LCA Based Metrics for Printed Wiring Boards

LMAS

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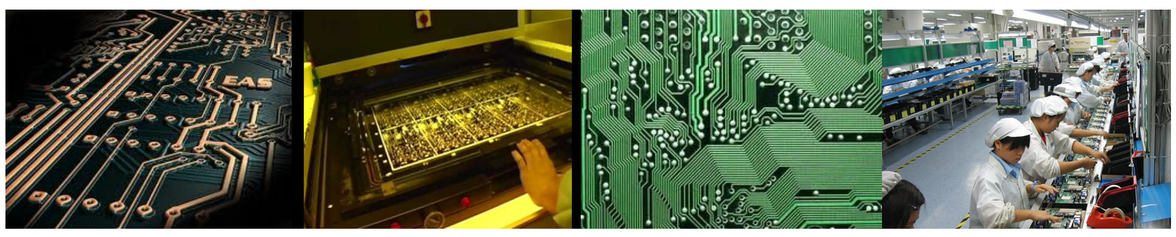
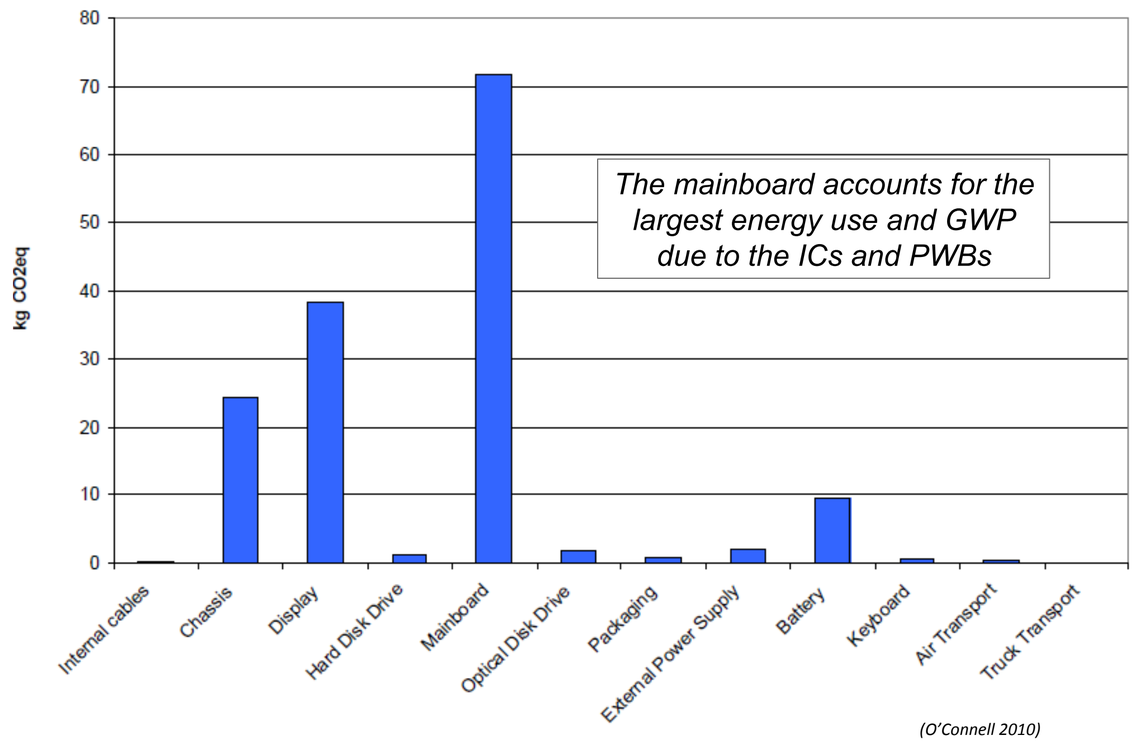
Introduction

- Electronics manufacturers are concerned with the financial, social, and environmental impacts of their products
- Metrics need to be defined in order to measure the environmental impacts within a company as well as the industry
- This work focuses on the environmental impacts over the life cycle of printed wiring boards (PWBs) using a cradle to grave approach



