Global drivers for LCA of resource supply & use

MINERAL RESOURCES IN LCIA: MAPPING THE PATH FORWARD, OCTOBER 14, 2015

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Overview

- What is LCIA? Why do we need it?
- Current status globally
- Current drivers
- Needs of decision-makers
- LCIA and the Area of Protection Concept
- Conclusions

Life Cycle Assessment – ISO 14040 series

Life Cycle Inventory (LCI)

Life Cycle Impact Assessment (LCIA)

What is LCIA?

- The part of LCA that helps us understand the overall potential impact of the product or function
- Potential impact from each inventory emission or input is modeled using a characterization model to try to understand overall impact to the environment of the functional unit
- Uses substance specific characterization factors to express potential impact in terms of the common unit of the indicator, e.g. Global warming equivalents (CO2 equivalent) defined in “Global Warming Potential (GWP)”
- Uncertainty is inherent, but typically stated or modeled in some way, e.g. GWP20, 100 & 500 models

ISO 14044: 2006 LCIA Requirements

"4.4.2.2.3 In addition to the requirements in 4.4.2.2.1, the following recommendations apply to the selection of impact categories, category indicators and characterization models:

the impact categories, category indicators and characterization models should be ***internationally accepted,*** i.e. based on an international agreement or approved by a competent international body;

the impact categories should represent the aggregated impacts of inputs and outputs of the product system on the category endpoint(s) through the category indicators;

value-choices and assumptions made during the selection of impact categories, category indicators and characterization models should be minimized;

the impact categories, category indicators and characterization models should avoid double counting unless required by the goal and scope definition, for example when the study includes both human health and carcinogenicity;

the ***characterization model for each category indicator should be scientifically and technically valid, and based upon a distinct identifiable environmental mechanism and reproducible empirical observation;***

the ***extent to which the characterization model and the characterization factors are scientifically and technically valid should be identified;***

the category indicators should be ***environmentally relevant***."

Current State of LCIA

Globally, the most commonly utilized and agreed upon categories are:

- Global Warming Potential,
- Ozone Depletion Potential,
- Photochemical Oxidant Creation Potential,
- Acidification Potential, and,
- Eutrophication Potential

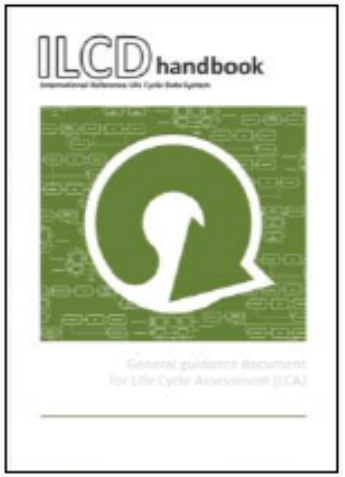
This is due to the availability of models that have one or more of the following:

- international acceptance via global agreements (such as the IPCC, Montreal Protocol, etc.),
- clarity of the impact area,
- robust regional models, and
- depth of research to date.

Current State of LCIA

- Impact categories that have the greatest variability/uncertainty and – in some cases - least agreement include:
  - Resource Depletion
  - Human Toxicity
  - EcoToxicity
  - Land Use
  - Social impacts
- These categories require some accounting for space, time, uptake, etc. - complexities that LCA is not particularly suited to
- As a result – there are many different opinions on methods and models

Current Status: ILCD



- International Reference Life Cycle Data System (ILCD)
- Funded by the European Commission
- Developed by broad group of experts and stakeholders in LCA
- Seen as global reference guide for LCA practitioners
- 2010 report - improvement needs greatest for Human Toxicity, EcoToxicity, Land Use and Resource Depletion
- *"…some impact categories are still not well defined….particularly the case for resource depletion categories, where the analysis was hampered by an insufficient understanding of the Area of Protection "Resources" and hence….what was really the issue to address by the characterization modeling of resource use."*
  - *Hauschild, M. et. al, International Journal of Life Cycle Assessment (2013) 18:683-697*

Current Drivers for Resource Assessment in LCIA

- **Desire to 'have an answer'**
- **PEF EU**
- Companies wanting integrated assessment tool – 'one tool'
- Initiatives for substitution
- **Building & Construction/Codes & Standards – LEED 4.0, IgCC**
- Consumer Awareness
- Architects
- Product Sales & Marketing – seeking differentiation
- Procurement initiatives – supply chain scrutiny
- Climate Change

Key Drivers: EU PEF

- European Union – Product Environmental Footprint Method: “a Life Cycle Assessment (LCA) based method to calculate the environmental performance of a product. It was developed by the European Commission's Joint Research Centre based on existing, extensively tested and used methods.”
- Pilot Phase
  - Multi-year project to test footprint method, including 14 impact categories, using various products for which Product Category Rules are being established
  - Sheet metal included as a pilot
  - http://ec.europa.eu/environment/eussd/smgp/product_footprint.htm

