REPORT

HP EvoMore Original Ink Cartridges LCA report

HP EvoMore Original Ink Cartridges compared to standard and equivalent predecessor XL Original HP Ink Cartridges

June 2024

1. Introduction

This document presents the environmental impacts of select Individual Ink Cartridges (IIC) from HP, following the life cycle assessment (LCA) framework, as described in ISO 14040 and 14044. Section 1 provides the study's goal. Section 2 describes the scope of the study. Section 3 explains data collection, modeling, and key components of the products assessed. Section 4 provides environmental impact results. Section 5 lists references and standards. The appendix defines the impact indicator.

1.1 Goal of the study

This life cycle assessment (LCA) study evaluates the environmental performance of two different types of cartridges across all black and color options over their lifetimes.

The system boundary of the study is cradle-to-grave, accounting for all life cycle processes from extraction of raw materials and environmental energy sources through disposal of the product and packaging at end of life.

The study was conducted as part of HP's larger LCA initiative to gain an understanding of environmental hotspots over the life cycle and understand how LCA can be applied to measurement, improvement, and communication of the product's environmental performance.

Because HP intends to communicate the results of this study publicly, the LCA model and report follow ISO 14040 (ISO, 2006a) and 14044 (ISO, 2006b) public disclosure requirements for comparative LCA studies. The end-to-end calculation system used in this study has been critically reviewed by a third party. A critical review statement can be made available upon request.

2. Scope of the study

The following sections describe the general scope of the project to achieve the stated goals, including the study's product system identification, product function(s), functional unit (FU), system boundary, allocation procedures, and cutoff criteria.

2.1 Product system and product specification

This document describes the lifetime use of the following HP IICs, including production of all materials and components, packaging, final product assembly, distribution to the customer, and expected end-of-life treatment.

HP 68/308 Original Ink Cartridges

PRODUCT NAME	PAGE YIELD	INK (ML)
HP 68/308 Black Original Ink Cartridge	160	3.00
HP 68e/308e EvoMore Black Original Ink Cartridge	320	6.50
Equivalent predecessor Black XL Original Ink Cartridge	240	6.50

HP 923/924/925 Original Ink Cartridges

PRODUCT NAME	PAGE YIELD	INK (ML)
HP 923/924/925 Cyan/Magenta/Yellow Original Ink Cartridge	400	7.75
HP 923/924/925 Black Original Ink Cartridge	500	12.50
HP 923e/924e/925e EvoMore Cyan/Magenta/Yellow Original Ink Cartridge	800	9.00
HP 923e/924e/925e EvoMore Black Original Ink Cartridge	1,000	25.50
Equivalent predecessor Cyan/Magenta/Yellow XL Original Ink Cartridge	825	9.00
Equivalent predecessor Black XL Original Ink Cartridge	825	25.50

HP 936/937/938 Original Ink Cartridges

PRODUCT NAME	PAGE YIELD	INK (ML)
HP 936/937/938 Cyan/Magenta/Yellow Original Ink Cartridge	800	10
HP 936/937/938 Black Original Ink Cartridge	1,250	33
HP 936e/937e/938e EvoMore Cyan/Magenta/Yellow Original Ink Cartridge	1,650	20
HP 936e/937e/938e EvoMore Black Original Ink Cartridge	2,500	65
Equivalent predecessor Cyan/Magenta/Yellow XL Original Ink Cartridge	1,600	29
Equivalent predecessor Black XL Original Ink Cartridge	2,000	52

