Low environmental impact printing with HP Indigo Digital Presses

For production of flexible packaging

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Consumer flexible packaging products printed on HP Indigo Digital Presses

Executive Summary

This report describes the Life Cycle Assessment (LCA) methodology and the results of an independent study performed by EarthShift Global, LLC to assess the environmental impact of pouches made using different printing techniques and volumes. The report details the findings which show that printing with the HP Indigo 20000 for short-run, flexible packaging results in lower environmental impacts for all 13 environmental impact categories considered, when compared to Rotogravure and CI Flexo.

Flexible packaging market trends

The global consumer flexible packaging market value was estimated at $91.7 billion in 2015 and is forecast to grow at an annual average rate of 4.4% during the period 2015–20 to reach $114 billion[1]. This high-growth market demands, faster time to market, growing SKU diversity, and frequent and seasonal redesigns are putting intense pressure on supply chains. Conventional printing technology has inherent limitations when attempting to address these industry trends. The HP Indigo 20000 Digital Press was introduced to the flexible packaging market in 2014. It was quickly adopted by early technology adapters within the global flexible packaging industry. Renowned global brands have been incorporating HP indigo digital printing technology into their supply chains and new product launches, which provides a disruptive new way of consumer communication – customized, personalized, game-changing. Today, the HP Indigo 20000 Digital Press is the only field-proven digital production press for the flexible packaging industry and is leading innovation in the digitally printed flexible packaging market.

Corporate Sustainability Reporting

EU Directive 2014/95/EU ("the 2014 Directive") on the disclosure of non-financial and diversity information, including information on Corporate Social Responsibility ("CSR") matters, requires Member States to enact implementing legislation by December 6, 2016. The Directive amends the 2013 Accounting Directive (Directive 2013/34/EU) to establish, among other things, new environmental, social, and governance ("ESG") reporting requirements for companies that are public-interest entities[2] with more than an average of 500 employees during the financial year. The Directive, by requiring corporate disclosure of information on sustainability， such as social and environmental factors, is designed to support the identification of sustainability risks and increase investor and consumer trust in companies' intentions to work towards a sustainable global economy by combining long-term profitability with social justice and environmental protection.

Currently about 2,500 companies voluntarily produce sustainability reports; that number will rise to nearly 7,000 by 2017, the first financial year for which reporting under the new provisions apply. Impacted public interest companies will have to report on environmental, social and employee-related, human rights, anti-corruption and bribery matters, in addition to describing their business model, outcomes and risks of their policies regarding these topics, and their diversity policy for management and supervisors.

Companies will be encouraged to use standardized, recognized frameworks, such as the Global Reporting Initiative (GRI) Sustainability Reporting Guidelines and the U.N. Guiding Principles on Business and Human Rights. Small businesses are exempt, but because reporting companies will need to include information on their suppliers' CSR activities, there will be a wide-ranging impact across supply chains generally, resulting in a globalized reporting standard for all actors in the supply chain of a given industry. In this regard it is clear that the flexible packaging industry will not be an exception.

[1] Vlad Savinov. The Future of Global Flexible Packaging to 2020. Published by Smithers Pira, page xix.

[2] The term 'Public-interest entities' includes: (a) Entities governed by the law of a Member State whose transferable securities are admitted to trading on a regulated market of any Member State； (b) Credit institutions as defined in point 1 of Article 43(1) of Directive 2013/36/EU of the European Parliament and of the Council, other than those referred to in Article 2 of that Directive; (c) Insurance undertakings within the meaning of Article 2(1) of Directive 91/674/EEC or; (d) Designated by Member States as public-interest entities, for instance undertakings that are of significant public relevance because of the nature of their business, their size or the number of their employees.

HP Indigo Designs with the Environment in Mind

The HP Design for Environment (DfE) program focuses on the sustainable design and development of HP Indigo supplies and presses. New-generation HP Indigo digital presses, such as the HP Indigo 20000, are designed with the environment in mind from the earliest design stages, taking into account the full product lifecycle, supply chain and end of life.
Carbon offsetting of new-generation press manufacturing is one of many steps HP Indigo is taking to reduce environmental impact. HP Indigo has established a program in collaboration with the Good Energy Initiative to offset carbon emissions associated with the manufacturing of the HP Indigo 20000 Digital Press. HP Indigo calculated the carbon footprint associated with the manufacturing of the HP Indigo 20000 using both primary and secondary data according to the PAS 2050 standard for assessing greenhouse gas emissions for products and services. BDO Israel, a leading third-party accounting company, has confirmed that the press carbon footprint identified for each press in fact represents the actual carbon footprint associated with its manufacturing.

HP Indigo invests in several different carbon offsetting projects including reforestation and social investment in renewable energy such as solar and biofuel. HP Indigo cross organizational engineering teams engage in dynamic collaboration from the design stage through production to meet this end. HP Indigo has a proven record of sustainability efforts over the years and we continue to take a leadership to drive sustainability through the product life cycle, working closely with industry stakeholders.

What is a Life Cycle Assessment (LCA)?

A life cycle assessment (LCA) is a data-based methodology that considers the environmental impacts and benefits at each stage of the product life cycle - from raw material selection to disposal of the packaging at the end of its life. It is a tool that evaluates potential environmental impacts of a product, system, or process. For this reason, LCA is often called a “cradle-to-grave analysis”.

