PRODUCT DISCLOSURES FOR SUSTAINABLE BUILDING PROGRAMS

An Overview of Life-Cycle Analysis (LCA), Environmental Product Declarations (EPD) and Health Product Declarations (HPD)

R. Duncan
Construction materials market is changing rapidly

....driven by architects, specifiers and building owners through sustainable building design programs
WHO IS DRIVING THE CHANGE?

- Green building publications (media) and organizations (NGOs)
- Large, influential architect-engineer (A-E) firms
- Sustainability consultants, programs and databases

- Athena
- GaBi
- NREL – US LCI
- NIST - BEES
- ...
Product disclosure requirement has or will be added in every major sustainable building standard or building code.

- **LEED v4**: Three-tier material disclosure credits
- **ASHRAE 189.1**: Proposed Addendum AW includes disclosure requirements
- **IgCC**: Several disclosure requirements will be proposed during 2015 code hearings
TYPES OF ENVIRONMENTAL DISCLOSURES

- Life Cycle Assessment (LCA)
- Environmental Product Declaration (EPD)
- Health Product Declaration (HPD)
- Other Disclosures
  - Corporate Sustainability Report (CSR)
  - Green Labels
**LCA ‘CYCLE’**

- Life-Cycle Assessment (LCA) is a technique to assess environmental impacts associated with ALL stages of a product's life.

- SPFA’s LCA was based on Cradle to End-of-Life. Note some LCAs are Cradle to Gate.
- Most stages have negative environmental impacts, but insulation products have positive environmental impacts during use stage.
LCAs prevent a narrow outlook on environmental concerns (single-attribute evaluations) by:

- **Utilizing a recognized global methodology** that provides a transparent, holistic and balanced approach to product evaluation
- **Compiling an inventory** of all energy/material inputs and environmental releases
- **Evaluating the potential impacts** associated with all inputs and releases
- **Interpreting the results** to help customers make informed and technically sound decisions

The International Standards Organization (ISO) provides a structured process to assure fair, credible and transparent LCA results.

Four Stages of an LCA

- Goal and Scope Definition
- Inventory Analysis
- Impact Assessment
- Interpretation
- **Goals**
  - **Enterprise/Industry:** Develop environmental strategy for products and services
  - **Manufacturing:** Create and improve sustainable manufacturing processes
  - **Customers:** Use materials and processes based on LCA results and avoid single-attribute product selection. Evaluate environmental impact, and provide LCA/EPD credits for sustainable building programs.
LCA SCOPE

FUNCTIONAL UNIT
Per 2011 Insulation Product Category Rule (PCR)
Impact Per “1m² of insulation material with a thickness that gives a design thermal resistance $R_{sl} = 1 \text{ m}^2\text{K/W}$ and with a building service life of 60 years”

SYSTEM BOUNDARIES

ASSUMPTIONS AND LIMITATIONS
• Time: Raw material and process data < 5 years old
• Technology: Generic LD, MD and Roof SPF formulations
• Geography: United States
• Data: Primary data from industry/recognized sources,
• Cut-off Rules: Ignore energy, materials or emissions <1% if not environmentally relevant

ALLOCATION METHODS
Defines allocation of resource consumption and environmental impacts from joint production of materials used for other processes

ENVIRONMENTAL IMPACTS
• Global Warming Potential (GWP)
• Eutrophication Potential (EP)
• Acidification Potential (AP)
• Photochemical Ozone Creation Potential (POCP)
• Ozone Depletion Potential (ODP)
• Primary Energy Demand (PED)
PEI used GaBi, NREL, LCI databases and manufacturer/installer surveys to determine (negative) environmental impacts per functional unit based on three generic formulations.

SSC used energy modeling software on typical residential envelope and typical commercial roof in three climate zones to determine (positive) environmental impacts from energy savings per functional unit.
In November 2012, SPFA combined the environmental impact results of the PEI and SSC reports into a single report showing the net impact from cradle to end-of-life.

SPFA concurrently published a 4-page technical summary for this combined report.

The SPFA combined report and technical summary documents are available from the SPFA website at www.sprayfoam.org
SPFA’s combined report shows that the environmental impacts avoided (benefits) from energy saving during the Use Phase overwhelm the embodied environmental impacts from other phases.

**LCA INTERPRETATION**

<table>
<thead>
<tr>
<th>Application</th>
<th>SPF Type</th>
<th>Ratio &amp; Payback</th>
<th>Houston</th>
<th>Richmond</th>
<th>Minneapolis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Energy</td>
<td>GHG</td>
<td>other [1]</td>
</tr>
<tr>
<td>Residential Insulation</td>
<td>Open-Cell SPF</td>
<td>Avoided/Embodied</td>
<td>64</td>
<td>92</td>
<td>35 - 134</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Payback (Yr)</td>
<td>0.9</td>
<td>0.7</td>
<td>0.4 - 1.7</td>
</tr>
<tr>
<td></td>
<td>Closed-Cell SPF</td>
<td>Avoided/Embodied</td>
<td>32</td>
<td>7.6</td>
<td>19 - 64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Payback (Yr)</td>
<td>1.9</td>
<td>7.9</td>
<td>0.9 - 3.2</td>
</tr>
<tr>
<td>Commercial Roofing</td>
<td>Roofing SPF R4 --&gt; R20</td>
<td>Avoided/Embodied</td>
<td>55</td>
<td>15</td>
<td>29 - 106</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Payback (Yr)</td>
<td>1.1</td>
<td>4</td>
<td>0.6 - 2.0</td>
</tr>
<tr>
<td></td>
<td>Roofing SPF R12 --&gt; R20</td>
<td>Avoided/Embodied</td>
<td>30</td>
<td>8.2</td>
<td>16 - 57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Payback (Yr)</td>
<td>2</td>
<td>7.3</td>
<td>1.1 - 3.8</td>
</tr>
</tbody>
</table>

