openLCA Advanced Training
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GreenDelta GmbH
December 4th & 5th, 2014
Berlin, Germany
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- Environmental Product Declarations
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- Feedback and closing remarks
Introducing GreenDelta
GreenDelta background

• Founded by Dr. Andreas Ciroth in 2004

• 10 employees (engineers, biologists, IT-Specialists, business administrators)

• Office in Berlin

• Business world-wide: sustainability research, life cycle assessments, databases, software for life cycle assessments and sustainability
GreenDelta, What we do

• (environmental) LCA: case studies, critical reviews, data collection, creating databases

• Social LCA: social impacts of products throughout their entire life cycle

• Life Cycle Costing: costs of products throughout their entire life cycle
GreenDelta, What we do (II)

- Software development:

  - openLCA: worldwide leading open source LCA software; the only professional software of its kind

  - openLCA Web Enterprise: web-based openLCA software, originally developed for BASF

  - E-DEA: Software for Eco-Design, connects with SimaPro

  - various LCA hubs (CAP’EM, Copper EPD Chile, ...)

GreenDelta
GreenDelta, What we do (III)

• Software and data sales:

  - SimaPro Center for Germany

  - database sales for ecoinvent, GaBi, Social Hot Spots Database, ...

  - openLCA Nexus: largest consistent collection of sustainability and LCA data worldwide
GreenDelta for openLCA

• Software expansion/adaptation

• Case studies

• Guided case studies

• Data acquisition

• Database compilation
GreenDelta for openLCA (II)

- Critical review (ISO 14040)
- LCA, LCC, SLCA
- Data management and hosting
- openCLA Training
- Service und Support
**GreenDelta Project examples**

- Laptop study: Life cycle assessment and social LCA for a notebook, carried out for Podde in 2011

- Life cycle assessment of satellite systems, carried out for the European Space Agency in 2013

- PROSUITE EU 7th FP research project 2009-2013, GreenDelta develops a sustainability assessment software based on openLCA for prospective technology assessment

- Nano3bio EU 7th FP research project, 2013-, GreenDelta’s contribution: modeling the LCA for chitosans
GreenDelta Project examples (II)

- EPD Editor: Development of a tool ("EPD Editor") for creating Environmental Product Declarations in openLCA, funded by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development, 2014, as openLCA plugin

- GreenDelta offers technical support to lecturers, tutors and students taking part in lectures on Life Cycle Assessment at Harvard University, 2014

- Guided Case Study with CCL Label Meerane GmbH: GreenDelta consultants assist and train label-producer CCL Label employees in carrying out an LCA for one of their products

- BASF BEST: Creation of a special openLCA version for BASF, 2012-2014+ (go-live October 2013)
GreenDelta Project examples (III)

• US Department of Agriculture: Development of An EcoSpold 2 import and a regionalized impact assessment approach in openLCA, with GIS integration, 2012-2014

• US EPA 2013: Implementing a non-expert user interface and report generator for openLCA

• US EPA 2014-: GreenDelta implements a refined Life Cycle Costing approach, a semantic web import export, a new OpenIO database, and a Sustainable Material Management tool in openLCA

• Fundación Chile: Support in development of a data collection plugin for openLCA, for use in a study about sustainability life cycle assessment for 12 companies in the food sector, 2014-
Corporate Customers

- BASF
- SIEMENS
- Steelcase
- Knoll
- SIG
- CCL LABEL
- Volkswagen
- CSC
- Mondi

GreenDelta
Institutional Customers

- Bundesinstitut für Bau-, Stadt- und Raumforschung
- UNEP
- Fundación Chile
- Karlsruher Institut für Technologie
- ADEME
- European Commission
- SYKE
- Finnish Environment Institute
- Umwelt Bundesamt
- United States Environmental Protection Agency
- USDA
Academic Customers

HARVARD SCHOOL OF PUBLIC HEALTH

Technical University of Denmark

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Universität für Bodenkultur Wien
University of Natural Resources and Life Sciences, Vienna

ETH Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

CHALMERS UNIVERSITY OF TECHNOLOGY
Consultants as Customers
Introducing openLCA
openLCA

- a free and (yet) professional approach to Life Cycle Assessment: powerful, feature-rich, (comparatively) easy to use, technically up-to-date
- developed by GreenDelta since 2006
- completely Open Source (Mozilla Public License)
openLCA

- native to Windows, Mac OS and Linux
- established, and growing, community of users; approx. 300 software downloads per week
- broadest selection of relevant, consistent LCI and sustainability databases available worldwide (!)
openLCA application (generic)

- Life Cycle Assessment, Life Cycle Costing, Social Life Cycle Assessment
- Carbon & Water footprint
- Product Environmental Footprint
- Environmental Product Declarations
- US Environmental Protection Agency’s Design for the Environment Label
- Integrated Product Policy
openLCA **features overview**

- All the features you expect for professional LCA modeling and analysis:
  working with and creating smaller and very large product systems, “autoconnect” (as in SimaPro) or by manual connection (as in GaBi); parameters, sensitivity analysis, scripting (Javascript, Python), system expansion and allocation, uncertainty assessment, Monte Carlo Simulation, LCIA calculation with optional normalization and optional weighting, refined result analysis features, GIS integration, “best of class” import and export interfaces, group collaboration features, …

- Fast calculation of large systems
openLCA features overview (II)

- Fast calculation of large systems: e.g. ecoinvent 3.0
openLCA **quality assurance**

- External and internal testers
- Beta versions before final release → more user input
openLCA: Why open source?

