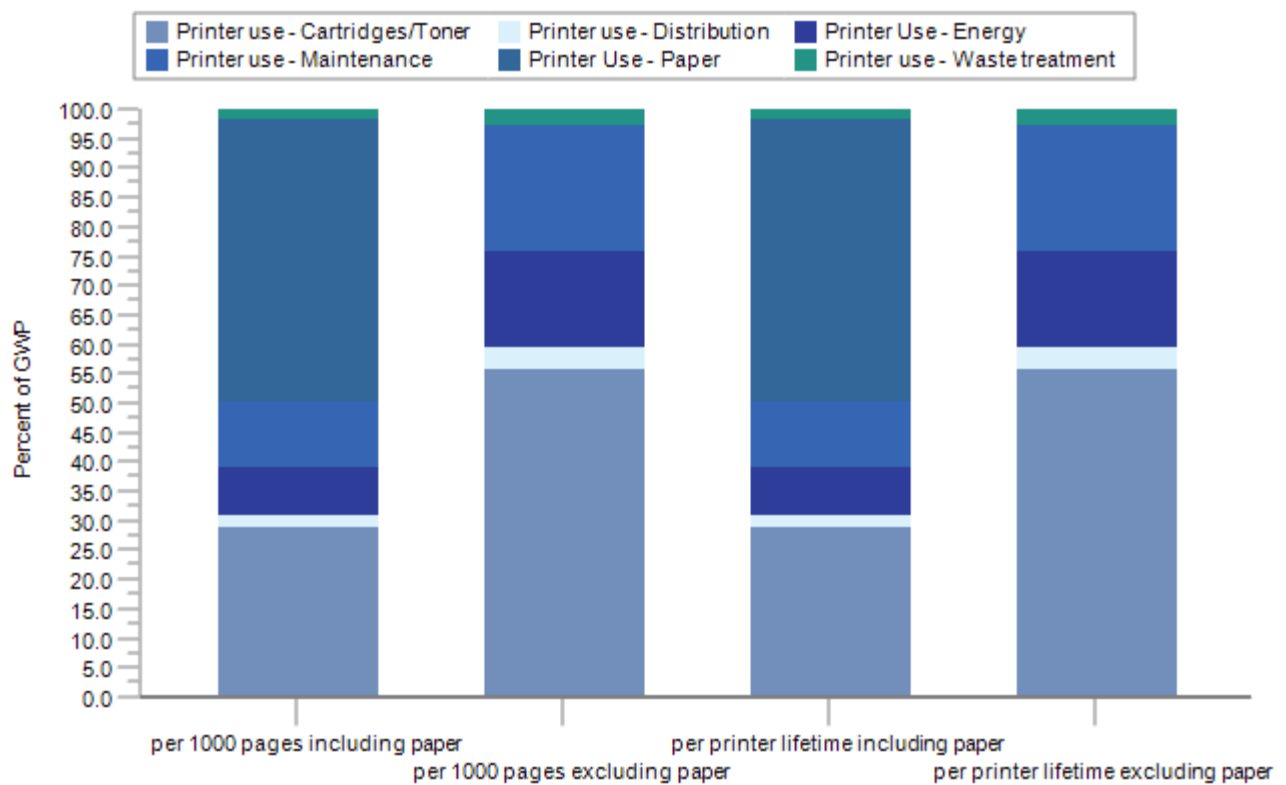


Figure 5: FDP dominance analysis of the use phase

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## Mineral Resource Depletion Potential

	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	6.90E-01	6.90E-01	5.45E02	5.45E02
Lexmark use phase <LC>	2.02E-01	2.02E-01	1.60E02	1.60E02
EoL phase <LC>	4.55E-05	4.55E-05	3.60E-02	3.60E-02

Table 10: MDP dominance analysis [kg Fe equiv]