Key Drivers: EU PEF Sheet Metal Pilot

- Using ADP with Reserve Base in the denominator
- Ongoing discussions on appropriateness of the method
- Pilots showing the confusion the method presents
- Point is to make decision-making clearer for the consumer – the opposite is happening
- Still no agreement on a method

Key Drivers: USGBC LEED 4.0

- The USGBC has over 13,000 member organizations globally
- LEED is the most widely used green building rating system globally.
- More than 72,500 LEED building projects located in over 150 countries and territories.
- Project expectations in four countries in 2015:
  - Brazil - 83 percent of firms planning new green commercial projects
  - Singapore - 69 percent of firms planning green renovation projects
  - United Arab Emirates - 73 percent of firms planning green institutional projects
  - United Kingdom - 65 percent of firms planning green renovation projects

Source: http://www.usgbc.org/articles/green-building-facts

Key Drivers: USGBC LEED 4.0

Top 10 Countries Registered & Certified (*as of February 2015*):

- Canada
- ***China***
- ***India***
- ***Brazil***
- Republic of Korea
- Germany
- Taiwan
- United Arab Emirates
- Turkey
- Sweden

Source: http://www.usgbc.org/articles/green-building-facts

Key Drivers: USGBC LEED 4.0

OPTION 1. Environmental Product Declaration (EPD) (1 Point)

Use at least 20 different permanently installed products sourced from at least five different manufacturers that meet one of the disclosure criteria below. (Criteria not shown here – pertain to the type of EPD)

Option 2: Multi-Attribute Optimization

Rewards projects that use at least 50 percent (by cost) of permanently installed products from manufacturers participating in an extended producer responsibility program, or adhering to another USGBC-approved program that will verify reductions in at least three of the following:

Global warming potential

Depletion of stratospheric ozone

Acidification of land and water resources

Eutrophication

Formation of tropospheric ozone

Depletion of non-renewable energy resources

How did we get so lost?

"…some impact categories are still not well defined….particularly the case for resource depletion categories, where the analysis was hampered by an insufficient understanding of the Area of Protection "Resources" and hence….what was really the issue to address by the characterization modeling of resource use."

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The Area of Protection Concept

Method	Intended Area of Protection	Actual Area of Protection	Data Used
ADP (Guinee and Heijungs 1995)	Depletion of Non-renewable resources	Long term depletion of (Primary) Abiotic Resources	Average Crustal Concentration Volume of the Continental Crust Production
ADP (Van Oers et al. 2002) Alternatives 1 & 2	Depletion of non-renewable resources	Medium-term availability of resources	Mineral resources Mineral reserves
EDIP (Hauschild and Wenzel 1998)	Depletion of non-renewable resources	Short-term availability of resources per person	Mineral reserves
Exergy (Finnveden & Ostlund 1997, Dewulf et al. 2007)	Environmental & socio-economic efficiency of resource use	"Natural" stocks and flows of exergy	Exergy co-efficients
IMPACT 2002 (Jolliet et al 2003) & EI99 (Goedkoop and Spriensma 2001)	Depletion of non-renewable resources	Medium-term availability of resources in current fleet of mines	Processed ore-grades
ReCiPe (Goedkoop et al 2009)	Damage to resource availability - "additional net present costs that society has to pay as a result of an extraction"	Medium-term availability of resources in current fleet of mines	Processed ore-grades and fuel prices
AADP (Schneider et al. 2011)	Depletion of non-renewable resources	Medium-term availability of resources	Mineral resources Anthropogenic stocks
AADP (Schneider et al. 2015)	Depletion of non-renewable resources	Medium-long term availability of resources	Ultimately extractable reserve estimations Anthropogenic stocks