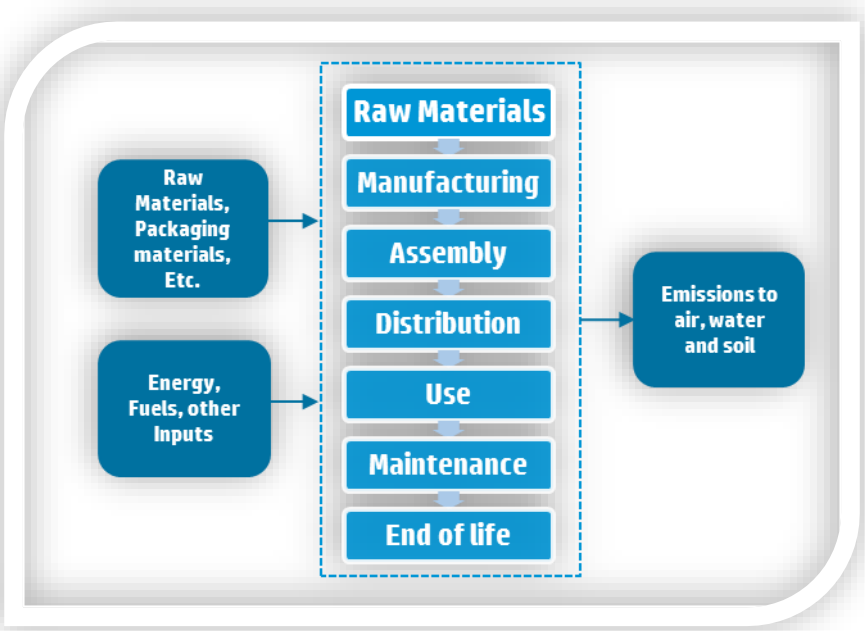

Figure 1. “Cradle to grave analysis” (LCA) process chart

LCA comparison of flexible packaging prints using three different methods

Flexible packaging converters have traditionally used one or both of two different analog technologies – CI flexo or Rotogravure as well-established technologies with successful records of printing flexible packaging. Digital printing is relatively new to the flexible packaging market, while analog technology stil dominates the flexible packaging market, as seen in Figure 2.

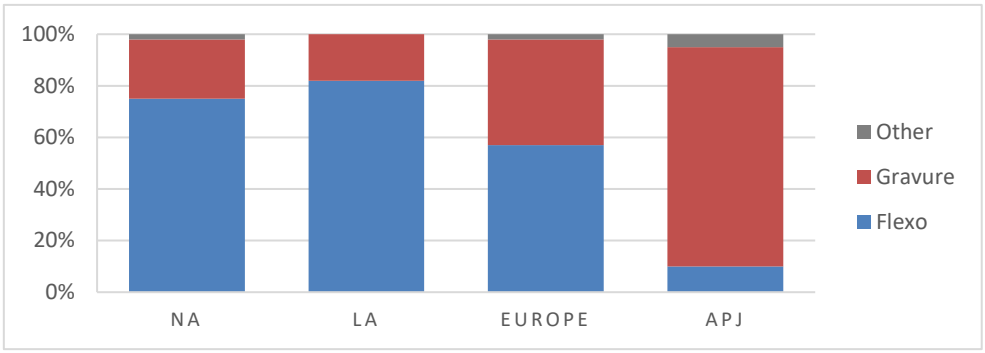

Figure 2. WW value of flexible packaging market share by printing process
Others include letterpress, web offset and HP Indigo Digital Press

What differentiates digital technology from analog technology is that there is no make-ready, other than RIPping the computer file, which makes the economics and reduced environmental impacts of short or customized runs attractive. Flexible packaging converters care about these impacts as does HP Indigo, which prompted HP to commission this LCA impact study on a coffee pouch made using a multilayer film construction. This coffee pouch is used as a representative flexible package substrate to show the relative impacts of packaging material production, printing and end of life with a special focus on the print stage to compare the two main analog technologies with the HP Indigo 20000 Digtal Press.

Our LCA Approach

An independent and unbiased study by a third-party consultant

This LCA study was conducted by third-party sustainability consultant EarthShift Global, LLC, life cycle assessment (LCA) experts and pioneers of Sustainability ROI, helping organizations integrate environmental, social, and economic sustainability into their business and manufacturing operations.

Goal and scope definition

The goal of this study is to assess the environmental impacts of coffee pouches made using flexible packaging and printed on all exterior surfaces using each of the three alternative printing technologies. In particular, the study explores the environmental impacts of printing and how it might change with different printing techniques and different print volumes.

This study is based on the attributional LCA approach. The LCA model and report follows ISO 14040 (ISO, 2006a) and 14044 (ISO, 2006b) requirements for comparative LCA studies intended to be disclosed publically. In compliance with ISO 14044 requirements for comparative assertions intended for public dissemination, a third-party critical review was conducted. The critical review was carried out by a panel of experts and stakeholders, whose main purpose was to ensure ISO compliance and decrease the likelihood that any processes or technologies were improperly represented.