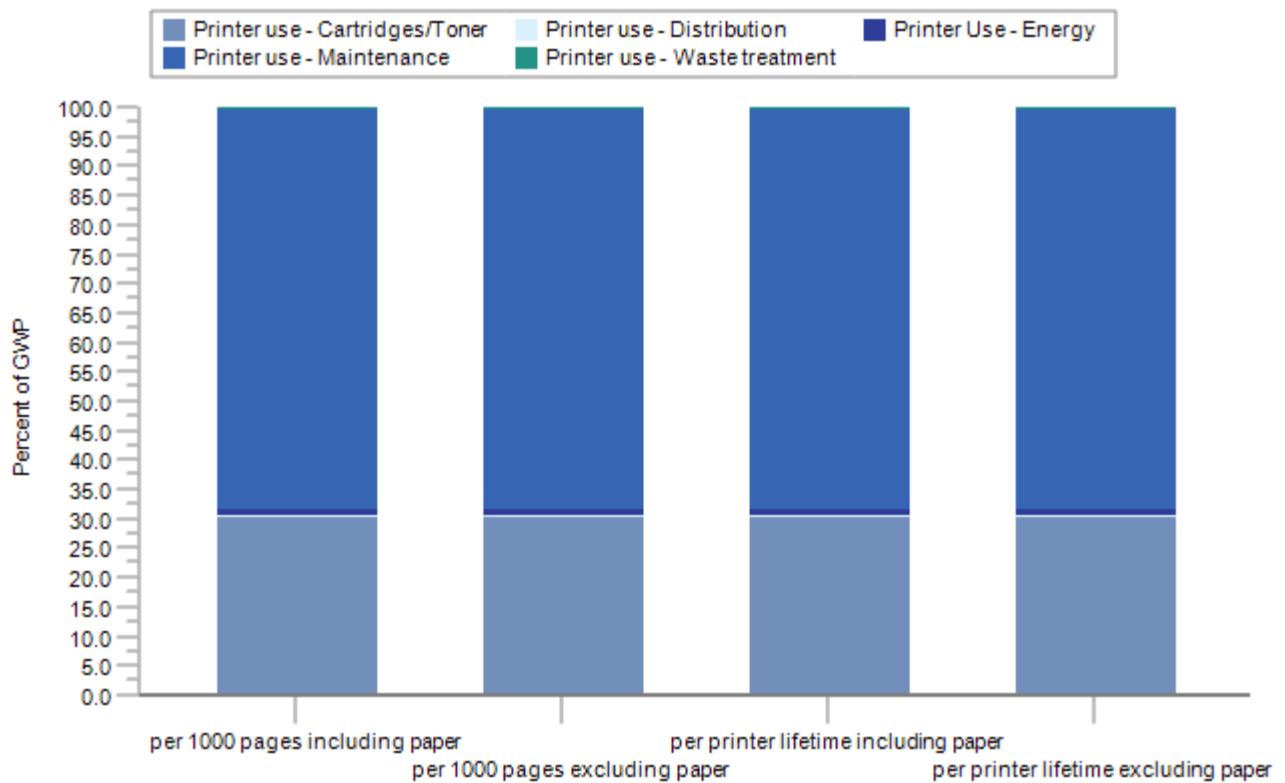


Figure 6: MDP dominance analysis of the use phase

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## Primary Energy Demand from Renewable and Non-renewable Resources

	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	1.62E 01	1.62E 01	1.28E 04	1.28E 04
Lexmark use phase <LC>	9.08E 01	4.44E 01	7.17E 04	3.51E 04
E oL phase <LC>	1.14E -01	1.14E -01	9.02E 01	9.02E 01

Table 11: PED dominance analysis [MJ]

