Validation of Watershed AI to Create Product Carbon Footprints

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Watershed ALBANY INTERNATIONAL

Background

Artificial intelligence (AI) is increasingly being explored to streamline the development of product carbon footprints (PCFs) and support corporate decarbonization efforts. Watershed AI, a sustainability-focused platform, offers an approach to PCF generation as companies seek more efficient ways to quantify and reduce their environmental impacts. This project evaluates the accuracy and reliability of PCFs generated using Watershed AI compared to openLCA, an established life cycle assessment software. Using a bill of materials (BOM) provided by Albany International, the study focuses on Printex XP, an engineered composite used in aerospace, commercial, and military applications.

Project Objectives

- ❑ Evaluate the accuracy, reliability, and practical applicability of Watershed's Auto-Mapper and Advanced-Mapper tools
- ❑ Compare PCF estimates generated using Watershed AI with those obtained from
- ❑ Examine how Watershed AI handles assumptions, addresses data gaps, and selects emission factors
- ❑ Identify major lifecycle greenhouse gas emission hotspots and evaluate opportunities to reduce the product's carbon footprint

Research and Methodology

- ❑ Printex is manufactured from PET and PA6 polymers, producing 83.5 m² per batch. BOM inputs were normalized to a functional unit of 1 m².
- ❑ Three levels of input detail were evaluated: poorly informed, moderately informed, and well informed, with increasing specificity of material and process data (Table 1).
- ❑ Watershed uses available databases (e.g., Ecoinvent) to select emission factors, relying on global averages to address data gaps and more specific factors when detailed inputs are provided.
- ❑ Each data-detail level was evaluated using both Auto-Mapper and Advanced-Mapper.
- ❑ Two comparisons were conducted: Auto-Mapper vs. Advanced-Mapper and Advanced-Mapper vs. openLCA.
- ❑ Watershed maps upstream supply-chain processes to identify major greenhouse gas emission hotspots.

Table 1: Summary of Watershed Scenarios

Poorly Informed	Material name and amounts only
Moderately Informed	Addition of electricity, natural gas usage, and corrected packaging information
Well Informed	Additional wastage rates included

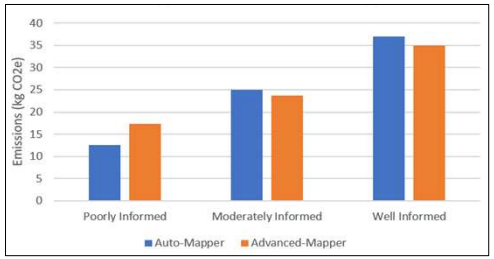


Figure 1: Auto-Mapper versus Advanced-Mapper Outputs

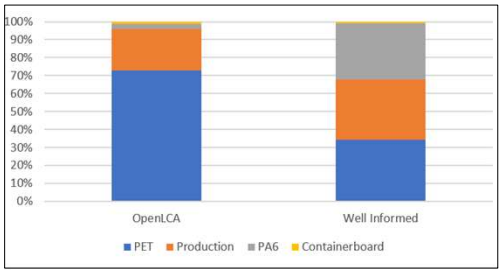


Figure 2: Emission Contributions by Category for openLCA and Well Informed Advanced-Maper

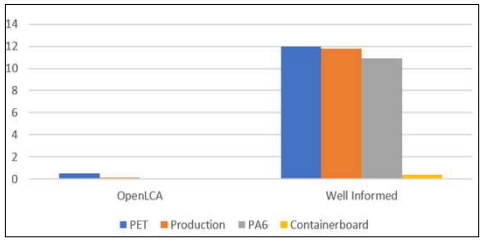


Figure 3: openLCA vs. Watershed's well-informed scenario by Emission Category

Table 2: Advanced-Mapper versus openLCA Emissions (kg CO2e)

	Poorly Informed	Moderately Informed	Well Informed	openLCA
Emission	17.4	23.7	35.0	0.74
% Difference with openLCA	95.7%	96.9%	97.9%	0

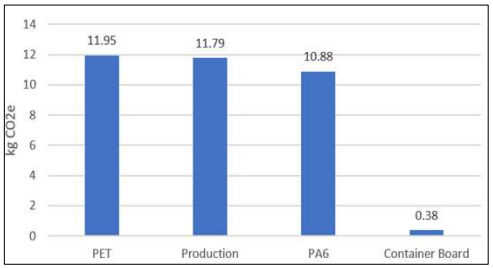


Figure 4: Emissions Hotpots Identified from Watershed Output

Limitations and Uncertainty

- ❑ **Data gaps:** Assess Watershed AI's assumptions and methods for estimating missing data.
- ❑ **Emission factors:** Evaluate the influence of outdated or geographically generalized data.
- ❑ **System boundaries:** Compare upstream supply-chain and gate-to-gate emissions coverage.
- ❑ **Database consistency:** Examine differences between Ecoinvent versions 3.7 and 3.9.1.

Results & Discussion

- ❑ The poorly informed Auto-Mapper failed to identify cardboard packaging and incorrectly classified all yarn as PET.
- ❑ Adding process-specific data, including electricity, natural gas, and material wastage, increased estimated emissions and significantly changed their relative contributions (Figure 1).
- ❑ PET was the largest emissions contributor in both models, although openLCA estimated considerably lower contributions from electricity, natural gas, and PA6 (Figure 2).
- ❑ openLCA estimated a substantially lower PCF of 0.74 kg CO_2e, despite using the same BOM and wastage rates as the well-informed Advanced-Mapper (Figure 3 and Table 2).
- ❑ Key emission hotspots included Nylon 6 (PA6) and upstream production processes, highlighting opportunities for further investigation and potential reductions (Figure 4).
- ❑ Differences in Ecoinvent database versions, emission factors, and system boundaries may explain discrepancies between Watershed and openLCA estimates.

Future Work

- ❑ Create a scalable/repeatable framework for creating PCFs
- ❑ Analyze the upstream processes and identify potential hotspots for errors
- ❑ Understand the discrepancies between openLCA outputs vs. Watershed PCFs