The product studied is a coffee pouch reverse image printed onto a 12 micrometre thick polyethylene terephthalate (PET) web with two images (2-up, single image) each 350 mm (Transverse Direction or TD) x 330 mm (Machine Direction or MD). The image is printed with 7 colors (CYMK + white + 2 spot colors) on the analog systems and only 5 colors (CYMK + white) on the HP Indigo 20000 digital press. Because the digital process can produce finer color gradations, the spot color inks are not required and only the five traditional

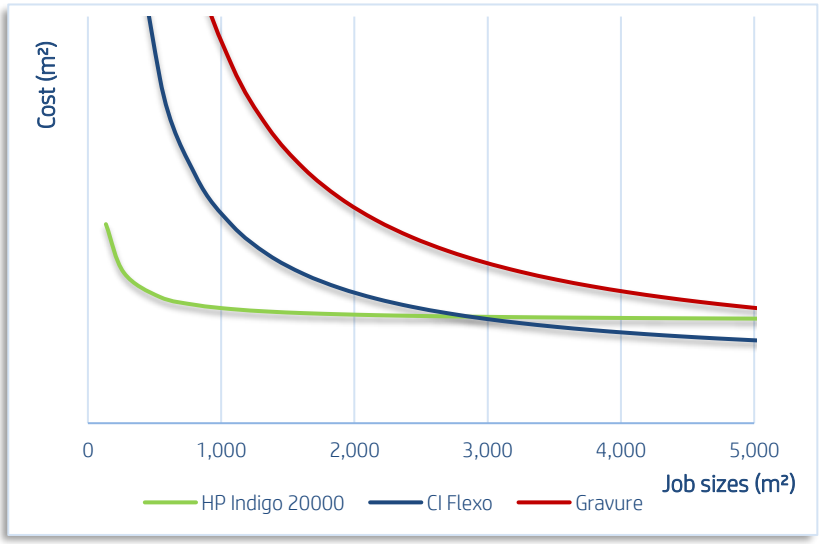

Figure 3. Coffee pouch's economic break-even point between HP Indigo 20000 Digital Press and analog printing (Gravure, Flexo)

colors are required by the HP Indigo 20000 digital press. After printing, the substrate is laminated with 12 micrometres of metalized PET and 70 micrometres of polyethylene, and slit and side trimmed, and shipped to the packing site to be formed, filled, and sealed.

Converters choose digital printing for flexible packaging for the flexibility and customization features. Above a certain run length, it is not economical to print on digital printing. At this economic cross-over point, seen in Figure 3, converters demand to know that they are printing on a system that is also more environmentally preferable. Points of particular interest are at the economic break-even point between the HP Indigo 20000 digital press and Rotogravure at 5,000 m^2 and at the economic break-even point between the HP Indigo Digital Press and CI flexo at 3,000 m^2. Also important is a view of up to 10,000 m^2 to understand the rate of change of different impacts as it relates to job size.

System boundaries

Defining the system boundary for study is essential in all LCAs in order to ensure clarity in how to attribute the results. In this study, system boundaries are set for cradle-to-gate LCA, which includes the input materials, printing and pouch production stages including their independent inputs of energy and materials and outputs of waste. During the printing phase, three different print methods were studied. The process of filling the pouch, getting it to the consumer and the use of the coffee are identical among the three print systems and are not considered. At the end of life, the pouch is expected to be disposed of either in an incinerator or in a landfill. There are no known differences in the behavior of the printing inks in either of the waste management treatments and so this aspect has not been included.

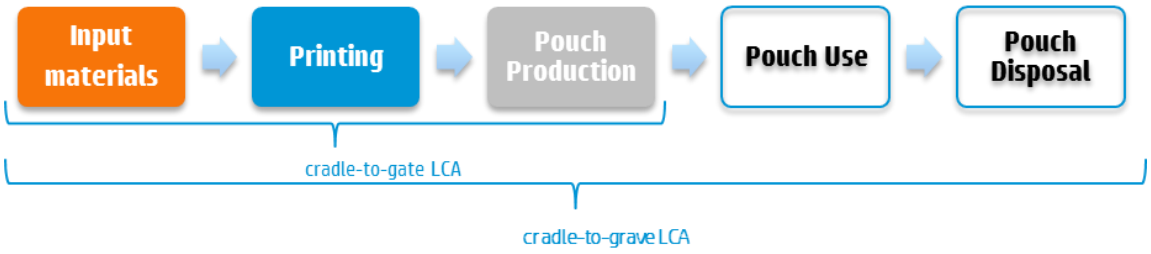

Figure 4. Difference between cradle-to-gate LCA and cradle-to-grave LCA

Impact assessment method

Impact assessment methods are used to convert life cycle inventory (LCI) data (emissions to the environment and raw material extractions) into a set of environmental impacts. ISO 14044 dictates that the chosen method should be an internationally accepted method.

The primary impact assessment method used for this study is the GPP v 2.00 method (The Consumer Goods Forum, 2010). This method was selected by the Global Packaging Project (resulting in the acronym “GPP”) and is frequently used to assess packaging. A secondary method is used that includes the endpoints from the ReCiPe (H) methods (Goedkoop & al., 2009). ReCiPe is one the most robust and updated impact assessment methods. Using the endpoint method, a variety of environmental impacts are combined to the three endpoint damage categories, Human Health, Ecosystems and Resources, which makes it easier for comprehension. Three single issue impact categories are found to be of interested and readily understandable to all types of consumers of LCA results and are shown in the report: Cumulative Energy Demand (Frischknecht, et al., 2007), Climate Change (IPCC, 2007) and Water Depletion (Goedkoop & al., 2009).

