ENVIRONMENTAL PRODUCT DECLARATION

LASER PRINTER MS421DN

According to ISO 14025

Lexmark's innovative imaging solutions and technologies help customers worldwide print, secure and manage information with ease, efficiency and unmatched value. Lexmark simplifies the complex intersection of digital and printed information.

As part of the commitment to our customers, Lexmark performs Life Cycle Analysis on our products. The results of the LCA analysis continues to assist Lexmark in reducing the environmental impact of the hardware, software and services offered to our customers.

Small workgroups can still have big ambitions with support from Lexmark's MS421dn, the perfect balance of performance and affordability. There's no shortage of processing power with a 1-GHz dual-core processor driving print jobs at up to 42 [40] pages per minute (letter/A4)1. Whether you connect via USB or gigabit ethernet, you'll keep going longer with 350 sheets of standard input that can expand to 900 with an optional tray. And replacement toner of up to 6,000 pages**, backed up by a long-life imaging unit, means fewer stops for refills and service.

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ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

Lexmark™

Laser Printer MS421dn

Printers and multi-functional printing units

According to ISO 14025

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 ar missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Lexmark International Inc.
DECLARATION NUMBER	4788501458.102.1
DECLARED PRODUCT	Laser Printer MS421dn
REFERENCE PCR	ULE Product Category Rules for preparing an environmental product declaration (EPD) for printers and multi-function printing units (v2.0). UL Environment. April 23, 2018
DATE OF ISSUE	April 1, 2019
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition 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) lise@earthshift.com
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	Grant R. Martin Grant R. Martin, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria Thomas P. Gloria, Industrial Ecology Consultants

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Product Description

Product Type	Mono Laser Printer
Printer Model	MS421dn
Maximum Print Speed	42 pages per minute
Intended use	primarily office
Range of applications	print images or text in mono onto paper or paper-like media
Product Lifetime	5 years
Introduction Date	4/17/2018
Product Specifications	http://www.lexmark.com/en_US/products/series/printer-and-multifunction/finder.shtml
Functional Unit	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).
Scope of Validity / Applicability	The EPD is representative for the printer model MS421dn 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.
Product Characterization	A solutions-capable, network-ready mono laser printer that features superior print quality, enhanced security, and lower energy consumption powered by a multi-core processor that prints up to 42 ppm mono (letter). 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.

ENVIRONMENTAL PRODUCT DECLARATION

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Printers and multi-functional printing units

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Technical Data

Product specifications	Lexmark MS421dn
Print	
Display	2-line 128 x 32 pixel All Points Addressable (APA) monochrome OLED display
Print Speed. Up to[6]	Black: 40 ppm
Time to First Page. As fast as	Black: 6.25 seconds
Print Resolution	Black: 1200 Image Quality, 1200 x 1200 dpi, 2400 Image Quality, 300 x 300 dpi, 600 x 600 dpi
Memory / Processor	Standard: 512 MB / Maximum: 512 MB / 1000 MHz
Hard Disk	Not Available
Recommended Monthly Page Volume[2]	1000 - 10000 pages
Maximum Monthly Duty Cycle: Up to[3]	100000 pages per month
Supplies[7]	
Laser Cartridge Yields (up to)[1]	6,000-page Cartridge, 15,000-page High Yield Cartridge, 20,000-page Extra High Yield Cartridge
Imaging Unit Estimated Yield: Up to	60000 pages, based on 3 average letter/A4-size pages per print job and ~ 5% coverage
Cartridge(s) Shipping with Product[1]	3,000-page Starter Return Program Toner Cartridge
Paper Handling	
Included Paper Handling	250-Sheet Input, 100-Sheet Multipurpose Feeder, 150-Sheet Output Bin, Integrated Duplex
Optional Paper Handling	250-Sheet Tray, 550-Sheet Tray, 550-Sheet Lockable Tray
Paper Input Capacity: Up to	Standard: 350 pages 75 gsm bond / Maximum: 900 pages 75 gsm bond
Paper Output Capacity: Up to	Standard: 150 pages 75 gsm bond / Maximum: 150 pages 75 gsm bond
Media Types Supported	Card Stock, Envelopes, Paper Labels, Plain Paper, Transparencies, Refer to the Paper & Specialty Media Guide
Media Sizes Supported	10 Envelope, 7 3/4 Envelope, 9 Envelope, A4, A5, DL Envelope, Executive, Folio, JIS-B5, Legal, Letter, Statement, Universal, Oficio, A6
General Information[4]	
Standard Ports	USB 2.0 Specification Hi-Speed Certified (Type B), Gigabit Ethernet (10/100/1000)
Noise Level: Operating	Print: 55 dBA
Specified Operating Environment	Temperature: 16 to 32°C (60 to 90°F), Humidity: 8 to 80% Relative Humidity, Altitude: 0 - 5000 meters
Product Warranty	1-Year Exchange, Return-to-Base Service
Size (mm - H x W x D) / Weight	260 x 399 x 374 mm / 14.0 kg

All information in this brochure is subject to change without notice. Lexmark is not liable for any errors or omissions.

