ENVIRONMENTAL PRODUCT DECLARATION

Lexmark International, Inc.
Laser Printer MX511DE

According to ISO 14025

Product Description

Product Type	Mono Laser Printer
Printer Model	MX511DE
Maximum Print Speed	45 pages per minute
Intended use	Office
Range of applications	print images or text in black and white onto paper or paper-like media
Product Lifetime	5 years
Introduction Date	10/16/2012
Product Specifications	http://www.lexmark.com/US/en/catalog/product.jsp?prodId=7656&catId=cat170005
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 MX511DE 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 network-ready mono laser printer fuses black toner 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.

System Boundary

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

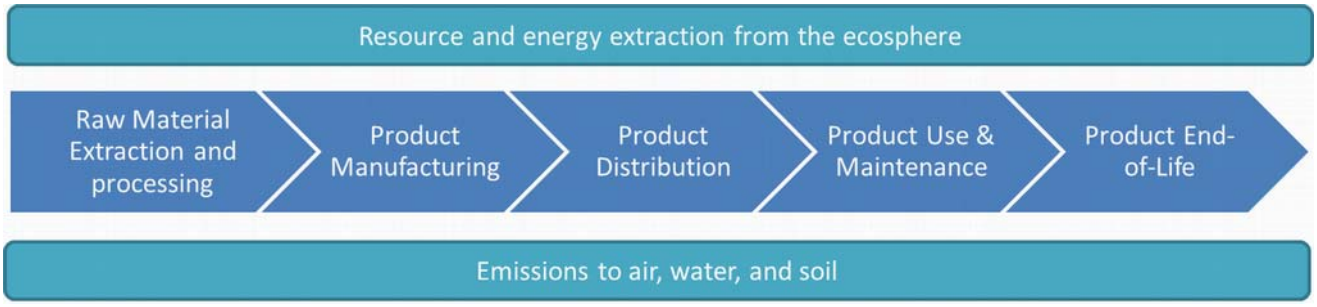

Figure 1: System Boundaries

Declaration of Basic Materials

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

Material	Mass (kg)
Plastics (recyclable)	9.04
Plastics (non-recyclable)	1.66
Ferrous Metals	7.27
Aluminum	0.17
Copper	0.0209
Glass	0.936
Electronics	2.64
Other Materials	0.0678

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. The toner is manufactured in Boulder, Colorado.

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 excluding 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	320
Renewable (excl. water)	785
Water	1E005
Use of Non-Renewable Primary Energy [MJ]	
Crude Oil	553
Hard Coal	737
Lignite	32.3
Natural Gas	839
Uranium	148
Use of Renewable Primary Energy [MJ]	
Biomass	0.00143
Geothermal	3.52
Solar	21.8
Wind	13.8
Hydropower	62.5

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]	0.484	624

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.

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 CO2-Equiv.]	7.681	1.302	9905.458	1678.971
Ozone Depletion Potential [kg CFC-11 eq]	0.000	0.000	0.000	0.000
Acidification Potential [kg SO2 eq]	0.046	0.004	59.038	4.588
Eutrophication Potential [kg P eq]	0.002	0.000	2.075	0.016
Fossil Fuel Depletion Potential [kg oil eq]	1.173	0.420	1512.773	541.824
Mineral Resource Depletion Potential [kg Fe eq]	0.084	0.084	107.789	107.789

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 table and chart display the results of the dominance analysis for Global Warming Potential (GWP).

	per 1000 pages including paper	per 1000 pages excluding paper	per printer lifetime including paper	per printer lifetime excluding paper
Printer	0.11	0.11	147.38	147.38
Use phase	7.57	1.19	9,756.48	1,529.99
EoL phase	0.00	0.00	1.60	1.60

Table 4: GWP dominance analysis [kg CO2 equiv]