Critical review

Finally, a critical review was conducted in accordance with ISO 14044 for comparative assertions intended for public dissemination. Critical review is a process that ensures consistency between a life cycle assessment and ISO requirements for carrying out an LCA. The main purpose of a critical review is to ensure ISO compliance. The critical review was carried out by a panel of experts and stakeholders in order to decrease the likelihood of misunderstandings and negative effects on external interested parties.

LCA Results

Contribution analysis

Contribution analysis results for the three different printing technologies in Europe for a ≈5,000 m² print job are provided in Figure 5. It shows key environmental impact categories such as Global Warning Potential, Photochemical Ozone Creation and Cumulative Energy Demand based on the GPP method. The contribution analysis shows that the primary hotspot by far in the life cycle is the input material followed by pouch production and printing. This is due to the impacts from several energy-intensive processes involved in extracting and processing the raw materials and processing the substrate and metallization. The **printing** contribution ranges **up to 30%** of the cradle-to-gate life cycle impacts and varies by environmental impact category and printing technology.

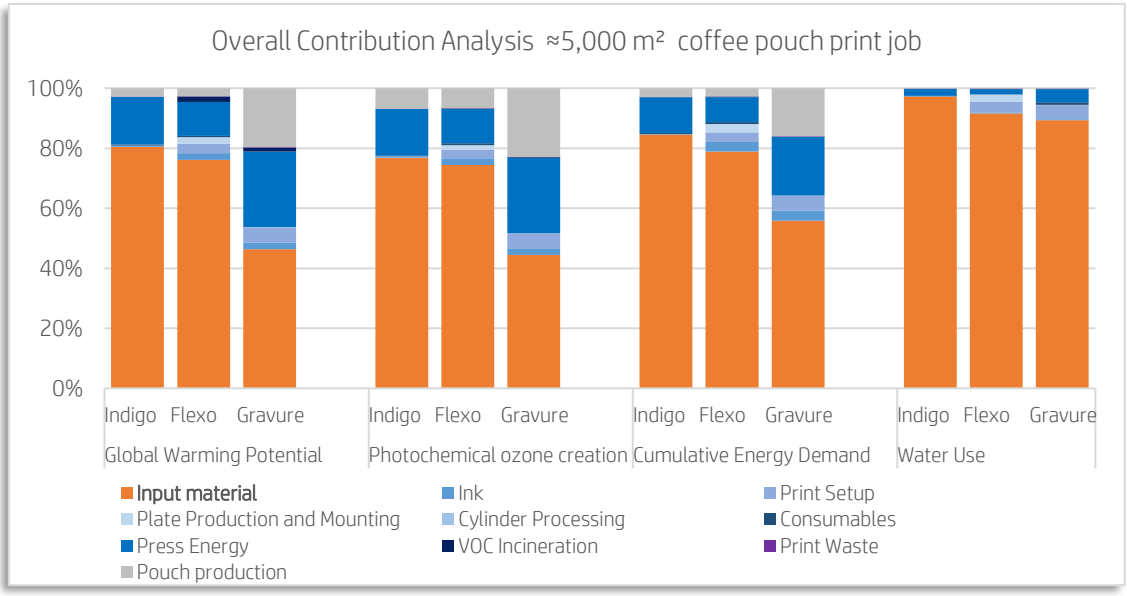

Figure 5. Overall contribution analysis for the characterized LCA results for a ≈5,000 m² print job using 3 different printing technologies on a flexible coffee pouch substrate.

Contribution analysis: Printing focus

A contribution analysis focusing on printing results for the 3 different printing technologies in Europe for a ≈5,000 m² print job are provided in Figure 6. In these key environmental impact categories, the **energy consumption** during printing is shown to be the largest environmental hotspot. Other activities that are significant are production of the printing ink, and the energy and ink consumption during print setup. Production and processing of the gravure cylinders is not a hotspot due to the durability of these components over a large number of print jobs.

