LIFE CYCLE ASSESSMENT AT HP

SCALING LCA IN THE IT INDUSTRY

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Hewlett-Packard Company
September 23, 2010
AGENDA

1. Introduction

2. LCA in HP today
   1. Marketing
   2. Design for Environment

3. A path forward
   1. Labeling discussion
   2. Recommendations
HEWLETT-PACKARD TODAY

– FY09 net revenue $114B
  • HP Enterprise Business (services, software, storage and servers) ~ $54B
  • Personal Systems Group (computers, handheld devices) ~ $35B
  • Imaging and Printing Group (hardware and supplies) ~ $24B
Orders of magnitude.

Printer use phase emissions include lifecycle emissions embedded in paper. (EUP Lot 4, base case V1)
LCA IN INDUSTRY
Identifying improvement levers

LCA is a tool to identify levers for continuous environmental improvement.

- **Marketing**
  - Inform customer decisions

- **Labeling**
  - DfE for products & services
  - Inform design decisions & encourage innovation

- **Mfg. & Operations management**
  - Supply Chain management

*What I’ll talk about today*
KEY MESSAGE

Scaling LCA in the electronics sector requires collaboration

– If we want to make big improvements, we need to **scale** LCA

– In order to **scale** LCA, we need to work together to increase our-
  • Wisdom to know when to use LCA (and when to use something else)
  • Ability to use LCA effectively and transparently

– **This requires a collaborative effort between OEM’s, Academia, LCA Consultants, GO’s, and NGO’s**
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MARKETING & LCA

- What
  - ISO 14040/44 “Comparative Assertion” LCA

- Why
  - Credibly show a potential customer the benefit of choosing one product or service over another

- How
  - Hire external LCA analysts, industry experts
  - Peer reviewed to be in keeping with ISO 140-
  - Regionally appropriate

- Improvement lever: Customer choice
MARKETING & LCA
Example: HP Inkjet Photo Minilab vs. Silver Halide Minilab
– Printing of 4x6 Photos

On an HP Minilab ML1000D Minilab...

...and a comparable silver halide printer from a major manufacturer
MARKETING & LCA

– Benefits:
  • Gained new insights and identified new improvement opportunities
  • LCA and ISO 14040/44 method gives critical structure for substantiating complicated marketing claims

– Barriers to scaling this approach:
  • Expensive & slow
  • Difficult to get data from vendors
  • Conflict between dynamic real-world and static results
    – Marketing doesn’t want the numbers to change
  • Hard to communicate the results
  • Methodology & data not transparent enough
SCALING LCA: CHALLENGES AT HP

• Largest IT supply chain
• Daily shipments:
  • Over 1 million print cartridges
  • 40,000 printers
  • 145,000 PC systems
  • 7,500 servers
• Supply chain depth: 6-7 tiers
• Over 10,000 active SKUs, with high refresh rate
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HP PRODUCT STEWARDSHIP LIFE CYCLE APPROACH

- Environmental requirements integrated in product specification
  - Category “green teams”
- GSE specification
- Supplier verification
- HP supplier auditing

- Regulatory data capture and reporting

- End of life programs globally available
- Recycling vendor policy and auditing
- Global Citizenship Report data validation & reporting

- Tracking & assessment
- Position and influencing strategies

- Chemicals
- Energy
- Materials
- Packaging
- End of Life
HOW LCA CAN FIT INTO DESIGN FOR ENVIRONMENT

DfE Roadmap

Product requirements (prescriptive)

Product goals ("measured")

Design

Modeling and analysis using defined calculators

LCA "measures"

Screening LCAs

White Papers

Answer questions

LCA informs

Calculators
What's the carbon footprint of paper? Studies available today vary widely.

**Office Paper CO2 by Phase**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Production</th>
<th>Landfill</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTF virgin</td>
<td>1.7</td>
<td>0.9</td>
<td>1.2</td>
</tr>
<tr>
<td>EI integrated virgin</td>
<td>0.9</td>
<td>-0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>EI non-integrated virgin</td>
<td>1.5</td>
<td>-0.3</td>
<td>1.2</td>
</tr>
</tbody>
</table>

**PTF**: The Paper Task Force 1995, 2002

**EI**: Ecoinvent- integrated and non-integrated mill virgin paper; 100 year time horizon, using the IPCC 2007 method. It is assumed that the PTF figure is also for a 100 year timeframe.
DfE & LCA- ANSWERING QUESTIONS

– Actual “grass roots” questions:
  • What is the environmentally optimum packaging cushions for a printer (container shipped) and a laptop (air shipped)...EPS, recycled EPS, or molded pulp?
  • What is the environmentally optimum material for a reusable shipping bag...RPET, PLA, HDPE, or PP?