[1]Average standard page yield value declared in accordance with ISO/IEC 19752. [2]"Recommended Monthly Page Volume" is a range of pages that helps customers evaluate Lexmark's product offerings based on the average number of pages customers plan to print on the device each month. Lexmark recommends that the number of pages per month be within the stated range for optimum device performance, based on factors including: supplies replacement intervals, paper loading intervals, speed, and typical customer usage. [3]"Maximum Monthly Duty Cycle" is defined as the maximum number of pages a device could deliver in a month using a multishift operation. This metric provides a comparison of robustness in relation to other Lexmark printers and MFPs. [4]Printers are sold subject to certain license/agreement conditions. See www.lexmark.com/printerlicense for details. [5]Actual Yield may vary based on other factors such as device speed, paper size and feed orientation, toner coverage, tray source, percentage of black-only printing and average print job complexity. [6]Print and copy speeds measured in accordance with ISO/IEC 24734 and ISO/IEC 24735 respectively (ESAT). For more information see: www.lexmark.com/ISOspeeds. [7]Product functions only with replacement cartridges designed for use in a specific geographical region. See www.lexmark.com/regions for more details.

System Boundary

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

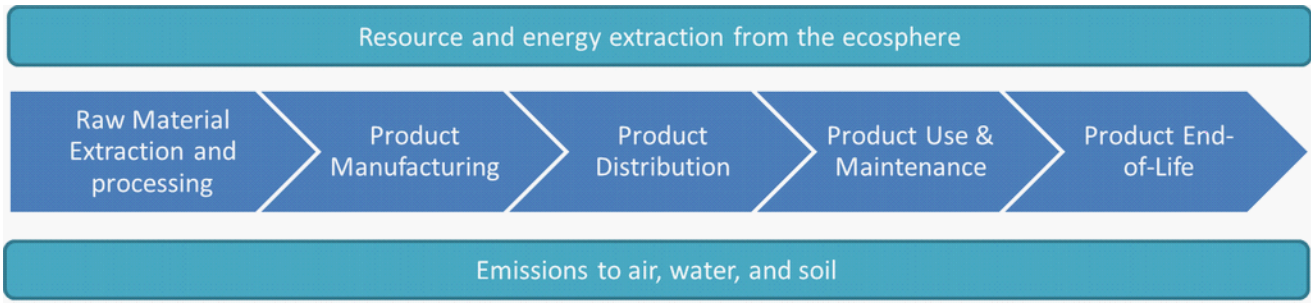

Figure 1: System Boundaries

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)
Plastics (recyclable)	4.8
Plastics (non-recyclable)	1.27
Ferrous Metals	6.63
Aluminum	0
Copper	0.00366
Glass	0.0387
Electronics	0.986
Other Materials	0.0661

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.

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	794
Renewable (excl. water)	715
Water	5.89E004
Use of Non-Renewable Primary Energy [MJ]	
Crude Oil	302
Hard Coal	571
Lignite	22.3
Natural Gas	553
Uranium	55.6
Use of Renewable Primary Energy [MJ]	
Biomass	-0.000595
Geothermal	1.04
Solar	38.8
Wind	18.1
Hydropower	45

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]	0.347	390

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 2016 Hierarchist (H) midpoint characterization factors (v1.1).

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 2016.

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.

ReCiPe2016, version 1.1	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Global Warming Potential [kg CO2 eq.]	8.08E00	1.70E00	9.07E03	1.91E03
Ozone Depletion Potential [kg CFC-11 eq.]	6.37E-07	6.37E-07	7.16E-04	7.16E-04
Acidification Potential [kg SO2 eq.]	8.71E-03	8.71E-03	9.79E00	9.79E00
Eutrophication Potential [kg P eq.]	1.16E-05	1.16E-05	1.30E-02	1.30E-02
Fossil Fuel Depletion Potential [kg oil eq.]	5.81E-01	5.81E-01	6.52E02	6.52E02
Mineral Resource Depletion Potential [kg Cu eq.]	2.79E-02	2.79E-02	3.14E01	3.14E01

Table 3: Summary of Life Cycle Impact Assessment Results

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

ReCiPe2016, version 1.1	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	8.74E-02	8.74E-02	9.82E01	9.82E01
Lexmark use phase <LC>	7.99E00	1.61E00	8.97E03	1.81E03
Lexmark EoL phase <LC>	1.01E-03	1.01E-03	1.14E00	1.14E00