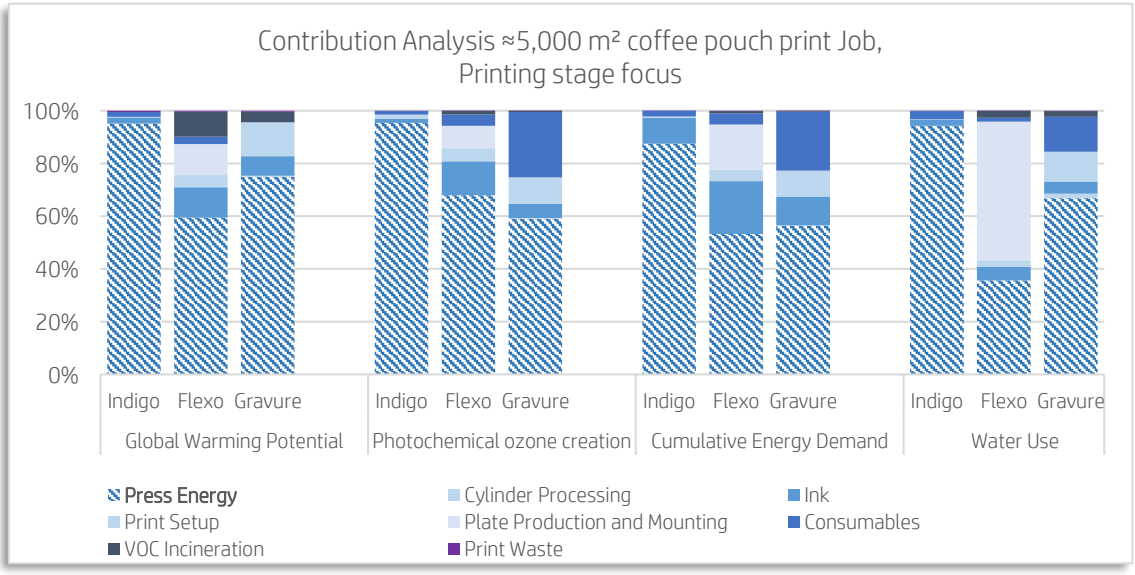

Figure 6. Contribution analysis focus on printing of the characterized LCA results for a ≈5,000 m² print job using 3 different print technologies on a flexible coffee pouch substrate.

CI Flexo vs. Rotogravure vs. HP Indigo 20000 for a job size of ≈3,000 m²

The results of a characterized LCA for a ≈3,000 m² print job using CI flexo, Rotogravure and HP Indigo 20000 print technologies on a flexible coffee pouch substrate are provided in Figure 7 showing that Global Warming Potential is on the order of **80% lower** for the HP Indigo 20000 than the **Rotogravure** print process. The HP Indigo 20000 demonstrates low environmental impacts across all 4 categories at an economical job size for the HP indigo 20000 Digital Press. At a ≈3,000 m² print job size in Europe, the HP Indigo 20000 has lower impacts than the **CI Flexo** print system across all impact categories considered, generally by a **margin of 40-65 %.**

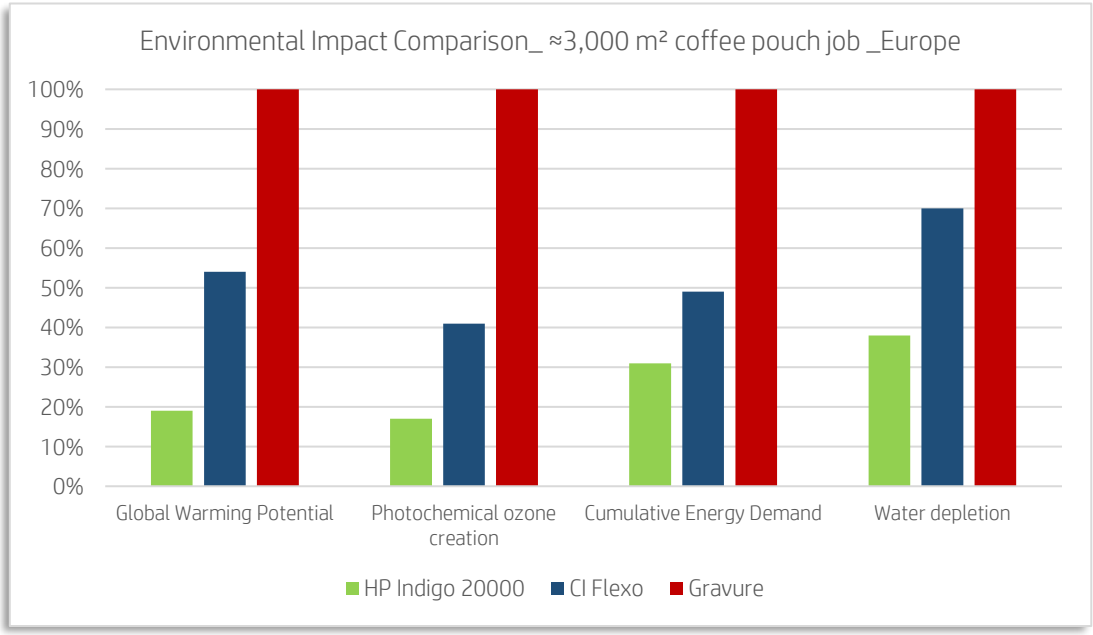

Figure 7.Characterized LCA results for a ≈3,000 m² print job using CI Flexo, Rotogravure and HP Indigo 20000 print technologies on a flexible coffee pouch substrate.

Rotogravure vs. HP Indigo 20000 for a job size of ≈5,000 m²

Figure 8 shows the relative results of the four key impact categories for the economic break-even point of HP indigo 20000 vs Rotogravure at ≈5,000 m² print job size. As the print job increases, the gap between the two processes closes slightly. For a ≈5,000 m² print job in Europe, the HP Indigo 20000 maintains lower impacts than printing with Rotogravure across all categories considered, generally by **a margin of 60-80%.**