GWP Impact of Laptop Components

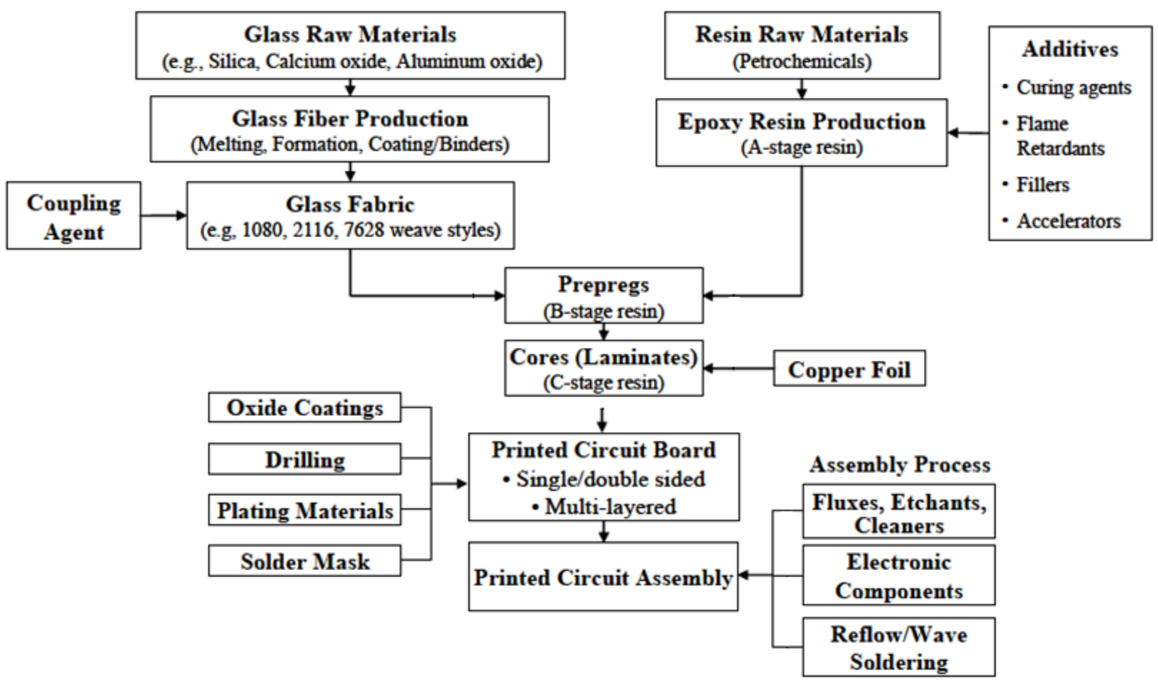


(O'Connell 2010)

Objectives

- Perform a hotspot analysis based on life cycle assessment (LCA) methodology in order to quantify the most energy and water intensive life cycle stages of PWBs
- Define metrics for PWBs to address the major points of impact within the life cycle including energy use, water use, and global warming potential (GWP)
- Identify potential areas for environmental improvements across the life cycle of PWBs

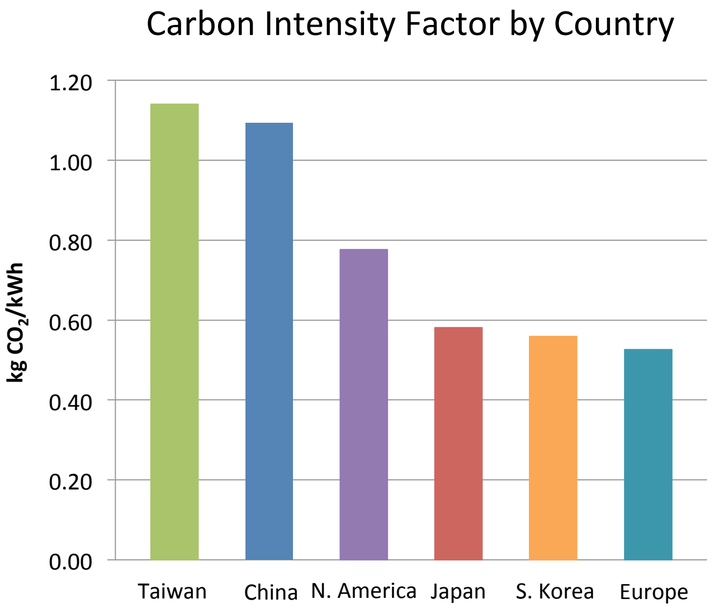
PWB Fabrication Process

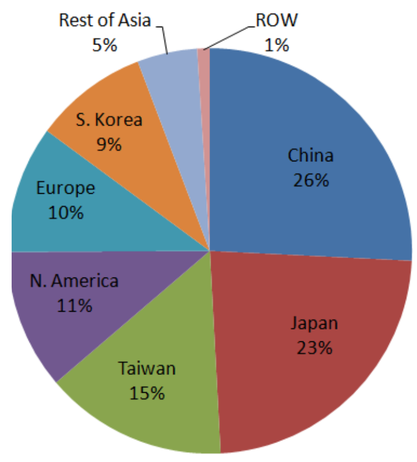


Resource Use During PWB Manufacturing

- Based on available LCA data, the largest sources of energy use, water use, and GWP during the life cycle of PWBs occur during the manufacturing stage
- Main consumers of energy during manufacturing
  - Lamination
  - Heating baths
- Main consumers of water during manufacturing
  - Multiple rinse stages
  - Plating baths

Energy Mix at PWB Manufacturing Facilities





Global PWB Production by Country

2009: $44.4 billion in sales

Custer Consulting - Henderson Ventures

Conclusions

- Energy and water consumption associated with PWB manufacturing is the largest contributor to GWP over its entire life cycle

Suggested PWB Manufacturing Metrics

Primary Energy Use	$\frac{MJ}{\frac{cm^2}{layer}}$
Electricity Use	$\frac{kWh}{\frac{cm^2}{layer}}$
Water Use	$\frac{liters}{\frac{cm^2}{layer}}$
Global Warming Potential (GWP)	$\frac{kgCO_2eq.}{\frac{cm^2}{layer}}$

Future Work

- More work needs to be done to assess other impacts over the life cycle of PWBs such as ecotoxicity, human toxicity, and additional social impacts
- Investigate alternative material choices, such as bio-based materials for PWB design in order to reduce environmental impact and potential toxicity
- Quantifying environmental impacts at end of life (EOL) will allow for more informed EOL design considerations for recycling, re-use, and refurbishment of PWBs

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