Table 4: Fossil GWP100 dominance analysis [kg CO2 equiv]

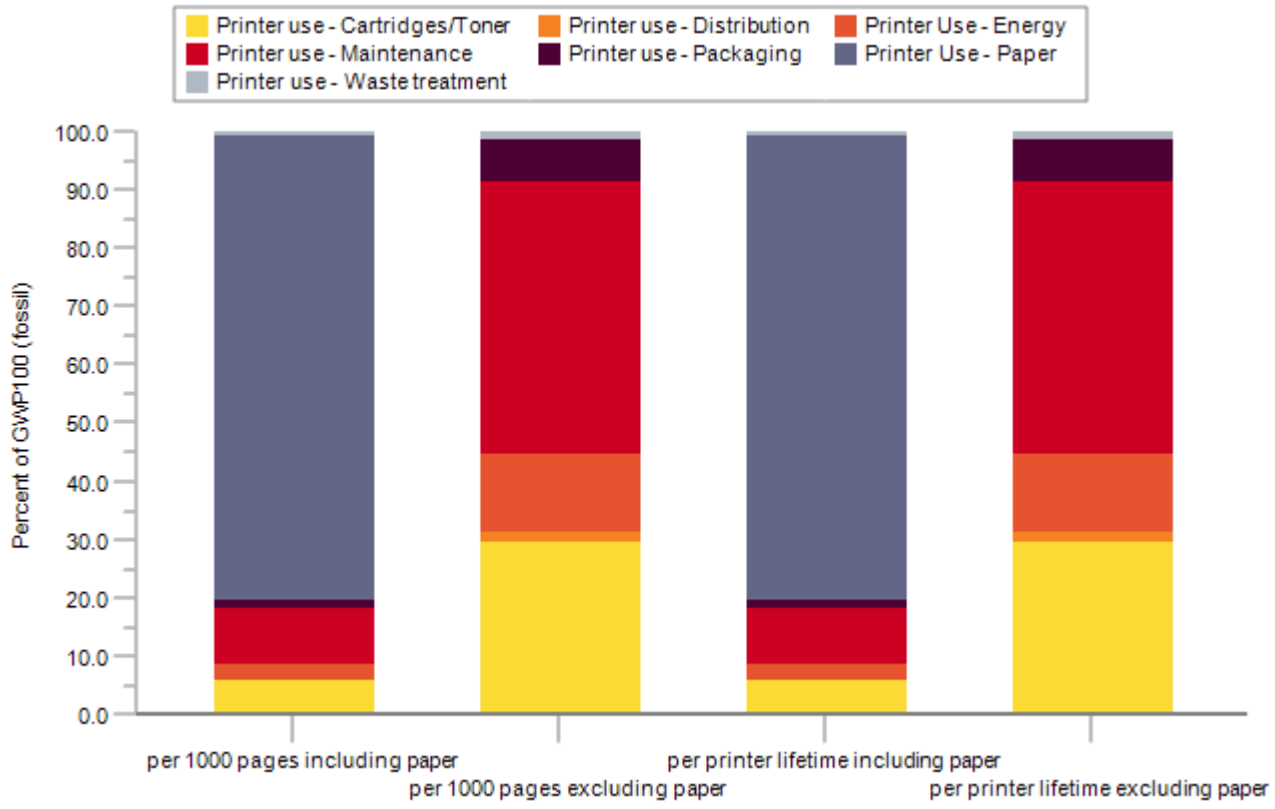

Figure 1: Fossil GWP100 dominance analysis of the use phase

Ozone Depletion Potential

ReCiPe2016, version 1.1	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	3.22E-08	3.22E-08	3.62E-05	3.62E-05
Lexmark use phase <LC>	6.05E-07	6.05E-07	6.80E-04	6.80E-04
Lexmark EoL phase <LC>	1.13E-10	1.13E-10	1.27E-07	1.27E-07