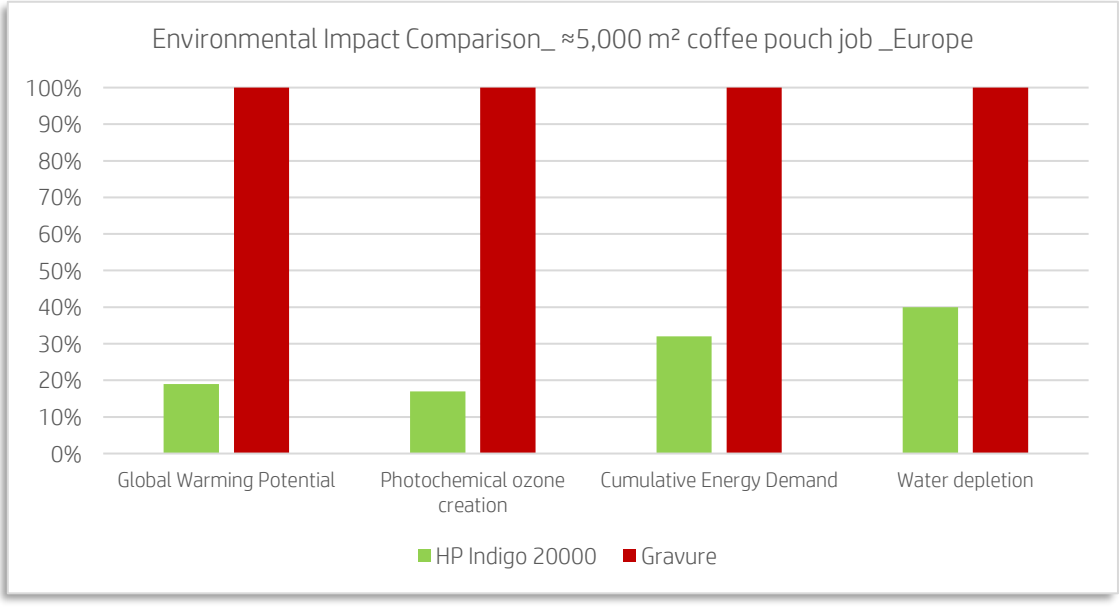

Figure 8. Characterized LCA results for a ≈5,000 m² print job using CI Flexo, Rotogravure and HP Indigo 20000 print technologies on a flexible coffee pouch substrate.

Environmental impact by print job size

As print job sizes increase, the setup impacts decrease. For job sizes of less than 10,000 m², the HP Indigo 20000 provides lower potential impacts in Europe for Global Warming Potential, Photochemical Ozone Creation, Cumulative Energy Demand and Water Depletion (Figures 9-11). An analysis comparing HP Indigo 20000, CI flexo and Rotogravure at 10,000 m² shows 100% probability that the HP Indigo 20000 is better or similar in not only all 4 key enviromental impact categories but also 12 of the 13 environmental impact categories even beyond the economical job sizes of digital printing.

Climate change impact

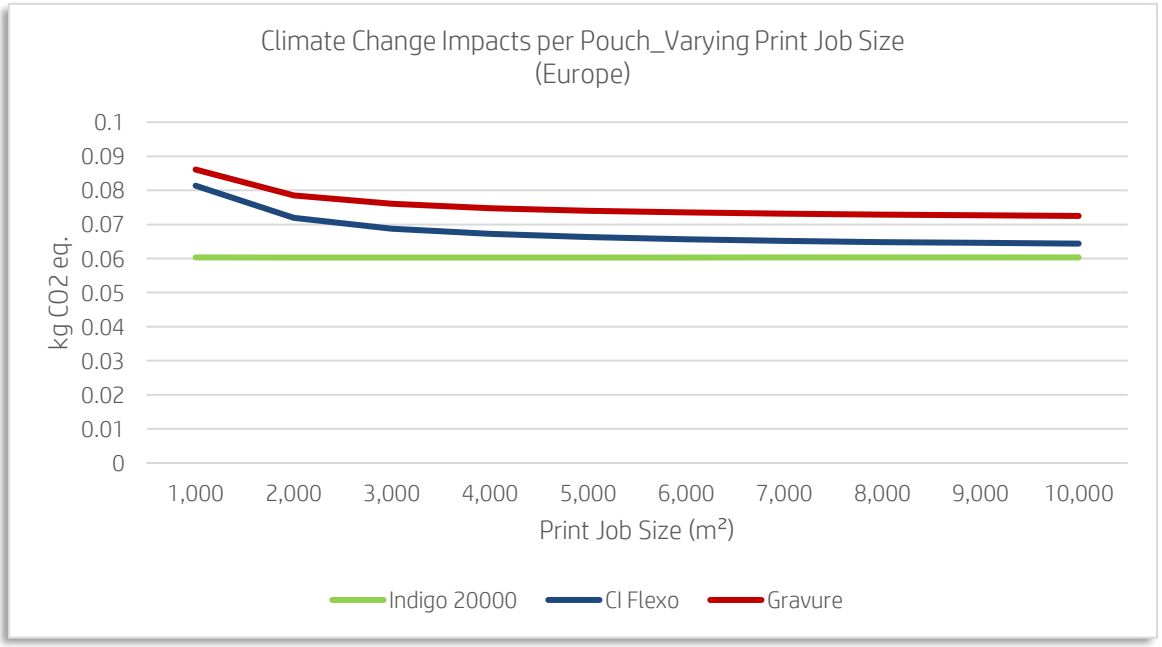

Figure 9. The effect of job size on Climate change (Global Warming Potential)