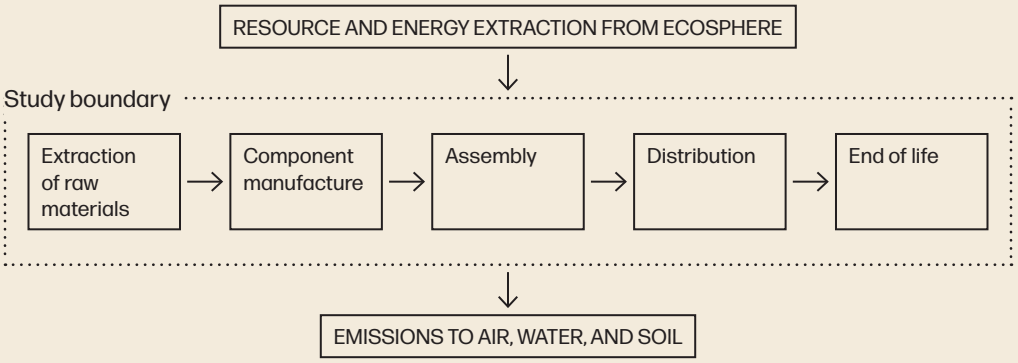
2.2 Functional unit and system boundary

HP IICs are designed to work with HP IIC printers for projects related to home, work, and/or school applications.

The FU of the study is defined by the number of printed pages by IICs in an inkjet printer. Two different scenarios exist:

SCENARIOS	NUMBER OF PAGES	DESCRIPTION
Cartridge	Based on the page yield of each cartridge as shown in the table above	This FU allows us to understand the impacts at the product level
1,000 pages	Based on printing 1,000 pages	This FU allows us to perform the assessment with a metric that is comparable to similar products

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



INCLUDED

- Intermediate part fabrication
- Electronic component production
- Assembly operations
- Production of upstream energy and ancillary materials used in manufacturing
- Transport to distribution center and retail (or customer, if purchased online)
- EOL without transportation to disposal/ recycling

EXCLUDED

- Production of capital equipment (factories, tooling, etc.)
- Employee travel time/commuting
- Use stage
- Network infrastructure outside of the product itself
- Refurbishment/reuse of parts
- Area electronics

2.3 Time coverage

This study is intended to represent the entire life cycle manufacturing, including distribution over reference service life, and disposal of the product as made and sold in the 2023 calendar year.

2.4 Technology coverage

This study assesses the impacts of the IICs (cradle-to-grave, including an option for different end-of-life scenarios) based on a global production and technology mix.

2.5 Geographical coverage

The geographical coverage of this study considers the following conditions: The products are assembled in China. The components are assumed to be mainly sourced from China.

2.6 End-of-life allocation

Three scenarios at end of life are available for the selection:

- Landfilling
- Incineration (without credit attribution)
- Recycling (without credit attribution)

2.7 Selection of life cycle impact assessment (LCIA) methodology and impact categories

The impact assessment categories and other metrics considered to be of high relevance to the goals of the project are Global Warming Potential (GWP 100, excluding biogenic carbon; see “Appendix A” on page 8) from the latest IPCC values (IPCC, 2013), non-renewable primary energy demand (PED nr, lower heating value), and blue water consumption (Water). The latter two are environmental indicators calculated from the life cycle inventory generated in the GaBi software.

Descriptions can be found in Appendix A. The selection is based on the IEEE 1680.1 standard requirements for disclosing life cycle assessment and carbon footprint results (IEEE, 2018). Additional impact categories are presented for the ReCiPe 2016 v1.1 methodology, in line with the impact categories typically assessed by HP.

Note that impact categories represent impact potentials, i.e., they are approximations of environmental impacts that could occur if the emissions would (a) follow the underlying impact pathway, and (b) meet certain conditions in the receiving environment while doing so. In addition, the inventory only captures that fraction of the total environmental load that corresponds to the functional unit (relative approach).

LCIA results are therefore relative expressions only and do not predict actual impacts, the exceeding of thresholds, safety margins, or risks.

2.8 Interpretation to be used

The results of the LCI and LCIA shall be interpreted according to the Goal and Scope. The interpretation identifies the significant findings, such as the main process step(s), material(s), and/or life cycle stage(s) contributing to the overall results.

2.9 Data quality

Inventory data quality is judged by its precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied), and representativeness (geographical, temporal, and technological).

To cover these requirements and to ensure reliable results, first-hand industry data in combination with consistent background LCA information from the GaBi 2023 database were used. The LCI datasets from the GaBi 2023 database are widely distributed and used with the GaBi 10 software. The datasets have been used in LCA models worldwide in industrial and scientific applications in internal studies, as well as in many critically reviewed and published studies. In the process of providing these datasets, they are cross-checked with other databases and values from industry and science.