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

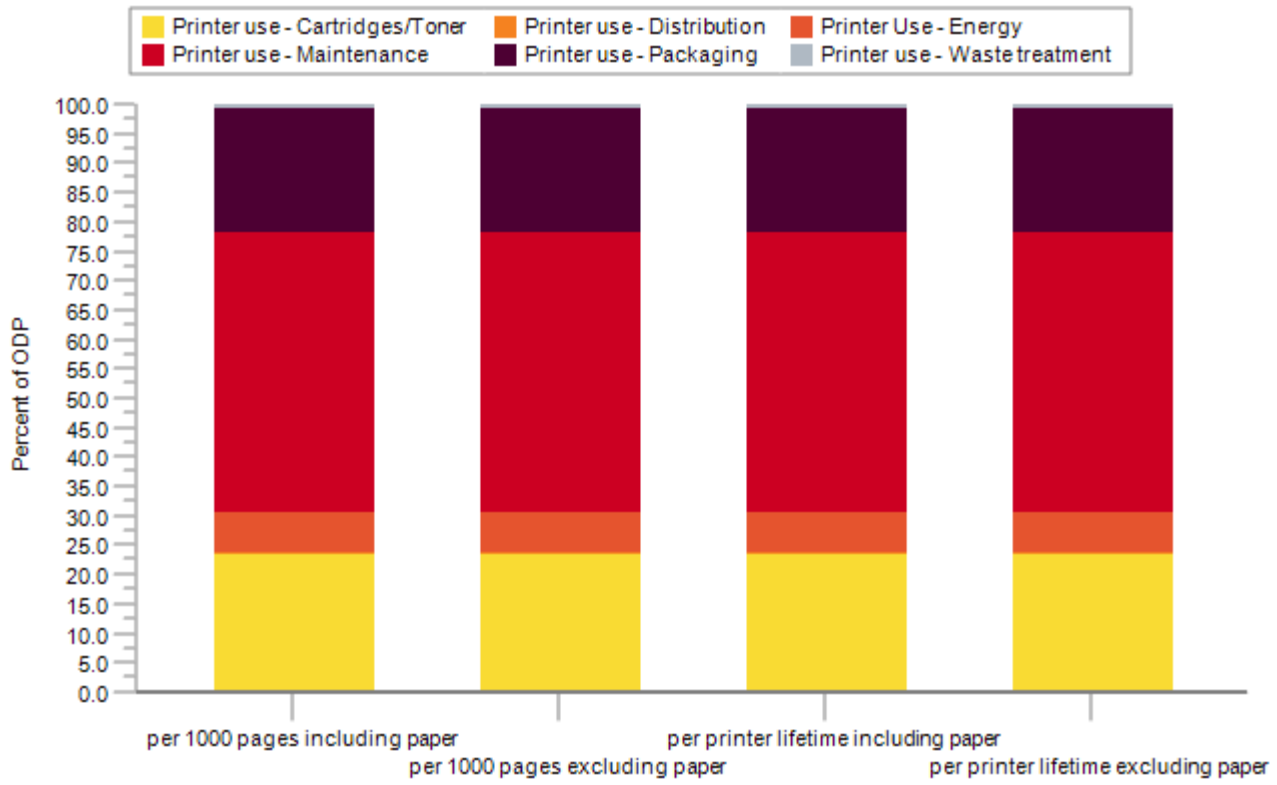

Figure 2: ODP dominance analysis of the use phase

Acidification Potential

ReCiPe2016, version 1.1	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	4.80E-04	4.80E-04	5.40E-01	5.40E-01
Lexmark use phase <LC>	8.23E-03	8.23E-03	9.24E00	9.24E00
Lexmark EoL phase <LC>	2.62E-06	2.62E-06	2.95E-03	2.95E-03

Table 6: AP dominance analysis [kg SO_2 equiv]