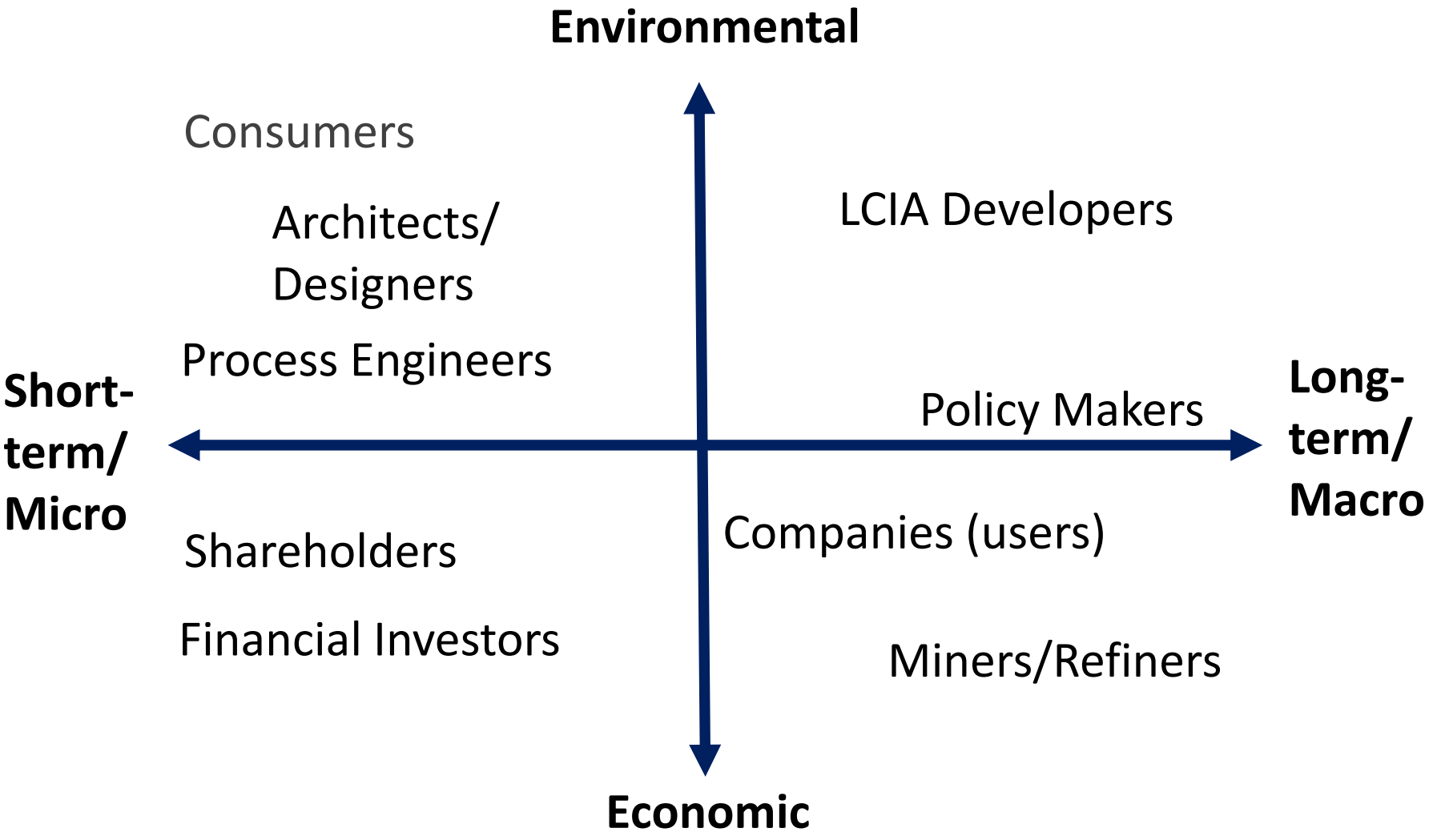
Meaningful LCIA requires an unambiguous AoP, a valid mechanism to link the studied product system to impacts on the AoP and a representative data-set

How we got lost

For a method to be viable and relevant, it must connect the Area of Protection to the inventory through a distinct environmental mechanism

- How do reserves of any kind provide an ***environmentally*** relevant indicator?
- If the AoP is truly the natural resource in and of itself – then the only relevant denominator is crustal content
- Yet while crustal content is a stable number, to make it more relevant we try to tie it to some indication of current depletion (the extraction rate) which is done using data that indicates availability – not depletion of a natural resource
- And so we lose the connection to the environmental mechanism
- Furthermore – we do not take into account stocks and flows in the economy currently – and therefore – the "indication" of depletion is no longer valid for most metals
- And are we not more concerned about availability anyway?

Different needs, different questions



Different questions, different tools

User	Need (some measure of….)	Tool/Metric
Architect	Resource use	Recycled content, resource efficiency & sourcing
Policy maker	Resource supply	Criticality
Consumer	Resource use	Recycled content, resource efficiency
Product Designer	Resource supply	Availability
CEO	Resource supply	ESP-type supply risk
Miner/Refiner	Resource provision	Demand, Cost curves

Conclusions

LCIA is a critical part of LCA

The distinction between depletion and availability is important – but hard to understand – the boundary can be blurred easily, yet is critical to understanding what type of method and parameters are suited to analysis

Resources have been a challenge to fit well into LCA due to its environmental focus, born by the AoP concept

Needs of decision-makers are different and truly demand a need to expand analysis beyond the traditional confines of LCA – integrating different resource assessment tools based on need