2.10 Background data

Documentation for all GaBi datasets can be found at: https://sphera.com/product-sustainability-gabi-data-search.

2.11 Software and databases

The LCA model was created using the GaBi 10 software system for life cycle engineering, developed by Sphera Solutions, Inc. (a leading consultant offering services for Environmental-Social-Government performance and risk-management software, data, and LCA). The GaBi 2023 LCI database provides the life cycle inventory data for several of the raw and process materials obtained from the background system.

2.12 Allocation and methodological principles

No significant allocations have been considered for the production of the IICs. 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). The impacts from all life cycle stages are considered within the system boundaries for the printing system.

3. Life Cycle Assessment

This section gives an overview of the considered parts, the data collection and model structure, as well as data used to represent the cartridge, its manufacturing, distribution, and end of life (EOL).

3.1 Data collection and modeling

Data was collected by a material science lab, using a combination of measurements taken after the physical teardown of the products. The IICs were then split into mechanical, electromechanical, and electronic components. Mechanical parts were identified and mapped to material types. Mechanical parts were also assigned to related manufacturing processes.

Parameters representing material type, composition, and manufacturing processes were assigned to respective mechanical parts, which were then imported into GaBi to build the LCA model. The electronics components were grouped according to each printed circuit board assembly (PCBA) in the IICs. The final assembly electricity was connected to the respective manufacturing country.

The GaBi model mirrors the structure highlighted in section 3.2. Each key component is represented by a material and manufacturing technology mix representing primary data collected for the product. The respective energy grid mixes are linked to the processes based on the manufacturing country.

3.2 Mechanical parts

HP IICs are composed of mechanical assemblies (housing and structure, non-electrical mechanical parts). The material composition of IIC products is summarized using the following structure:

- Container
- Ink Delivery System
- Packaging
- Interfaces

3.3 Ink

Ink is the main component of a cartridge. It can be differentiated into four different types: black, yellow, cyan, and magenta.

3.4 Electronics

Electronic components found within the IICs are populated with electronics, active components, passive components, and electromechanical components on the printed wiring board substrate.

Various PCBA models were developed by Sphera, based on primary data (bills of materials for electronics boards) provided by the material science lab.

3.5 Distribution

HP IICs are manufactured and assembled at production facilities. Products are then distributed to various markets around the world. This distribution may occur by plane, rail, ship, or truck.

3.6 Transportation to EOL

This section was proxied as 200 km of transport distance to EOL by ground freight.

3.7 EOL

Product recycling was modeled to reflect treatment in compliance with WEEE regulations, manual disassembly, recovery of recyclable plastics, shredding, and incineration. A cut-off allocation approach has been applied to end-of-life treatment wherein no credits are assigned to energy or material recovery.

4. Environmental Impact Assessment

This section presents the cartridges' environmental impact potentials and indicators, representing the typical results for an average printing system sold in the North American market. Results are presented per product and per functional unit (printing 1,000 images of the reference standard), as indicated below. The results of this study are shown in two sets: (1) overall life cycle results, and (2) detailed production phase results.

The following provides an overview of the HP IIC life cycle impact assessment results, reported using the IPCC 6th Assessment Report for GWP. This assessment does not include any other midpoint or endpoint indicators.

4.1 Life cycle results

The following table provides an overview of the LCIA results of the respective life cycle stages of a single cartridge. Global Warming Potential (GWP) is given per cartridge and for each 1,000 pages printed. A lower GWP reflects lower greenhouse gas emissions. Values are given in units of kilograms of carbon dioxide (kg CO_2).

