

Life Cycle Assessment

Flexographic Printing and Platemaking Update

Life Cycle Assessment performed by:
Steve Barr and Tinu-Ololade Folayan

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Executive Summary

The original DuPont life cycle assessment (LCA)^[1] from 2008 was updated in 2021^[2] using the Ecoinvent 3^[3] database for relevant inputs and the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment^[4] values for the global warming potential impact method. The impacts studied remained the same as the original study (global warming potential (GWP) and non-renewable energy (NRE) consumption) in the 2021 update. The current update uses 2023 data, Ecoinvent version 3.9.1^[5], and IPCC 6th Assessment^[6] for the GWP factors. This latest update focuses on only GWP impact from cradle through plate imaging, because new data for printing was not collected. The current update also includes GWP impacts both with and without CO₂ uptake. This allows users to properly account for the biogenic carbon content that is mostly contained in the packaging materials.

The updated results validated the findings of the original study. Thermal plate processing is still shown to have a lower environmental footprint than solvent processing. Impacts have reduced somewhat overall due to the reduced impact of evolving renewable electricity production methods and changes in Ecoinvent and IPCC GWP impact versions. **Digital thermal processing is shown to have a 48% lower GWP impact and 49% lower GWP when CO₂ uptake is included compared to digital solvent processing, without including the plate manufacturing.** When including the plate manufacturing, digital thermal has a 20% lower GWP impact and a 23% lower GWP including CO₂ uptake compared to digital solvent processing.

It was also determined that 0.25 plate thickness for Digital solvent processing has up to 64% more GWP than 0.067 plate thickness and 66% more when CO₂ uptake is included.

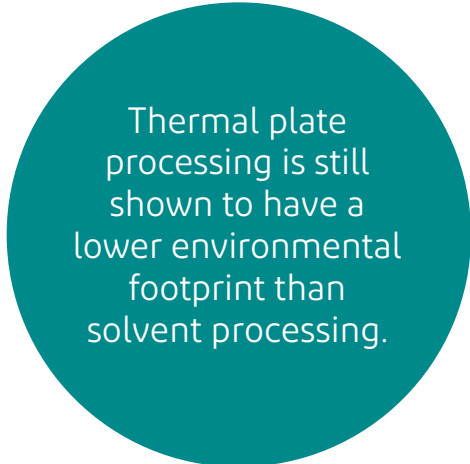
1. Reason for Update

The original study was completed in 2008, with an update to the digital solvent information in 2010 and a more complete update in 2021. The Ecoinvent databases have had significant updates with more current data. The Ecoinvent 3.8 database, which was used in 2021, has been updated to Ecoinvent 3.9.1. The IPCC released its 6th assessment values for GWP and DuPont also made the switch to using renewable electricity in the plate production process. With this updated information for the input data and impact assessment calculations, it was time to update the study to see if the conclusions had changed over the last three years.

2. Life Cycle Impact Assessments

The environmental impacts considered in this study are global warming potential with and without CO₂ uptake.

An update from the original study is the use of the latest GWP impact assessment methodology and including CO₂ uptake. A period of 100 years is customary, and the Intergovernmental Panel on Climate Change (IPCC) (100 yr) methodology is applied in this study using the values from the 6th Assessment.



Thermal plate processing is still shown to have a lower environmental footprint than solvent processing.

3. Results

Flexographic Plate Imaging:

Figure 1 shows the GWP and GWP including CO₂ uptake for plate imaging at tradeshops, without inclusion of the plate manufacture.

As seen in Figure 1 above, the updated digital thermal plate imaging impact has a 48% lower global warming potential (49% lower including CO₂ uptake) compared to the updated digital solvent plate imaging processes for a 0.067 plate.

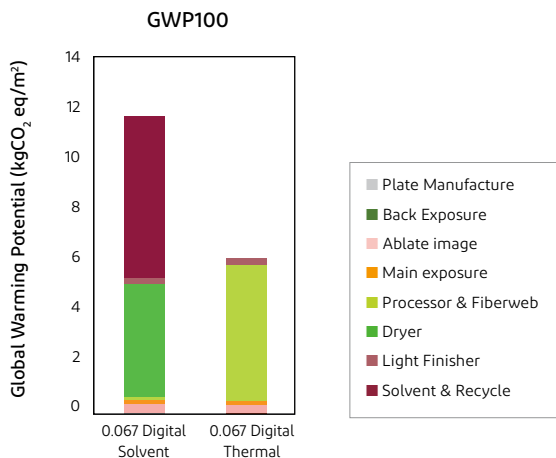


Figure 1: Average Digital Flexographic Plate Imaging Impact

The digital thermal plate imaging impact has a 48% lower global warming potential.

Flexographic Plate Manufacturing and Imaging:

Figure 2 combines the information presented in Figure 1 with the environmental footprint of plate manufacturing.

It can be seen that there is no significant difference in plate manufacturing between the different processes. The differences are in the imaging process, which includes the categories besides plate manufacturing. Digital thermal has 20% lower global warming

potential (22% lower including CO₂ uptake) compared to the updated average digital solvent plate manufacturing and imaging processes for a 0.067 plate. A significant change in the results is due to the switch to 100% renewable electricity in plate manufacturing, replacing some secondary raw material data with primary data from suppliers, and following current LCA methodology guidance. These changes have resulted in a reduction in carbon footprint compared to the 2021 update.

