ecoinvent 3 in openLCA

Ecoinvent 3 from the point of view of a software provider

Andreas Ciroth, Michael Srocka
GreenDelta Berlin

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ecoinvent 3 in openLCA

1 Introduction
   a) ecoinvent 3
   b) openLCA

2 Implementation tasks for openLCA, due to ecoinvent

3 ecoinvent 3 in openLCA: status at present

4 Discussion
1 Introduction, ecoinvent 3

(just some points)
1 Introduction, ecoinvent 3

Ecoinvent 3 brings

- A new, feature-rich data format, EcoSpold02
  - According to a final format specification
  - Formulas, parameters, multiple languages, own intelligence, child-parent relationships in LCA datasets,
  - New reference lists for flows, asf., now with UUIDs
  - …

- An interpretation of the data format EcoSpold02 data format for ecoinvent 3 data sets
  - Usually of course following the specification but some modifications and additions
  - Important for the implementation
1 Introduction, ecoinvent 3

Ecoinvent 3 brings

- New types of process data sets, for markets, that typically link one process with another

→ a drastically increased number of data sets in one typical product system (with the same number of LCA process data sets).
openLCA

- Professional open source LCA software, free
- Developed by GreenDelta since 2006
- So far we are the only developer but currently several projects started, e.g. by US EPA, to develop additional content
- Quite popular, worldwide, with 300 downloads / week
- Users: many universities, consultants, US EPA and other research institutes, first companies
- Last release: version 1.3.1, 28 Sept 13
- www.openlca.org
openLCA – graphical modeling
openLCA – graphical modeling

- And also automatic completion of product systems for a calculation, similar to e.g. SimaPro
openLCA – analysis features
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openLCA

- Broad import and export features:
openLCA

- Many databases supported, including:
  - Ecoinvent
  - Other databases in EcoSpold 1 format, as NREL
  - All GaBi databases
  - Social Hot Spots Database (SHDB)
  - Ökobaudat
  - …

**Database provider**

- GaBi 6544
- Social Hotspots 6356
- ecoinvent 4087
- Ökobaudat 972
- ELCD 272
- NEEDS 187
- bioenergiedat 178
2 Implementation tasks for openLCA suggested by ecoinvent 3
3 Implementation tasks for openLCA, due to ecoinvent

(first task: *Understand* the EcoSpold02 format and its interpretation in the ecoinvent 3 database:

- not all features are used in ecoinvent
- some features address issues that can be solved rather internally in a software than in an data exchange format (parent child datasets)
- The ecoinvent database uses additional tricks that need to be addressed
- (revisions on the ecoinvent side – a bit of a moving target)
3 Implementation tasks for openLCA, due to ecoinvent

- Implementation of an EcoSpold 02 interface (for import and export)
- Reduction of memory space requirements
- Faster loading of product systems
- Faster calculation
- (improved treatment of parameters)
EcoSpold 02 interface

- Format specification as available in our github repository: https://github.com/GreenDelta/olca-modules/blob/master/olca-ecospold-2/schemas/EcoSpold02Activity.xsd
EcoSpold 02 interface

- API created to import and export EcoSpold02
EcoSpold 02 interface

- `olca-io` created to map the format to the database
EcoSpold02 interface: noteworthy

• ActivityLink – Default provider structure: in openLCA since 1.2.9 → fits nicely

• Flow properties (water content etc.): in ecoinvent linked to an exchange, in openLCA and ILCD linked to a flow →

• Waste is a negatic amount in ecoinvent 3 → change input and output in openLCA → fine

• No unit groups in ecoinvent 3 → direct mapping to openLCA units → fine.

• Allokation factors of migrated ecoinvent 2 activities are flow properties, „EcoSpold01Allocation_undefined_XY“ → these cannot be used in a reasonable way any more?

• Parameters: Formulas contain often hard links to specific computer hard drives → ?

• Master data often saved also in process data sets, redundantly → risk of inconsistencies
activity id="b46483cf-6b87-4898-9f8e-004dd13c4c76“, ecoinvent 3.0.1 (just one example)
Memory space requirements

- Issue: Memory space requirements in a matrix calculation is $\sim O(n^3) \Rightarrow$ cubic increase with the number of data sets
Memory space requirements

- Issue: Memory space requirements in a matrix calculation is \( \sim O(n^3) \) \( \rightarrow \) cubic increase with the number of data sets

\( \rightarrow \) Stick to matrix calculation but make element loading and calculation more efficient
Memory space requirements, example:
Loading and analysing a product system, ei2

openLCA 1.3:
Product system open:
200 MB
Analysis peak:
450 MB
Product system & result open:
250 MB
Memory space requirements, example:
Loading and analysing a product system, ei2

openLCA 1.4:
Product system open:
25 MB
Analysis peak:
300 MB
Product system & result open:
125 MB

(identical system)
Memory space requirements, example:
Loading and analysing a product system, ei2

openLCA 1.4:
Product system open:
25 MB
Analysis peak:
300 MB -33%
Product system & result open:
125 MB -50%
(identical system)
Loading and analysing a product system, Ecoinvent 3

openLCA 1.4:
Product system open:
25 MB
Analysis peak:
1100 MB (!)
Product system & result open:
250 MB
Performance improvements

Performance improvements due to

• Improved data structures
• Improved queries (batching)
• Improved memory usage (caching)
• Improved algorithms and a faster numerical library
## Performance improvements

**Ecoinvent 2 example (same computer & product system)**

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Performance improvements

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• A first version 1.4 is available since last week, for use with ecoinvent 3
• This version openLCA 1.4 contains the EcoSpold02 interface and the performance improvements
• It is not publicly released yet
• We are looking for some external testers
• And you can of course schedule a test presentation at our booth or directly with me
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- We are looking for some external testers – if you are interested, please let us know (openlca@greendelta.com or send me a direct email, or leave a message at our booth)
3 ecoinvent 3 in openLCA: Status
4 Discussion
4 Discussion – one remark only from my side

• The ecoinvent 3 database must be really good to make the implementation effort worthwhile
• Of course performance improvements make sense also for other databases
Thank you..

Contact: Dr. Andreas Ciroth  
GreenDelta GmbH  
Müllerstrasse 135, D-13349 Berlin  
ciroth@greendelta.com  
www.greendelta.com