– More questions than people to answer
  • Working with grad student class projects
DfE & LCA- CALCULATORS
Environmental Metrics Pilot Program in Imaging & Printing Group

- **Goal:** *Provide product teams with an 80/20 business decision support tool* that allows them to understand the environmental aspects of their design decisions
  - Starting with carbon footprint

- Scope determined by materiality as per EuP Lot 4 Study
  - Included (cradle to gate): hardware, cartridges, paper, use-phase electricity
  - Not included at this time: ink, toner, logistics, packaging

- Process LCA approach
  - Secondary data, primarily from the ecoinvent database
HP IPG’S ENVIRONMENTAL METRICS PROGRAM

- Enter in material & mass data for:
  - Printer
  - Cartridges
  - Any other consumables

- Enter in system parameters:
  - Page volume
  - Lifetime
  - Power consumption
  - Cartridge yields
  - Duplex
HARDWARE CARBON FOOTPRINT BY MATERIAL:
Today and ideas for the tomorrow of consumer inkjet all-in-ones

![Graph showing carbon footprint by material and strategies for reduction.]

- **Doubled (to 74%) recycled content**
- **Require suppliers to purchase 20% renewable energy**

<table>
<thead>
<tr>
<th>Material</th>
<th>Cradle to gate CO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals</td>
<td></td>
</tr>
<tr>
<td>Plastics</td>
<td></td>
</tr>
<tr>
<td>Wire Cables</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td></td>
</tr>
<tr>
<td>Rubber, Logic</td>
<td></td>
</tr>
<tr>
<td>Cork, Power Supply Cables</td>
<td></td>
</tr>
<tr>
<td>Misc Materials</td>
<td></td>
</tr>
<tr>
<td>LCDs</td>
<td></td>
</tr>
</tbody>
</table>

- Current model
- Hypothetical model
HARDWARE CARBON FOOTPRINT BY SUBSYSTEM:
Today and ideas for the tomorrow of consumer inkjet all-in-ones

Image: 1 side of an A/A4 size page
SUPPLIER MANUFACTURING LOCATIONS
Product materials, components, and services

- Americas – 20%
- Europe & Middle East – 5%
- Asia Pacific & Japan – 75%

[Map showing distribution of manufacturing locations]
ASSUMPTIONS

- What % of users turn off their printers for nights and weekends versus let them stay in sleep mode?

![Bar chart showing annual KWh for CM1312nfi and P1102 printers. The CM1312nfi is significantly higher than the P1102 in both 'Sleep' and 'Off' modes.]
DfE & LCA

– Benefits:
  • LCA well suited for informing DfE: identifies tradeoffs, good starting point, common language
  • LCA provides benchmarks needed for continuous improvement and to inspire innovation

– Barriers to scaling this approach:
  • When is it worth the overhead of an LCA calculator versus just telling a designer “what to do”?
  • Some LCA impacts (global warming potential, energy demand) appear to be well developed, others (human toxicity) not as well. Which areas do we cover the areas with other methods?
  • For the impacts that are well developed, what is a meaningful difference for a high volume approach?
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LABELING & LCA

Electronic Product Environmental Assessment Tool (EPEAT)

– EPEAT is an environmental procurement tool to assess the environmental impact of commercial electronic products*
– 23 required criteria and 28 optional criteria in 8 categories:

1. Reduction or Elimination of Environmentally Sensitive Materials
2. Materials Selection
3. Design for End of Life
4. Product Longevity/Life Cycle Extension
5. Energy Conservation
6. End of Life Management
7. Corporate Performance
8. Packaging

* Desktop computers, Notebooks and Video Display Units (Monitors)
LABELING & LCA
HP Product LCA and Carbon Footprint Activity Timeline

Key:
Purple = Type 1 eco-label
Green = PCF label
Red = Data, methodology & tool
Blue = PCF standard

Dashed-line box indicates uncertainty

2010
Japan – PCF label
Carbon Trust

2011
Taiwan – PCF label
Korea – PCF label

2012
Thailand – PCF label

2013
China – PCF label
EO #13514

20xx

EPEAT 1680.1
(computers)

French ADEME/Loi Grenelle 1 Label

EPEAT 1680.2
(printers)

ULe Env Std for HHs

PAIA PCF Data & Tool

APPEAR LCA Data & Tool

Earthster - LCA Tool

TSC SMRS - data

PAS 2050

EPEAT's EcoSense?

TSC Index for Walmart, Best Buy Labels

EPEAT for servers, handhelds?

WRI – GHG Reporting Protocol

ISO 14067

EPEAT's EcoSense?

EPEAT for servers, handhelds?