[1] Other impact Categories include Acidification, Eutrophication, Ozone Depletion and Smog Creation
SPFA’s combined report shows that the environmental impacts avoided (benefits) from energy saving during the Use Phase overwhelm the embodied environmental impacts from other phases.

**Primary Energy**

47 to 73 ocSPF  
93 to 144 ccSPF  

Using this many energy units to insulate a home with SPF (MJ)...

... saves this many energy units (MJ) over a 60 year service life

- 14,000 Minneapolis
- 6,900 Richmond
- 3,000 Houston

Primary Energy investment is recovered in less than one year for ocSPF and less than two years for ccSPF

Before comparison of environmental impacts, check:
- Functional Unit
- Data Quality
- Geographic Region
- Study Boundary
- Peer-Reviewed Process

Based upon SPFA’s ISO-compliant Life Cycle Assessment study.
SPFA’s combined report shows that the environmental impacts avoided (benefits) from energy saving during the Use Phase overwhelm the embodied environmental impacts from other phases.

**Greenhouse Gases (GHGs)**

- 2 to 4 ocSPF
- 27 to 42 ccSPF

Releasing this many units of GHG to insulate a home with SPF (1,000 kg of CO₂ eq.)...

GHG releases are recovered in less than nine months for ocSPF and less than eight years for ccSPF

.... avoids these GHG emissions from energy savings over a 60 year service life

Based upon SPFA’s ISO-compliant Life Cycle Assessment study
**ENVIRONMENTAL PRODUCT DECLARATION (EPD)**

Discloses common environmental impacts...

<table>
<thead>
<tr>
<th>Global Warming</th>
<th>Smog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone Depletion</td>
<td>Energy Use</td>
</tr>
<tr>
<td>Acidification</td>
<td>Water Use</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>Solid Waste</td>
</tr>
</tbody>
</table>

...using established equivalent metrics...

<table>
<thead>
<tr>
<th>kg CO₂</th>
<th>kg O₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>kg CFC-11</td>
<td>kJ</td>
</tr>
<tr>
<td>moles H⁺</td>
<td>kg H₂O</td>
</tr>
<tr>
<td>kg N</td>
<td>kg</td>
</tr>
</tbody>
</table>

...applied to a functional unit for the product or material

<table>
<thead>
<tr>
<th>ft², ft³, lb., R=1 / bd. ft.</th>
<th>etc.</th>
</tr>
</thead>
</table>
An Environmental Product Declaration (EPD), is an extension of an LCA developed to provide specific and comparable environmental information in a common format.

The common format comes from a set of rules, known as Product Category Rules (PCR).

- PCRs are developed per the ISO 14025 standard.
- PCRs are developed using consensus process by trade associations and other organizations.
  - A PCR for U.S. building insulation was jointly developed by several trade associations in 2011 (NAIMA, PIMA, XPSA, CIMA, RIMA, and SPFA) based on a European insulation PCR.
  - The program operator for the U.S. Insulation PCR is UL Environments.
A properly-developed EPD follows an ISO process to deliver:

- **Scientific** approach over the entire product life cycle
- **Quantitative** measure of key environmental impacts

**EPD PROCESS**

- Product Inputs
  - energy
  - water
  - materials

Life Cycle Assessment (LCA)
per ISO Standards 14040 and 14044

Environmental Product Declaration (EPD)

Product Category Rules (PCR)
per ISO Standard 14025
An EPD follows a specific format developed by the program manager.
EPD APPLICATIONS

- **For Manufacturers**
  - Consider joint development of generic EPDs for key industry product segments
  - Use the EPD format to tell the entire story for your product
  - Get the information to the data integrators – and make sure they are using the best information available

- **For Designers and Builders**
  - Recognize that EPDs are still in the early stages of development and their data is difficult to use and compare
  - Encourage suppliers to develop EPDs and support improvement of impact databases
SPFA published an EPD for SPF in December 2013
- Available from UL Environment website (program operator)
- Covers three generic SPF formulations: LD, MD and Roofing
- Separate Transparency Briefs for each formulation

Meets the industry/generic Type III EPD requirements for sustainable building programs and codes like LEED, ASHRAE 189.1 and IgCC.
Under LEED v4, the SPFA EPD meets the industry generic Type III requirement. So ANY SPF product used will automatically earn ½ point.