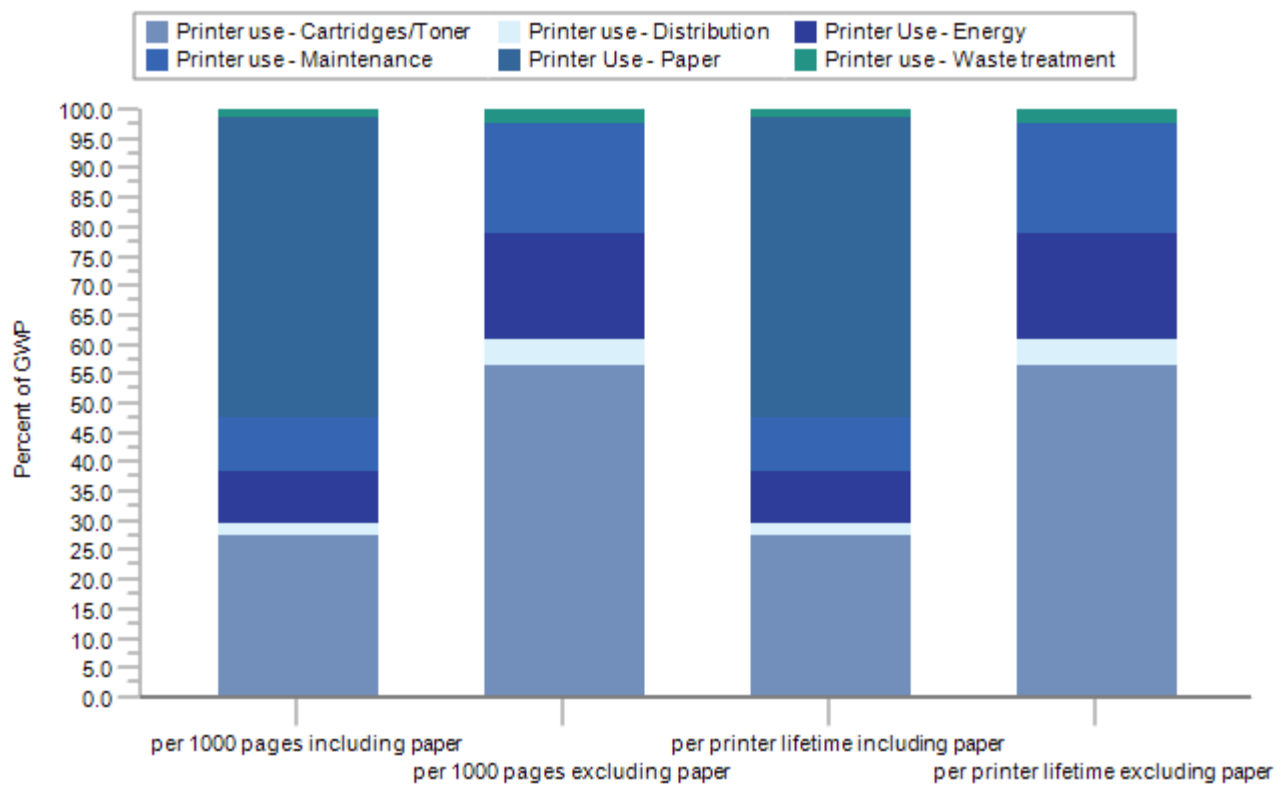


Figure 7: PED dominance analysis of the use phase

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### Assumptions and Estimations

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Assumptions and estimations follow the governing PCR on printing equipment. Full details are documented in the EPD's background report, which was provided for verification purposes alongside the EPD. The LCA results represent the specific printer model as sold in the North American market.

In line with the PCR, the model assumes a printer lifetime of five (5) years. The printer is modeled to print an average of 608 pages per day based on a maximum print speed of 35 images per minute. The printer further possesses an automatic mechanic duplexing feature.

Power consumption figures are based on Energy Star testing of the printer using the average job load described above. Consumables consumption is based on the market-average yield across all available cartridge capacities. In addition, market-average use of remanufactured cartridges is taken into account, as applicable.

Printer and cartridge transportation distances to the end consumer are based on their points of origin and the population-weighted average distance to the 100 most populous cities in the continental US based on 2010 census data. The printer is shipped to the end consumer from the distribution center near Nashville, TN, and the cartridges are shipped from Ciudad Juarez, MX.

The LCI data for office paper is adopted from the uncoated, free sheet paper inventory developed by the American Forest & Paper Association (AF&PA). This paper dataset assumes that average office paper contains 4% recycled content. The mass of consumed paper is based on the US letter format and a surface weight of 75 g/m<sup>2</sup>. The AF&PA data includes paper production, transportation, and End-of-Life treatment (72% recycling, 23% landfill, 5% incineration).

The End-of-Life treatment for the printer is based on the assumption that 66.7 % of the printers are returned to Lexmark for recycling, while the remainder is disposed of through local waste streams, where the metal fractions are assumed to be recycled and the remainder landfilled. The EoL cartridges are assumed to go to remanufacturing, recycling, and landfill in equal shares.

In accordance with the cut-off methodology prescribed by the governing PCR, materials sent to End-of-Life recycling are considered to cross the system boundary without any further transformation. Only the impacts associated with waste transportation and disposal are included in the results.

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### Description of Data and Period Under Consideration

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All primary data is based on technical documentation and sales data accessed in 2017. All background data is taken from the GaBi 2017-8.0.0.247 Databases.