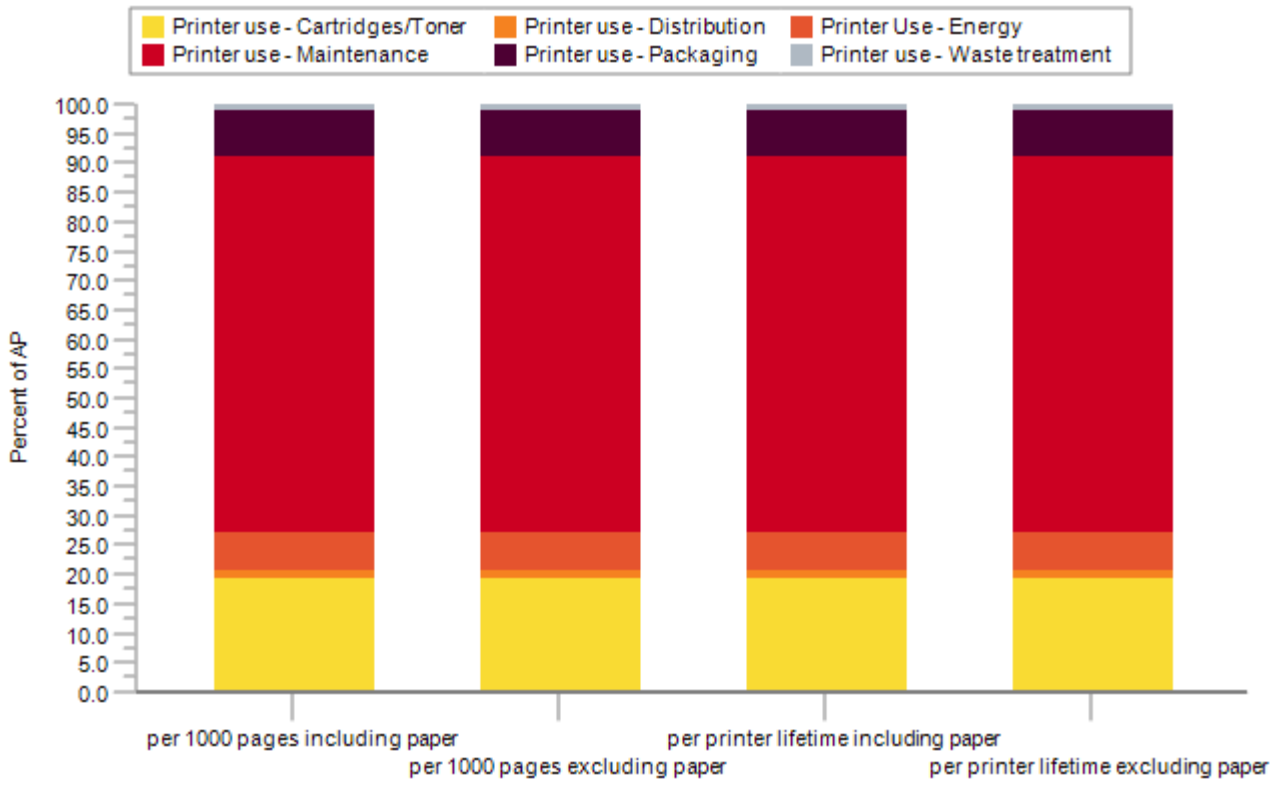

Figure 3: AP dominance analysis of the use phase

Eutrophication Potential

ReCiPe2016, version 1.1	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	4.89E-07	4.89E-07	5.50E-04	5.50E-04
Lexmark use phase <LC>	1.11E-05	1.11E-05	1.25E-02	1.25E-02
Lexmark EoL phase <LC>	3.36E-09	3.36E-09	3.77E-06	3.77E-06

Table 8: EP dominance analysis [kg P equiv]