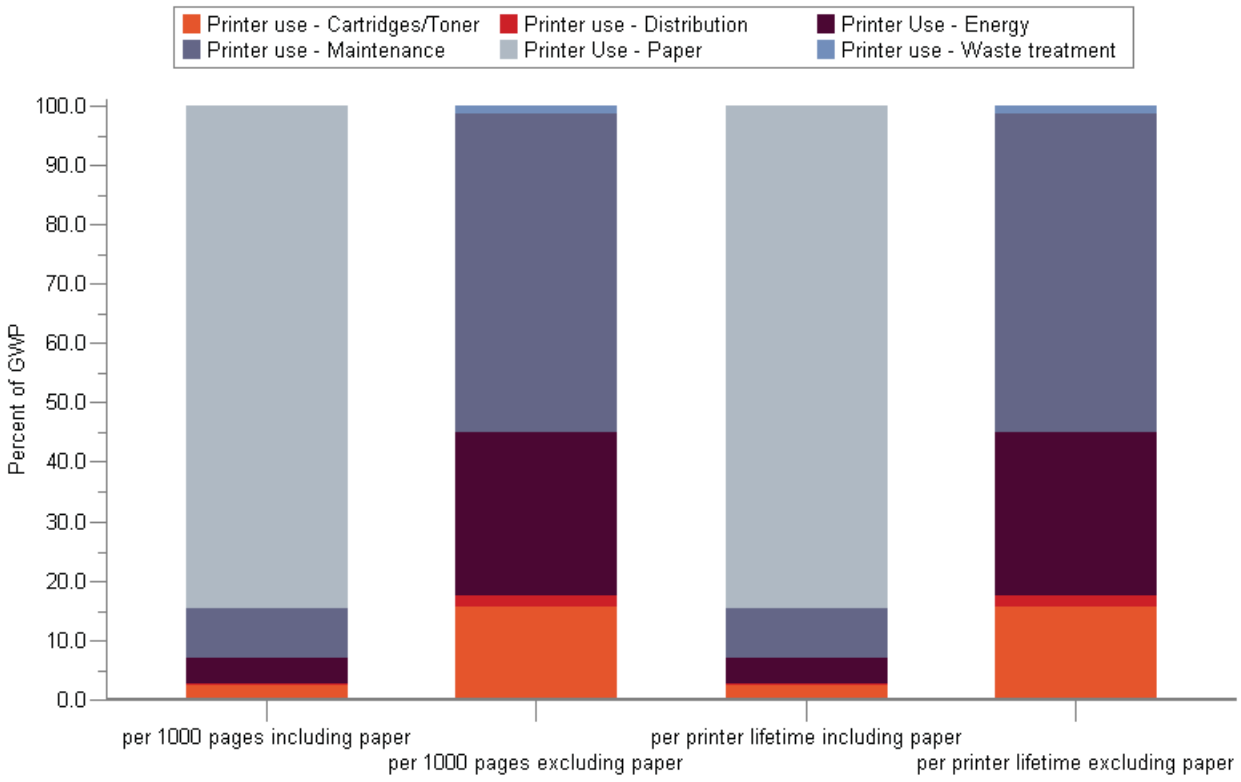

Figure 1: GWP dominance analysis of the use phase

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 992 pages per day based on a maximum print speed of 45 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 288 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 Memphis, 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^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 67 % 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 2013. All background data is taken from the GaBi 2013 Databases.

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 2013 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 2013 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.

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	4.34E+001	2.73E-007	2.89E-005
Printer use - Distribution	1.79E+000	6.55E-009	8.76E-007
Printer Use - Energy	1.05E+001	7.11E-008	7.52E-006
Printer use - Maintenance	1.76E+002	4.76E-007	9.22E-005
Printer Use - Paper	7.32E+006	4.08E-005	6.85E-002
Printer use - Waste treatment	5.21E+000	1.97E-008	1.95E-006

References and Standards

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

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.

ISO (2007) ISO 14065: Greenhouse gases - Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition. 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
PE (2013) GaBi 6 Product Sustainability Software. PE INTERNATIONAL AG, Leinfelden-Echterdingen. http://www.gabi-software.com

ReCiPe (2008) *ReCiPe* methodology for Life Cycle Impact Assessment, version 1.08. Available at 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.