Life Cycle Environmental Impact Comparison of Retail Photo Systems

HP Photosmart Minilabs and Microlabs vs. Silver Halide Systems

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Executive Summary for Distribution in Europe

EXECUTIVE SUMMARY

Retail photofinishing systems provide retail stores with a means to offer photo printing services to their customers. Retail photofinishing systems convert customers' digital images to physical prints. Silver halide (AgX), or wet, technology has been the traditional method for providing retail photo processing services. Due to the nature of the technology, AgX systems consume significant chemicals, water, and energy. Over the past several years, dry photo processing technology alternatives, such as the HP Minilab solutions, have been introduced. HP systems are based on inkjet technology.

HP commissioned Four Elements Consulting, LLC to perform an environmental Life Cycle Assessment (LCA) to quantify the environmental impacts of HP systems compared to AgX systems.

The AgX and HP systems were compared for the European market. The systems compared include three HP systems—HP Photosmart ML 1000D Minilab, HP Photosmart ML2000D Minilab and HP Photosmart pm2000e Microlab—and 2 AgX systems: Fuji Frontier 350 and Noritsu QSS-3212.

Results summary

Overall, the HP retail photo systems studied performed better than the AgX systems studied on the set of environmental impacts measured. HP products performed better or on par with AgX processes on all of the 12 indicators measured. Key findings included:

- HP performed significantly better on two key measures: carbon footprint and total energy use.
    - HP systems' carbon footprint, or climate change impact, was up to 33% lower.
    - HP systems used up to 26% less total energy over the lifetime of the products.
- HP also performed significantly better or on par with AgX processing on a broad set of measures of water, air and land pollution.
- Overall water use is equivalent. Total water use for both technologies is driven primarily by photo paper manufacturing—a water intensive process.
- During operation, AgX photo printing processes require an external water source and produce water effluent. Printing photos with HP retail photo printers uses no external water and produces no effluent. As a result, the impact on local water supplies is lower for the HP printing process. This is reflected in a difference in process waste water.
- The key driver of lower climate change, pollution measures and total energy is the lower electricity use overall for HP systems compared to AgX systems. The HP systems used about three times less electricity than the AgX systems.

Table 1 Overall Results—HP vs AgX systems

Environmental Impact	HP compared to AgX
Climate change "Carbon Footprint", greenhouse gas emissions	Up to 33% less
Ozone depletion Ozone depleting gases	Up to 26% less
Human toxicity	Equivalent
Photochemical oxidant formation Smog forming gases	Up to 16% less
Particulate matter formation Particles in the air due to use of fuels	Up to 16% less
Terrestrial acidification Acid rain	Equivalent
Freshwater eutrophication Nutrients released with potential species shift in freshwater bodies	Up to 18% less
Terrestrial ecotoxicity Potential for damage to ecosystems on land	Up to 12 % less
Freshwater ecotoxicity Potential for damage to ecosystems in freshwater bodies	Up to 23% less
Total water use	Equivalent
Fossil fuel depletion	Up to 18% less
Total energy Energy from all sources to print photos and produce and transport all upstream materials. Includes 'embedded energy'.	Up to 26% less

Methodology

The study was conducted in strict accordance with the International Standards Organization (ISO) guidelines for conducting LCA. The analysis covered the resources necessary in each technology to convert a digital image source to a physical print and evaluated a broad and comprehensive spectrum of environmental indicators.[1] Typical usage trends, materials consumption, processing techniques, and waste management practices specific to the geographic region were assessed, and detailed data collection for the systems studied was performed. HP supplied the data for the HP systems, and CCDS communication & design GmbH provided data for the AgX systems. CCDS also provided electricity use measurements for both HP and AgX systems.

This LCA adheres to ISO principles and framework in ISO 14040 as well as the guidelines specified in ISO 14044.[2] LCA is a tool for the systematic evaluation of the environmental impacts of a product through all stages of its life cycle, which include extraction of raw materials, manufacturing, transport and use of products, and end-of-life management—recycling, reuse or disposal. The study has undergone an external peer review process to ensure the credibility and objectivity of the data and results as well as conformance with ISO standards on LCA.

The systems selected for the study were:

		4x6 photos printed/hour[3]
HP systems	HP Photosmart ML1000D Minilab Printer (ML1000D)	1500
	HP Photosmart ML2000D Minilab Printer (ML2000D)	1500
	HP Photosmart pm2000e Microlab Printer (pm2000e)	720
AgX systems	Fuji Frontier 350 (Fuji 350)	1050
	Noritsu QSS-3212 (Noritsu 3212)	1150

The AgX products selected for comparison are believed to comprise the majority of the installed base in the region, based on primary and secondary research data.[4]

[1] ReCiPe was created by the RIVM, CML, PRé Consultants, Radboud Universiteit Nijmegen, and CE Delft. It was first made available in Fall, 2009. Please see www.pre.nl for more information.