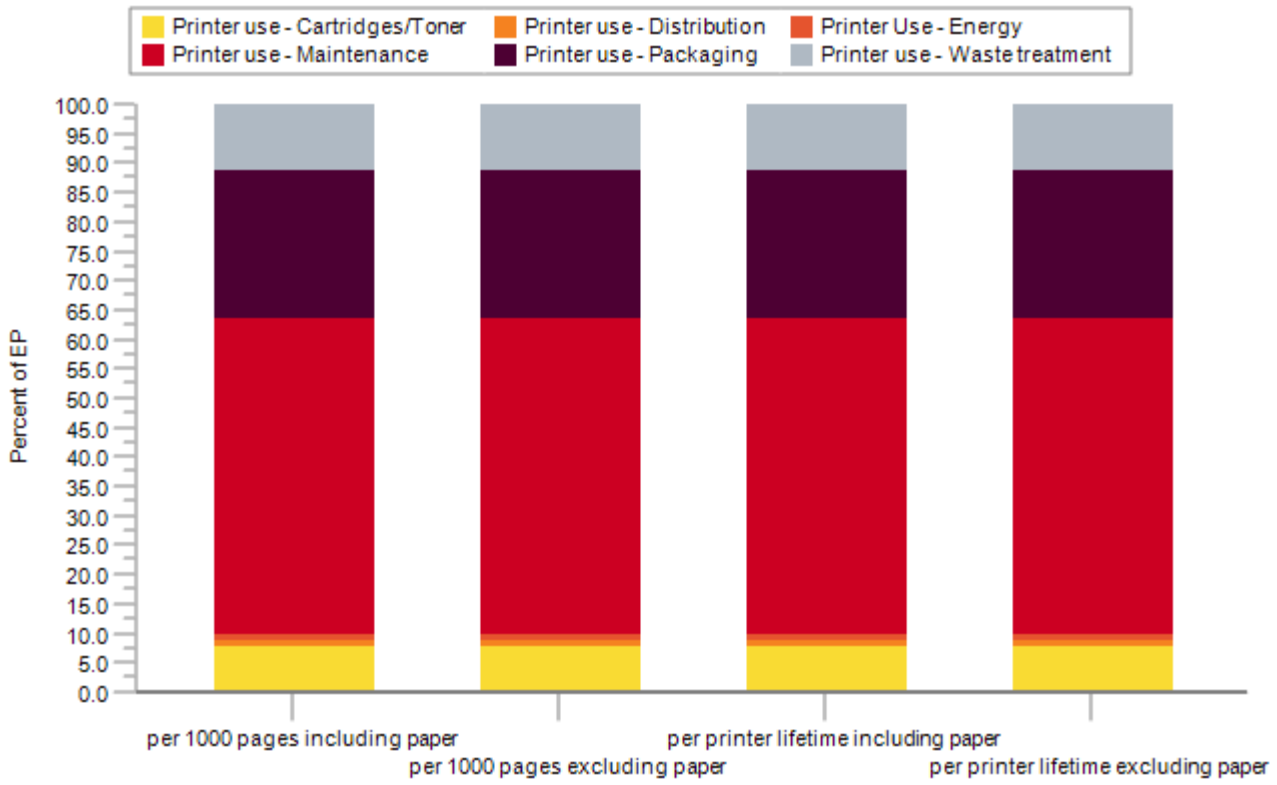

Figure 4: EP dominance analysis of the use phase

Fossil Fuel Depletion Potential

ReCiPe2016, version 1.1	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	3.13E-02	3.13E-02	3.52E01	3.52E01
Lexmark use phase <LC>	5.49E-01	5.49E-01	6.17E02	6.17E02
Lexmark EoL phase <LC>	3.42E-04	3.42E-04	3.84E-01	3.84E-01

Table 9: Fossil fuel depletion dominance analysis [kg oil equiv]

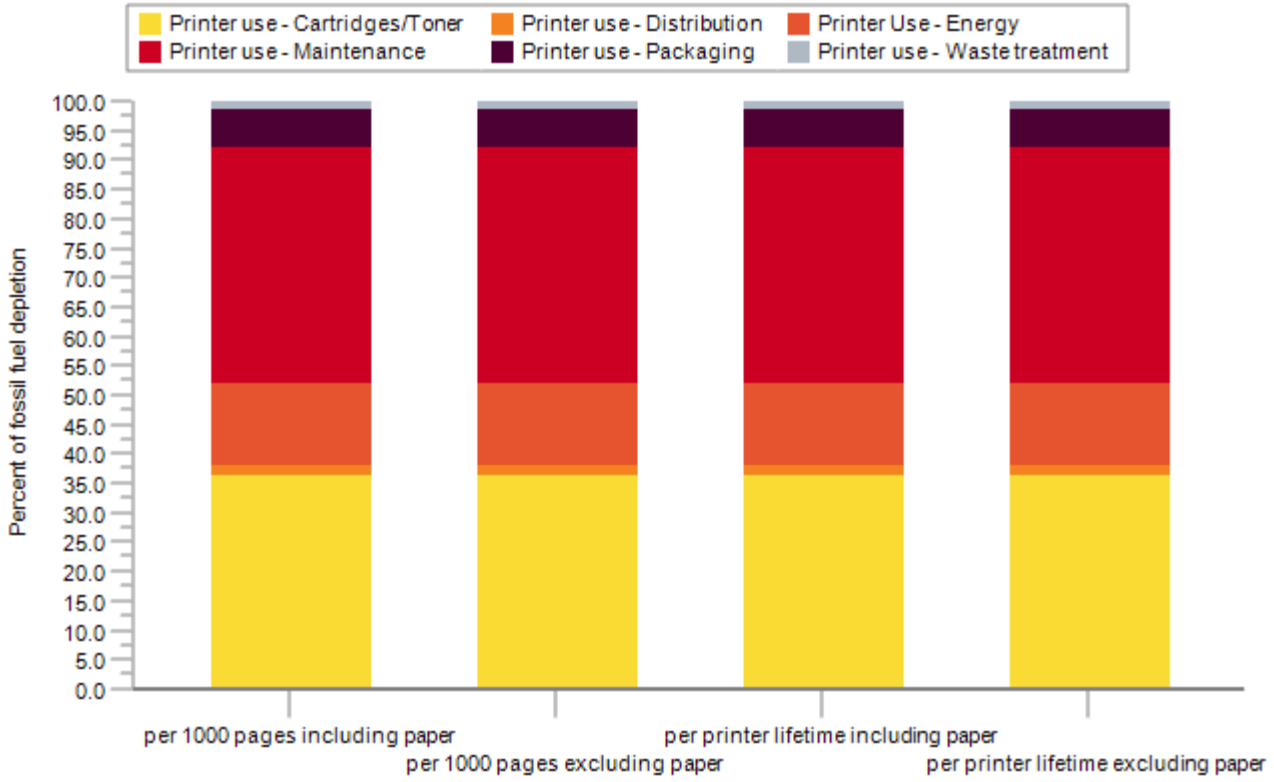

Figure 5: Fossil resource depletion dominance analysis of the use phase

Mineral Resource Depletion Potential

ReCiPe2016, version 1.1	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	3.46E-03	3.46E-03	3.89E00	3.89E00
Lexmark use phase <LC>	2.45E-02	2.45E-02	2.75E01	2.75E01
Lexmark EoL phase <LC>	5.09E-06	5.09E-06	5.71E-03	5.71E-03