TSC SMRS - data
LABELING & LCA
PROPOSAL FOR TRANSPARENTLY INTEGRATING LCA INTO LABELING

Goal #1
Develop sector specific methods, tools & data; guidance on how to use

Goal #2
Use method to develop PCRs that fit appropriate standards

Goal #3
Labels employ LCA standards & PCRs according to guidance

Result: Consistency. Different labels pointing to the same underlying LCA standards & methods
DRIVING PCF

HP is using a collaborative approach to create a credible, industry-wide methodology.

International standards
GHG Protocol, PAS 2050, ISO 14040

Other organizations
NGOs & GOs, customers, competitors, suppliers

Research
iNEMI, TSC, universities

Product carbon footprint process
Assessment rules, methodology, calculator

External reporting
Customers, labels, regulations

Harmonization
Labels, regulations, standards
CREATING AN ACCURATE PCF

Arriving at an accurate, reliable product carbon footprint for complex computing products is a challenge.

- Thousands of components
- Multiple suppliers
- Variability of data
- Components are constantly improved
- Many suppliers don’t measure emissions
- Data is often generic, outdated or inaccurate
DOES PCF LABELING MAKE SENSE?

- “ISO 14024 Type I labels should be retained as lead labels”
  - All relevant environmental and health aspects should be included

- “A static PCF stand-alone label providing a total CO2 footprint on products does not make sense and is not very relevant for consumer decision making.”
  - Source: “Requirements on Consumer Information about Product Carbon Footprint”, commissioned by ANEC, written by Oko-Institut e.V. (February 2010)

- HP: PCF disclosure to business, government customers make sense; for consumers, PCF should be a part of a broader label
SETTING THE INDUSTRY STANDARD

HP is collaborating to develop a universal product carbon footprint methodology for IT.

- Transparent
- Objective
- Based on scientific methods
- Certified to international standards
- Credible and relevant to customers
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SMART SCALING TACTICS

– Divide up the model in an effective yet efficient way
– Identify & fill gaps in data
– Define common assumptions
– Identify uncertainty and a roadmap for reducing it
– Determine what should LCA be used to measure (global warming potential, energy demand), and what should it inform on (e.g. human toxicity)
– When you want to scale something, start small & build off success
– Collaborate when there are common interests
SOLUTIONS TO SCALING

example 1

Laptop PAIA Overview and Update

Research collaboration:

MIT, CMU, ASU, TSC, UCB
Carbon Trust, ENERGY STAR
Dell, HP, Intel, Lenovo, AMD
SOLUTIONS TO SCALING

example 1

What is the result?

Numbers are examples only, not actual result

<table>
<thead>
<tr>
<th>Species</th>
<th>LCD algorithm</th>
<th>HDD algorithm</th>
<th>Battery algorithm</th>
<th>PWB algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input:</td>
<td>Laptop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardware Characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15&quot; Screen</td>
<td>200 GB Hard drive</td>
<td>9 Cell Battery</td>
<td>6 Layer PWB</td>
<td></td>
</tr>
</tbody>
</table>

Activity | Amount  | Activity | Amount  |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>20 g</td>
<td>Anhydrite, in ground</td>
<td>0.1 kg</td>
</tr>
<tr>
<td>Electricity</td>
<td>140 kWh</td>
<td>Carbon dioxide, in air</td>
<td>1.2 kg</td>
</tr>
<tr>
<td>Lithography</td>
<td>0.5 g</td>
<td>Oil crude, in ground</td>
<td>3.6 g</td>
</tr>
<tr>
<td>Injection molding</td>
<td>40 g</td>
<td>Transformation, to industrial area</td>
<td>40 km²</td>
</tr>
<tr>
<td>Transport</td>
<td>4 tkm</td>
<td>Zinc, in ground</td>
<td>0.2 kg</td>
</tr>
</tbody>
</table>

Result

PCF = 140 kg CO₂
SOLUTIONS TO SCALING

Example 2

The answer = APPEAR Electronics
From Electronic Component LCA to Equipment LCA

APPEAR = Advanced Platform for Product Environmental Assessment and Reporting

An initiative of the Electronics sector
with support of PE INTERNATIONAL and Five Winds International

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A PATH FORWARD
SCALING INDUSTRIAL LCA

“Today”
- Unsure of what LCA can/can’t differentiate
- Single, “hand-made” studies
- Generic data
- Proprietary

“Tomorrow”
- Understand what LCA can/can’t differentiate
- Volume process
- Real-time data
- Open source
- Accepted methods & standards
- Well-developed IT infrastructure

Design for Environment
Supply chain differentiation?
Disclosure
KEY MESSAGE

Scaling LCA in the electronics sector requires collaboration

- If we want to make big improvements, we need to **scale** LCA

- In order to **scale** LCA, we need to work together to increase our-
  - Wisdom to know when to use LCA (and when to use something else)
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- *This requires a collaborative effort between OEM’s, Academia, LCA Consultants, GO’s, and NGO’s*
Q&A