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### Data Quality

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Manufacturing data of printers and consumables is based on a combination of Bills of Material and teardown analyses and is considered to be of overall high quality with low uncertainty. Distribution from printer manufacturing to the end consumer is representative of logistical data from Lexmark and best estimates of US average shipping distances, and is of moderate quality and high uncertainty.

Printer power consumption represents measured power consumed during printer operation in accordance with the use scenario outlined in the reference PCR and is of high quality and moderate uncertainty; actual print loads may differ. Toner cartridge use is based on expected yields based on the ISO test standards for cartridge use, and is of high quality and low uncertainty. Replacement rate for consumable parts is based on part design specifications, and is of high quality and moderate uncertainty.

The disposition of the printer and consumables at End-of-Life is based on best-available information by the respective experts at Lexmark. This data is of average quality and moderate uncertainty.

### Background Data

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All background datasets relevant to production, power generation, transportation, and material disposal were taken from the GaBi 2017-8.0.0.247 Databases.

The data used for office paper is based on the data developed for the American Forest & Paper Association (AF&PA) and is representative for average North American office paper production in 2010.

The additional use of third-party background data from industry associations (e.g., worldsteel) is documented in the background report. They represent the latest LCI data as available in the GaBi 2017-8.0.0.247 Databases.

### Allocation and Methodological Principles

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No significant allocations have been considered for the production of the printer. Allocation of production or use impacts across the various functions of a multi-function system is not included (i.e., allocation of production impacts to the provision of scanning services) and the impacts from all life cycle stages are considered within the system boundaries for the printing system.

Treatment of recycled or resold material is not considered in the body of the EPD, in accordance with the cut-off methodology required by the governing PCR.

A description of all of the methodological decisions made in modeling the life cycle impacts of office paper, including descriptions of the approach to modeling carbon sequestration and paper recycling, are described in the American Forestry & Paper Association's LCA report on printing and writing papers.

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## Additional Environmental Information

As required by the governing PCR, the assessment of human toxicity and ecotoxicity shall be included in this additional information section. The following metrics, which are based on the scenario 'per printer lifetime including paper' can help identify toxicity hot spots, but decision-making should also consider an exposure assessment.

	USEtox - Ecotoxicity [CTUe]	USEtox - Human toxicity (cancer) [CTUh]	USEtox - Human toxicity (non-cancer) [CTUh]
Printer use - Cartridges/Toner	6.86E 01	6.91E -07	8.03E -05
Printer use - Distribution	8.66E 00	2.39E -08	2.57E -06
Printer Use - Energy	7.70E 00	6.14E -08	3.80E -06
Printer use - Maintenance	8.93E 01	3.68E -07	4.71E -05
Printer Use - Paper	<b>4.49E 06</b>	2.50E -05	4.20E -02
Printer use - Waste treatment	6.00E 00	3.46E -08	3.31E -06





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## References and Standards

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- BSI (2011) PAS 2050: Specification for the assessment of the life cycle greenhouse gas emissions of goods and services. The British Standards Institution. London, \.
- EPA (2006) ENERGY STAR(R) Qualified Imaging Equipment Typical Electricity Consumption (TEC) Test Procedure. [https://www.energystar.gov/ia/products/fap/IE\\_TEC\\_Test\\_Procedure.pdf](https://www.energystar.gov/ia/products/fap/IE_TEC_Test_Procedure.pdf)
- ISO (1999) ISO/IEC 10561: Information technology -- Office equipment -- Printing devices -- Method for measuring throughput -- Class 1 and Class 2 printers. International Organization for Standardization. Geneva.
- ISO (2006a) ISO 14025: Environmental labels and declarations – Type III environmental declarations – Principles and procedures. International Organization for Standardization. Geneva.
- ISO (2006b) ISO 14040: Environmental management - Life cycle assessment – Principles and framework. International Organization for Standardization. Geneva.
- ISO (2006c) ISO 14044: Environmental management - Life cycle assessment – Requirements and guidelines. International Organization for Standardization. Geneva.
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- ReCiPe (2008) *ReCiPe* methodology for Life Cycle Impact Assessment, version 1.08. Available at [www.lcia-recipe.net](http://www.lcia-recipe.net)
- ULE (2012) Product Category Rules for preparing an environmental product declaration (EPD) for printers and multi-function printing units (v1.0). UL Environment. Washington, DC.

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### Contact Information

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Dr. Gloria is a certified Life Cycle Professional (LCACP) through the American Center for Life Cycle Assessment.