Table 10: Mineral resource depletion dominance analysis [MJ surplus]

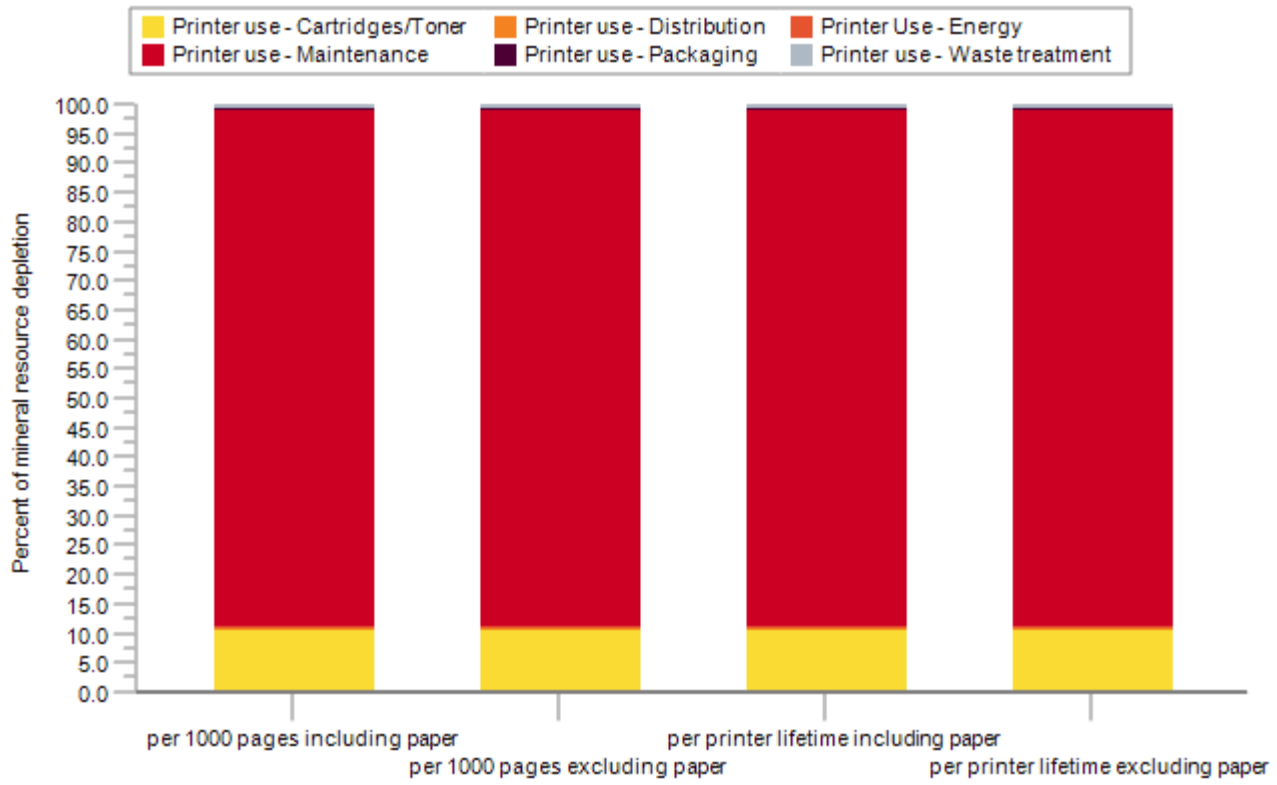

Figure 6: Mineral resource depletion dominance analysis of the use phase

Primary Energy Demand from Renewable and Non-renewable Resources

ReCiPe2016, version 1.1	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	1.43E00	1.43E00	1.61E03	1.61E03
Lexmark use phase <LC>	7.16E01	2.53E01	8.04E04	2.84E04
Lexmark EoL phase <LC>	1.52E-02	1.52E-02	1.71E01	1.71E01

Table 11: PED dominance analysis [MJ]