Photochemical ozone impact

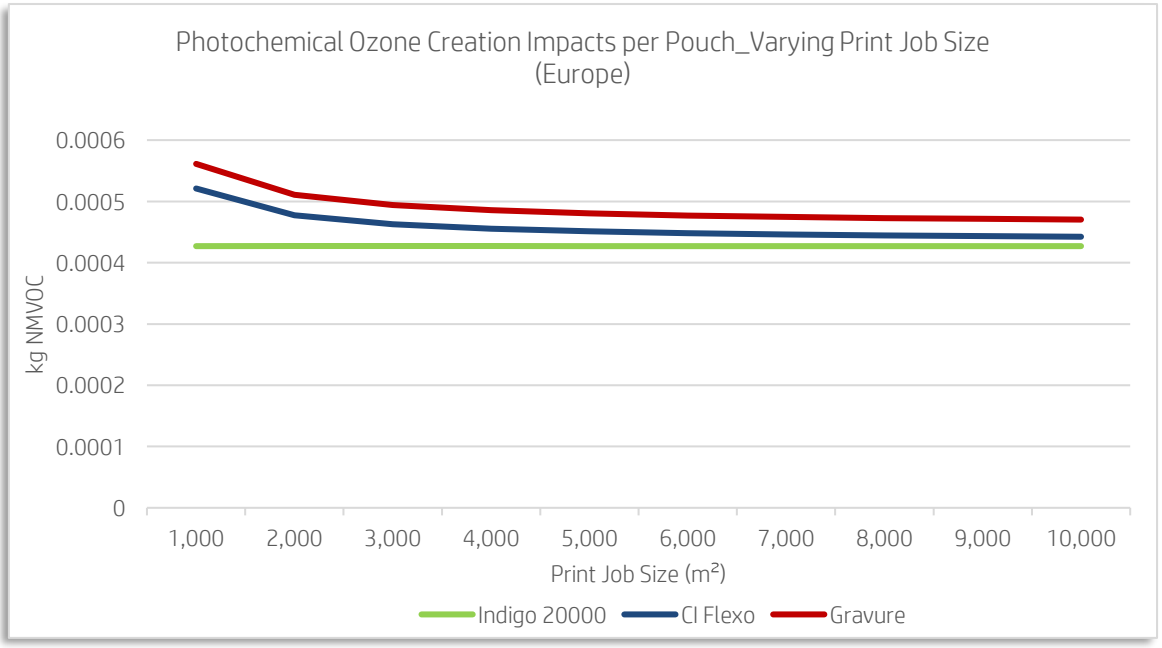

Figure 10. The effect of job size on Photochemical ozone creation

Cumulative energy demand

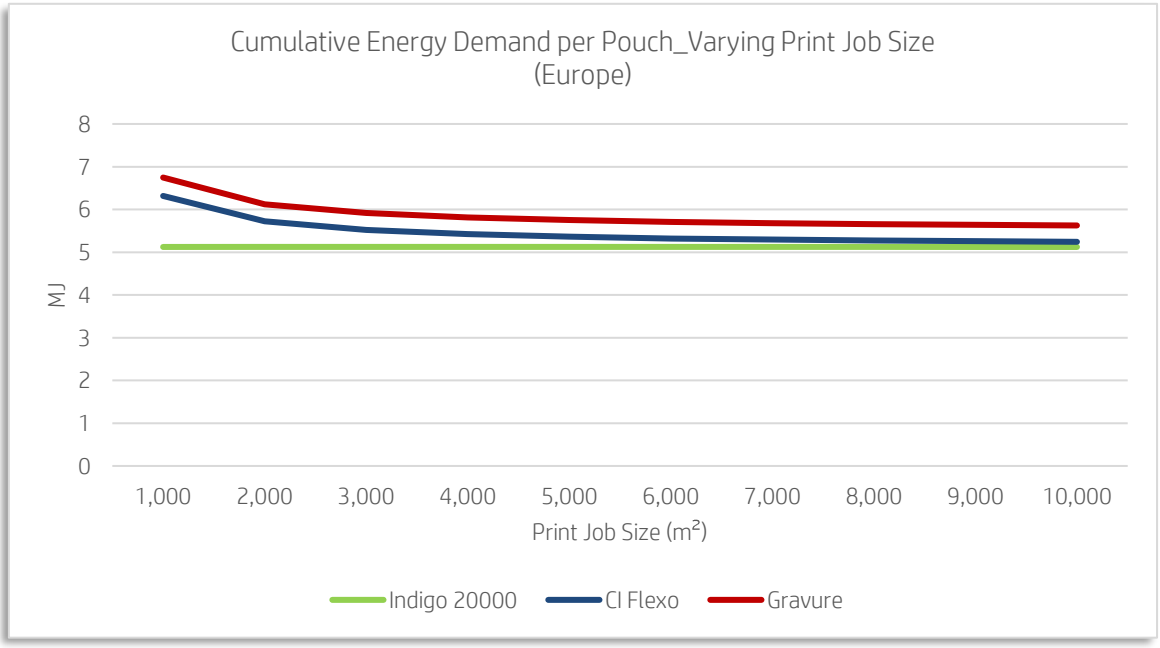

Figure 11. The effect of job size on Cumulative energy demand

Water depletion

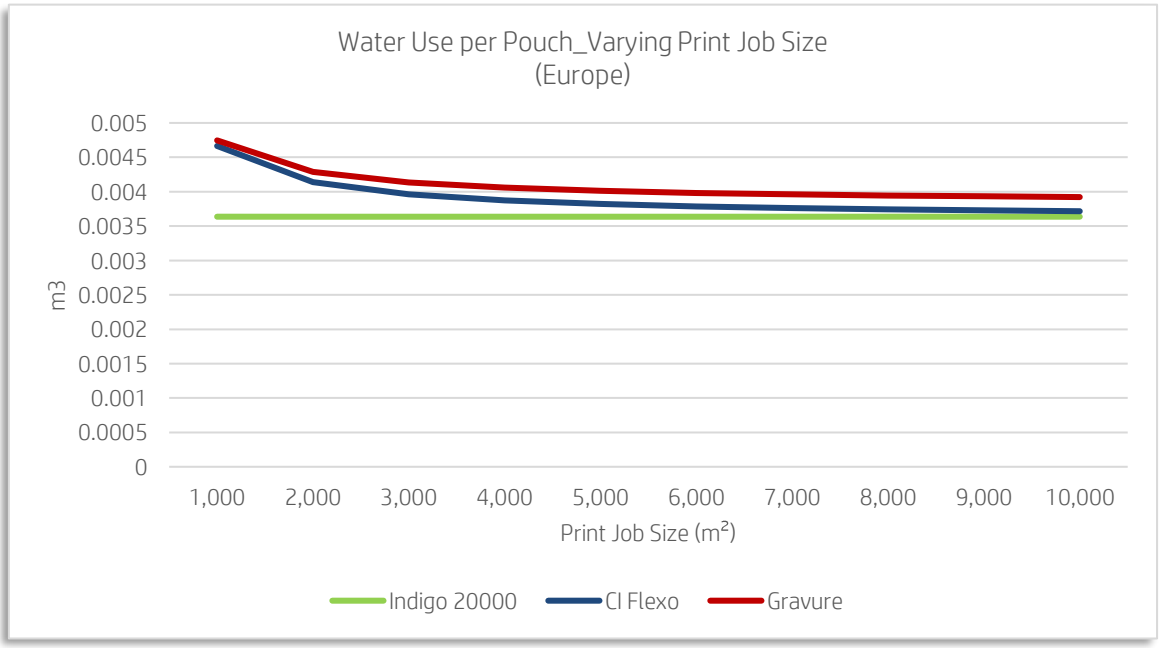

Figure 12. The effect of job size on Water depletion

The reasons for HP Indigo 20000 enviromental impact advantage beyond its economical job sizes

- HP Indigo 20000 has significantly lower press energy requirements than Rotogravure.
- HP Indigo 20000 does not require the material and energy inputs to produce and process plates and cylinders for the print process.
- HP Indigo 20000 has a minimal print setup, compared to flexo and Rotogravure, which use more energy, ink, and substrate during print setup.

- The material and energy use that go into print setup, and making and processing plates and cylinders for flexo and Rotogravure are steps that must occur regardless of print job size. It is the fixed nature of these steps in the process that drive the curve we see in the job size analysis charts for Flexo and Gravure.

- HP Indigo 20000 on the other hand has minimal setup, and no plates and cylinders to manufacture. The environmental impact of the HP Indigo 20000 is constant regardless of job size because it does not have these fixed inputs.

Conclusions

- Contribution analysis results for the three different printing technologies identify the primary hotspot, by far, for the coffee pouch as the input materials. Pouch production and printing are next in line. Working on more sustainable pouch materials is a recommended focus area for anyone interested in reducing the environmental impact of flexible packaging.