To earn a full 1 point, SPF suppliers need to develop a LCA/EPD for specific products, which should be relatively easy using the template provided by the SPFA work.
EPD LIMITATIONS

- **Expensive.** An ISO-compliant EPD requires an ISO-compliant LCA. Collecting, processing and reviewing this data can cost over $100k per product.

- **Complex.**
  - Data is difficult to understand and use, except by scientists and engineers.
  - Difficult for most to include into whole building design.
  - Practitioners may obtain different impact results due to limited underlying data.

- **Omits Energy Efficiency.** EPDs typically consider only negative impacts from cradle to end-of-life. Fails to address energy efficiency contributions, such as those from insulation during use phase.

- **Omits Health Impacts.** → Health Product Declaration
HEALTH PRODUCT DECLARATION (HPD)

- New disclosure advocated by green building community
- Promotes reporting of health-related information (hazards) of chemicals used by building product manufacturers
- The Health Product Declaration (HPD) Open Standard V1
  - A standard disclosure format of product contents, emissions, and health information.
  - Increases transparency by referencing existing hazard lists and providing a human health context for information disclosed in an EPD
HEALTH PRODUCT DECLARATION (HPD)

Discloses known and suspected health hazards...

...using no metric or functional unit...

...from a variety of “authoritative sources”

CMR-BPT hazards...
- Carcinogenicity
- Mutagenicity
- Reproductive disruption
- Bio-accumulation
- Persistent
- Toxic (endocrine, development, etc.)

Measures and criteria to be defined:
- Risk Assessment
- Exposure Pathways
- Threshold Levels, etc.

IARC, REACH, NTP, CA Prop 65, San Antonio Statement, etc.
An HPD will follow a process resembling the following:

- Product Ingredients from LCA/EPD
- Hazard Screening Process per HPD Open Standard
- Health Product Declaration (HPD)
- Authoritative Hazard Lists (some are “Red List”)

HPD PROCESS
HPD PROCESS

- Select one of four certification options
  - Manufacturer self-certification
  - Self-certification with 3rd party testing
  - 2nd party certification (trade association, etc.)
  - 3rd party certification

- Use one of two disclosure options
  - All ingredients
  - All ingredients plus residuals

- Select one hazard criterion
  - Check all ingredients against “Priority Lists”
  - Disclose all listed hazard phrases and warnings

1May be considered confidential business information
An HPD follows a specific format developed by the HPD Open Standard.
Included in LEED v4: Credit MRc4 (Option 2)

Likely to be proposed for next version of IgCC

Under LEED v4, there is significant ongoing debate regarding which authoritative lists will be used to identify hazards by the HPD Open Standard.
HPD BENEFITS AND LIMITATIONS

BENEFITS

- Inexpensive. ... compared to LCA/EPD
- Simple. Identify the ingredients and screen them using the hazard lists

LIMITATIONS

- Based on ad-hoc open standard with little or no formal public review
- Identifies hazard without assessing risk
- Identifies “chemicals of concern” using many sources with widely different thresholds, some based on incomplete research
- Does not address chemical conversion (upstream hazards vs. end-user risk)
- New SDS standard may already provide HPD requirements
- Disclosure of Confidential Business Information
HPD APPLICATIONS

- For Manufacturers
  - Take initiative and be involved.
  - Develop a consistent, industry-wide approach to assure uniform reporting.
  - Promote risk assessment for use phase of product.

- For Designers and Builders
  - Understand the sources of the “authoritative” lists
  - Request suppliers to disclose HPDs in a transparent and responsible manner
  - Be open-minded and understand risk assessment before making product decisions
  - Consider HPD alternatives
  - Develop your own conclusions

The RFCl PTD approach
- identifies 6 reliable authoritative lists
- Requires disclosure of VOC emissions
- Relies on OSHA HCS/CA Prop 65 for risk assessment
OTHER DISCLOSURES

- Corporate Sustainability Report (CSR)
  - Prepared by a company
  - Information about economic, environmental, social and governance performance
  - Included in LEED v4: Credit MRc3 (Option 1)
    - Self-Declared: ½ pt.
    - Third-Party Certified: 1 pt.
  - Two Primary Reporting Options
    - Global Reporting Initiative (GRI)
    - ISO 26000

- Green Product Labels
  - Disclosure of ingredients using a variety of metrics
    - Extended Producer Responsibility
    - Recycled Content
    - Bio-Based Content
    - Material Reuse
    - FSC-Certified Wood
  - Included in LEED v4: Credit MRc3 (Option 2)
    - Complex Point Formula
SUMMARY

- **Product Transparency**
  - Clear identification of ingredients
  - Better understanding of product impact on health and environment
  - Now part of sustainable building codes and standards

- **LCA-EPDs**
  - Quantified understanding of product impact on environment
  - Somewhat costly to produce
  - Promotes continuous improvements for manufacturing and product selection
  - Avoids single-attribute criteria which can unfairly exclude products

- **HPDs**
  - Simple to develop and low cost
  - Potential to define impacts on health
  - Health impacts are somewhat subjective depending on source
  - Need to rate materials based on risk, not hazard