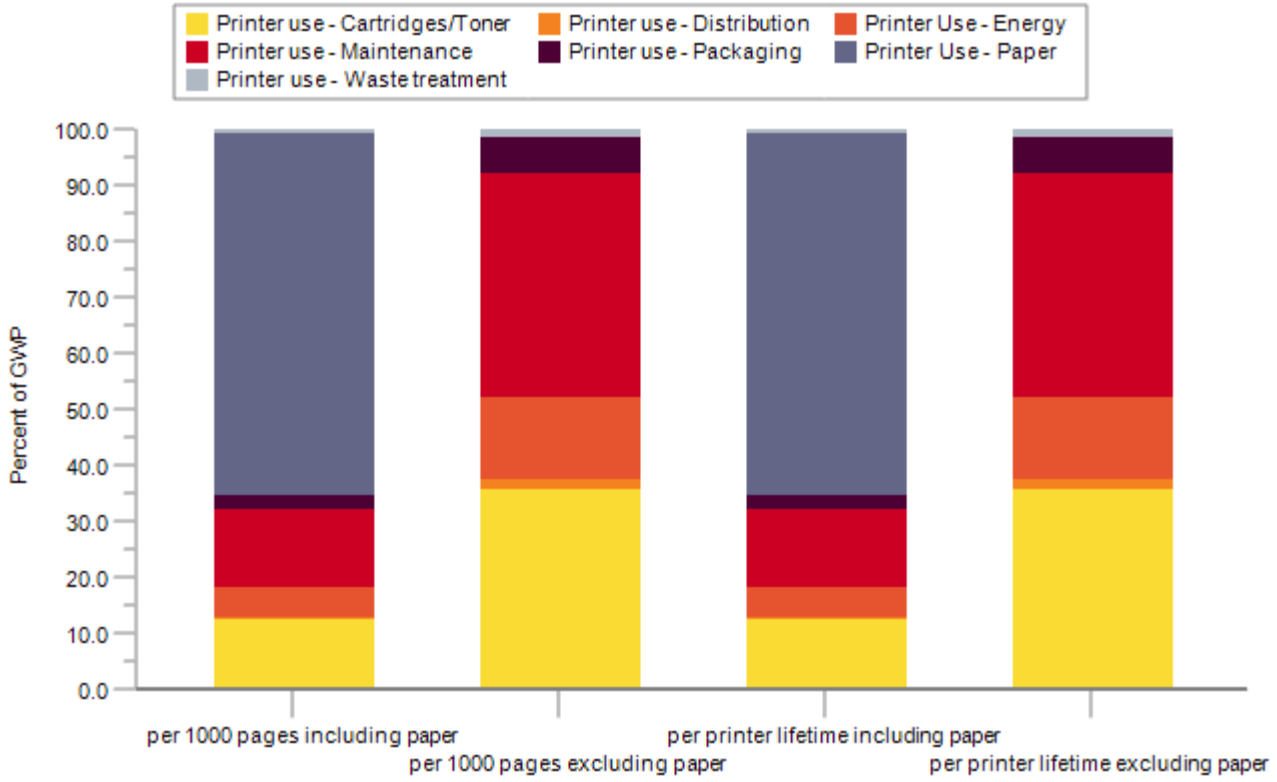

Figure 7: PED dominance analysis of the use phase

Assumptions and Estimations

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 864 pages per day based on a maximum print speed of 42 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.

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 as well as replacement fuser kits and waste toner bottles are manufactured in China and shipped to the point of use from the distribution center near Nashville, TN, while the cartridges and the imaging unit 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^2. 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.

Description of Data and Period Under Consideration

All primary data is based on technical documentation and sales data accessed in 2018. All background data is taken from the GaBi 2018-8.6.20 Databases. No primary data is collected from the Original Equipment Manufacturer's manufacturing plant.

Data Quality

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

All background datasets relevant to production, power generation, transportation, and material disposal were taken from the GaBi 2018-8.6.20 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 2018-8.6.20 Databases.

Allocation and Methodological Principles

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	5.94E00	6.69E-08	2.31E-09
Printer use - Distribution	1.76E-01	1.88E-10	4.90E-11
Printer Use - Energy	3.37E-01	7.93E-09	5.48E-10
Printer use - Maintenance	3.43E00	2.79E-08	2.58E-09
Printer use - Packaging	2.66E-01	1.97E-08	1.62E-07
Printer use - Waste treatment	9.90E-02	1.28E-09	1.30E-09

References and Standards

EPA (2013) ENERGY STAR Program Requirements for Imaging Equipment – Test Method (Rev. Jun-2013) https://www.energystar.gov/sites/default/files/FINAL%20Version%202.0%20Imaging%20Equipment%20Program%20Requirements%20%28Rev%20Oct-2014%29_0.pdf

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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.

NCASI (2010) Life Cycle Assessment of North American Printing and Writing Paper Products − Final Report. Prepared for the American Forest and Paper Association (AF&PA) and the Forest Products Association of Canada (FPAC) by the National Council for Air and Stream Improvement, Inc. Research Triangle Park, NC

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