HP 68/308 Original Ink Cartridges

PRODUCT NAME	PRODUCTION	DISTRIBUTION	END OF LIFE	GWP PER CARTRIDGE	GWP PER 1,000 PAGES
HP 68/308 Black Original Ink Cartridge	2.58	0.03	0.01	2.63	16.42
HP 68e EvoMore Black Original Ink Cartridge (US and Canada)[1]	2.61	0.03	0.01	2.66	8.31
HP 68e/308e EvoMore Black Original Ink Cartridge (excluding US and Canada)	2.58	0.03	0.01	2.63	8.22
Equivalent predecessor Black XL Original Ink Cartridge	1.64	0.03	0.01	1.69	7.04

HP 923/924/925 Original Ink Cartridges

PRODUCT NAME	PRODUCTION	DISTRIBUTION	END OF LIFE	GWP PER CARTRIDGE	GWP PER 1,000 PAGES
HP 923/924/925 Cyan/Magenta/Yellow Original Ink Cartridge	0.53	0.01	0.02	0.56	1.40
HP 923/924/925 Black Original Ink Cartridge	0.53	0.01	0.02	0.56	1.12
HP 923e/924e/925e EvoMore Cyan/Magenta/Yellow Original Ink Cartridge	0.53	0.01	0.02	0.56	0.70
HP 923e EvoMore Black Original Ink Cartridge	0.56	0.03	0.03	0.61	0.61
HP 924e/925e EvoMore Black Original Ink Cartridge	0.54	0.02	0.02	0.58	0.58
Equivalent predecessor Cyan/Magenta/Yellow XL Original Ink Cartridge	0.53	0.01	0.02	0.56	0.68
Equivalent predecessor Black XL Original Ink Cartridge	0.56	0.03	0.03	0.61	0.74

HP 936/937/938 Original Ink Cartridges

PRODUCT NAME	PRODUCTION	DISTRIBUTION	END OF LIFE	GWP PER CARTRIDGE	GWP PER 1,000 PAGES
HP 936/937/938 Cyan/Magenta/Yellow Original Ink Cartridge	0.52	0.01	0.01	0.55	0.68
HP 936/937/938 Black Original Ink Cartridge	0.63	0.03	0.02	0.68	0.54
HP 936e/937e/938e EvoMore Cyan/Magenta/Yellow Original Ink Cartridge	0.53	0.02	0.01	0.56	0.34
HP 936e EvoMore Black Original Ink Cartridge	0.67	0.04	0.03	0.74	0.29
HP 937e/938e EvoMore Black Original Ink Cartridge	0.66	0.03	0.02	0.72	0.29
Equivalent predecessor Cyan/Magenta/Yellow XL Original Ink Cartridge	0.53	0.02	0.01	0.56	0.35
Equivalent predecessor Black XL Original Ink Cartridge	0.66	0.03	0.02	0.72	0.36

[1] Cartridge packaging includes an HP Planet Partners return envelope for the US and Canada.

5. References and Standards

IPCC. (2013). Climate Change 2013: The Physical Science Basis. Genf, Schweiz: IPCC.

ISO. (2006). ISO 14040: Environmental management Life cycle assessment principles and framework. Geneva: International Organization for Standardization.

ISO. (2006). ISO 14044: Environmental management life cycle assessment requirements and guidelines. Geneva: International Organization for Standardization.

JRC. (2010). ILCD Handbook: General guide for life cycle assessment detailed guidance. EUR 24708 EN (1st ed.). Luxembourg: Joint Research Centre.

Sphera. (2020). GaBi LCA Database Documentation. Retrieved from Sphera Solutions, Inc.: https://sphera.com/product-sustainability-gabi-data-search.

Appendix A

Impact categories and indicator descriptions

IMPACT CATEGORY	ABBREV.	DESCRIPTION	UNITS
Global Warming Potential (100 years), excluding biogenic carbon	GWP 100	Global Warming Potential (GWP) is a measure of greenhouse gas emissions, such as CO_2 and methane. These emissions are causing an increase in the absorption of radiation emitted by the earth, increasing the natural greenhouse effect. This may, in turn, have adverse impacts on ecosystem health, human health, and material welfare. GWP is expressed in terms of impacts from biogenic materials and fossil or non-biogenic materials. GWP excluding impacts from biogenic sources is presented in this report.	kg CO_2 equivalent (IPCC AR 6)

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