[2] ISO 14040:2006, the International Standard of the International Standardization Organization, Environmental management. Life cycle assessment. Principles and framework. ISO 14044:2006, Environmental management – Life cycle assessment – Requirements and guidelines.

[3] HP speeds from www. hp.com/go/RPS, Fuji speeds from http://home.fujifilm.com Noritsu speeds from http://www.noritsu.co.jp/english

[4] Market sizing and installed base assumptions for both technologies for Europe were based on a survey of 74 German photo retailers conducted in November 2009 and HP internal data.

The systems evaluated in this study are comparable. They produce photos of comparable quality in terms of color gamut, longevity and consistency. And, the output speeds for all systems meet the study's daily print assumption. The study took into account differences in output speed and expected service life.

Detailed quantitative and qualitative primary data for the use phase of AgX systems was provided by CCDS, a firm with specific expertise in the industry. CCDS collected data by observing and measuring processes in retail environments and based on their historic experience with the industry. Primary data for HP Minilab processes were based on interviews with HP engineers and suppliers and HP internal data. Some publicly available data were used but data points were checked for sensitivity. All data sources used in the study were evaluated for temporal, geographical, and technological coverage. Data available from LCA software databases were evaluated and the best data available at the time of the study were used. Data from the EcoInvent, U.S. LCI, and SimaPro databases were used. Energy use calculations were based the Cumulative Energy Demand methodology.[5] Electricity use was measured using CCDS methodology.

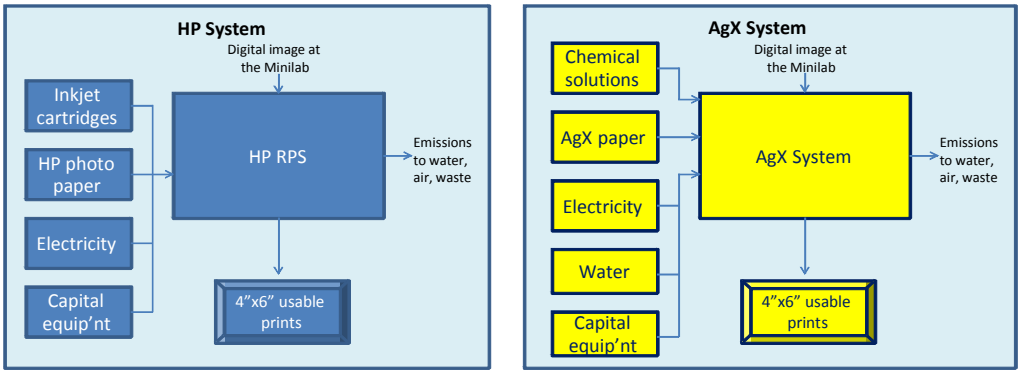
Sensitivity analyses were done to test the robustness of key assumptions. In all cases, the sensitivity analyses did not change the overall direction of the result.

Typical operating life assumptions are based on information from FutureSource and Photographic Consultants, Ltd.

An average daily print volume of 1250 4x6 prints per day, 375,000 per year was assumed, based on comparing input from FutureSource, Photographic Consultants, Ltd. and HP internal data. Because of typical operating life assumptions, the number of machines included in the capital equipment analysis is two for pm2000e compared to a single machine for ML1000D & ML 2000D.

The process studied begins with the delivery of a digital image source (i.e., not physical film) to the Minilab printer or photo developer and ends with the photos ready to be picked up by the customer. It is assumed that the upstream and downstream steps are identical for each alternative. The figure below presents the overall system boundaries.

Figure 2 Overall Study System



[5] CED is based on EcoInvent version 2.0 and has been expanded to include elements from the SimaPro database. See www.pre.nl and www.ecoinvent.org for more information.

All consumables in the use phase for both technologies were modeled and included in the analysis. The photofinishing use phase has been determined to drive the overall environmental performance of photo prints,[6] but full life cycle aspects were modeled or evaluated as possibilities for inclusion/exclusion from the system. For all inputs, extraction of raw materials, all resources and materials in the manufacturing process, packaging and average transportation from the manufacturer to retailers and end of life disposition was included. Energy use from all sources for extraction, manufacturing and transportation of inputs and the printing process itself was also included.

The scope and boundaries excluded impacts for human activities, such as employee travel to and from work. Both HP and AgX systems use PCs as input devices and in both cases the options for input equipment set-ups are numerous. As a result, input devices were not considered in the analysis.

The inputs included are:

- Print media/photo paper, including trim waste and other scrap
- Printing consumables, i.e. HP inkjet cartridges and AgX chemicals
- Water consumption, for photo development and for system maintenance
- Photo effluent solution and other water effluents
- Electricity consumption
- Maintenance
- AgX photographic process control strips
- Long-life consumables, parts that are replaced over the life of the machines
- Capital equipment, all system hardware

At least 99.5% of inputs, based on mass, were covered in the analysis.

[6] "Life Cycle Assessment of Film and Digital Imaging Product System Scenarios", Georgia Institute of Technology, Eastman Kodak Company, 2006 International Conference on Life Cycle Engineering.