- Printing can contribute up to 30% of the cradle-to-gate life cycle impacts. In the printing stage, the energy consumption during printing is shown to be the largest environmental hotspot. This is followed by production of the printing ink, and the energy and ink consumption during print setup. The following methods can help improve environmental impact at the printing stage:

    - Reduce energy consumption during printing. The HP Indigo presses offer an optional feature called EPM (Enhanced Productivity Mode) that increases production throughput and reduces overall energy consumption.
    - Increase the use of renewable energy. As many of the printing impacts considered in this LCA are significantly affected by the source of electricity generation, the use of renewable energy will reduce these impacts for all 3 print processes.
    - Reduce waste. The package carries the highest impacts. Reducing waste will reduce the amount of substrate, processing and waste that is created.

- Printing with the HP Indigo 20000 on flexible packaging demonstrates low environmental impacts across all environmental impact areas at their associated economical job sizes across all 13 environmental impact categories considered.

    - At a ≈3,000 m² print job size in Europe, the HP Indigo 20000 has lower impacts than the CI flexo print system across all impact categories considered, generally by a margin of 40-65 %.
    - At a ≈5,000 m² print job in Europe, the HP Indigo 20000 has lower impacts than printing with Rotogravure across all categories considered, generally by a margin of 60-80%.

- The HP Indigo 20000 digital printing advantage of lower environmental impact is relevant for print jobs sizes of up to 10,000 m².

Figure 13: HP Indigo 20000 Digital Press

Learn more at
hp.com/go/indigo

4AA7-5259ENW, May 2020

HP Indigo