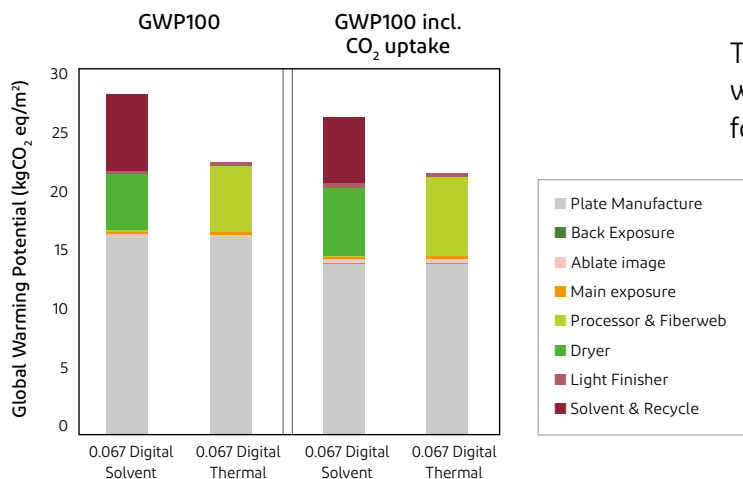


Figure 2: Average Digital Flexographic Plate Manufacturing and Imaging Impact

The impact from plate manufacturing is reduced when CO₂ uptake is included because of the credit for the sequestered carbon associated with the packaging cardboard. GWP impacts are shown both with and without CO₂ uptake to allow for proper accounting of biogenic carbon in the product packaging.

Table 1: Summary of Global warming potential for Plate manufacturing and Plate processing

	GWP100		GWP100 incl.CO ₂ uptake	
	Digital Solvent	Digital Thermal	Digital Solvent	Digital Thermal
0.067 Plate Manufacturing	28.0kg CO ₂ -eq / m ²	22.3kg CO ₂ -eq / m ²	24.8 kg CO ₂ -eq / m ²	19.2 kg CO ₂ -eq / m ²
0.067 Plate Processing	11.6kg CO ₂ -eq / m ²	6.0kg CO ₂ -eq / m ²	11.7 kg CO ₂ -eq / m ²	6.0 kg CO ₂ -eq / m ²

Plate Thickness:

Figure 3 shows the GWP for plate manufacturing and imaging for various plate thicknesses.

The GWP impact logically increases as the plate thickness increases. This shows the benefits of utilizing the minimum plate thickness for printing.

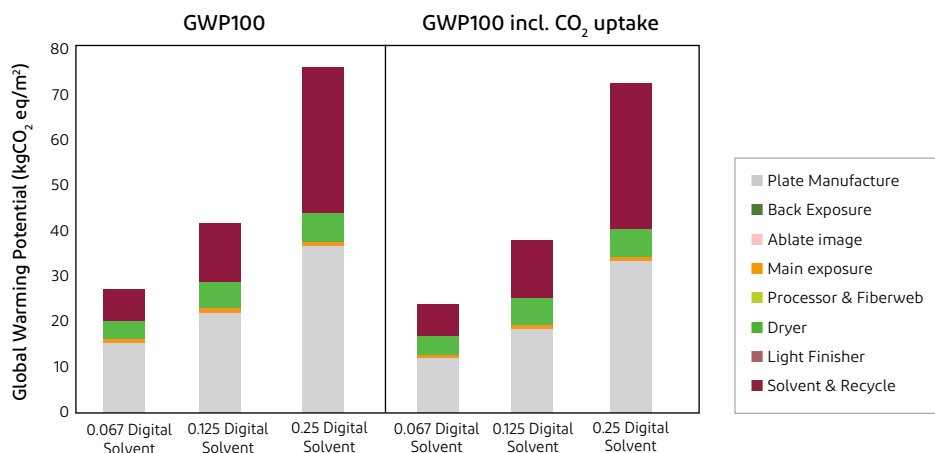


Figure 3: Effect of Plate Thickness for Digital Solvent Processing

4. References

- (1) S. Veith, S. Barr, DuPont, "Life Cycle Assessment: Flexographic and Rotogravure Printing Comparison & Flexographic Plate Imaging Technologies", 2008, (<https://www.dupont.com/flexographic-systems/cyrel-sustainability.html>): available upon request
- (2) S. Barr, "Life Cycle Assessment: Flexographic Printing and Platemaking Update", 2021, ([https://www.dupont.com/content/dam/dupont/amer/us/en/cyrel/Public/documents/en/EI00433-Flexo%20LCA%20Public%20Report%20Update-digital%20\(1\).pdf](https://www.dupont.com/content/dam/dupont/amer/us/en/cyrel/Public/documents/en/EI00433-Flexo%20LCA%20Public%20Report%20Update-digital%20(1).pdf))
- (3) ecoinvent Version 3: Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E., and Weidema, B., 2016. The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, [online] 21(9), pp.1218–1230. Available at: (<http://link.springer.com/10.1007/s11367-016-1087-8>)
- (4) Intergovernmental Panel on Climate Change (IPCC): Fifth Assessment Report (<https://www.ipcc.ch/assessment-report/ar5/>)
- (5) Ecoinvent 3.9.1 (<https://support.ecoinvent.org/ecoinvent-version-3.9.1>)
- (6) Intergovernmental Panel on Climate Change (IPCC): Sixth Assessment Report (<https://www.ipcc.ch/assessment-report/ar6/>)

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