- **flexibility** and **freedom**, for both user and developer

- **security, accountability and high quality** coding style is visible to everyone; “quick and dirty” solutions cannot be hidden

- **cost benefit**, despite maintenance, configuration and support costs for developer behind the scenes

- open source nature of the software makes it very **suitable for use with sensitive data** (point brought forward by Lockheed Martin, users of openLCA)

- **No further obligations for users**, especially no obligation to share / distribute / … created LCA processes and systems
openLCA.org

- Downloads (software, LCIA methods, ...)
- Videos, manuals, case studies
- Services (service contracts, training, critical reviews, hosting & data management solutions...)
- Forum
Downloads

In this section you find the latest installation files of the openLCA framework. Also available are the format converter and other freely available software tools, with their source code. You can also download the files from sourceforge. Here you can find older versions and further information like the public bug tracker, too.

openLCA

openLCA Version 1.4 is now available! (Release date: June, 2014) We recommend you install this version. Our tests have not shown any issues but should you run into any, please let us know. Thanks in advance!

Important changes include drastically improved performance of about 400%, numerous usability improvements and many new features.

To see video tutorials on openLCA installation, click here.

Installation files

openLCA
Version 1.4
Windows 64 bit

openLCA
Version 1.4
Mac 64 bit

openLCA
Version 1.4
Linux 64 bit
Learn more

The following pages contain manuals and tutoring material and resources for openLCA and for the openLCA format converter. All material is available free of charge.

If you are interested in our instructing, consulting or software solution services, please see our services page.

If you are looking for information or would like to ask a question, you can also check the openLCA forum at www.openlca.org/forum.
Services

We and our partners provide a broad range of services in the context of openLCA:

- **Service contracts:** If you are using openLCA in a professional environment (a company, for example) a service contract may make sense. With a service contract we guarantee response times, you are informed about changes in the software in due time, we are available for answering technical support questions.

- **Training:** GreenDelta provides regular training courses for openLCA in English, German, and Spanish. We offer training for beginners and advanced users inhouse, online and in Berlin. All courses contain theoretical as well as practical content, and illustrative case studies.

- **Guided case studies:** Typically, both openLCA and Life Cycle Assessment case studies are learned best in a practical application. Therefore we offer guided case studies, especially for those new to openLCA and to Life Cycle Assessment. A guided case study will be performed mainly by you, but at important milestones, from software installation to definition of goal and scope to inventory modeling to interpretation, we provide feedback and discuss modeling decisions and conclusions and interpretation. Of course, a non-disclosure agreement makes sure that you can share also sensitive information.

- **Critical reviews:** We perform critical reviews of LCA case studies according to ISO 14040 and 14044. With openLCA you can easily share your complete LCA models with your clients, as well as within the review panel.

- **Hosted solutions:** openLCA can interact with a ILCD database that serves users as a central repository for exchanging process data sets and also complete product system models (see openLCA features for more information). We offer hosting solutions for this database, so that you do not need to care for the technical hosting requirements.

- **Adaptations and extensions:** If openLCA (or other LCA software) does not meet your...
openLCA.org/forum

View unanswered posts • View active topics

<table>
<thead>
<tr>
<th>FORUM</th>
<th>TOPICS</th>
<th>POSTS</th>
<th>LAST POST</th>
</tr>
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<td>Installation</td>
<td>25</td>
<td>103</td>
<td>by aciroth [02 Sep 2014 13:18]</td>
</tr>
<tr>
<td>Modelling</td>
<td>78</td>
<td>236</td>
<td>by aciroth [27 Aug 2014 16:30]</td>
</tr>
<tr>
<td>Data and Data Exchange</td>
<td>66</td>
<td>233</td>
<td>by aciroth [23 Aug 2014 09:17]</td>
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<tr>
<td>Developer</td>
<td>13</td>
<td>45</td>
<td>by aciroth [26 Jun 2014 17:09]</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
<td>52</td>
<td>by Martinez [11 Jun 2014 11:19]</td>
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<td>Version 1.2 test</td>
<td>6</td>
<td>17</td>
<td>by aciroth [01 Jun 2013 12:48]</td>
</tr>
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LOGIN • REGISTER

Username: Password: Login

WHO IS ONLINE

In total there are 2 users online: 0 registered, 0 hidden and 2 guests (based on users active over the past 5 minutes).
Most users ever online was 54 on 30 Jun 2013 00:22.
Registered users: No registered users.
Functions and features
Graphical modeling of product systems

Product system = Process networks

- Process networks can be created automatically and manually

- Graphical modeling based on the Eclipse Graphical Editing Framework (GEF)

- Different product systems can be compared using the “Projects” feature
Graphic modeling of process networks based on Eclipse GEF
Allocation and system expansion for modeling multi-output processes
Modeling with parameters

- Parameters can be used instead of concrete values for inputs/outputs
- Define as simple value, formula or complex function
- Parameters can overwrite each other
- Available on different levels
  - process
  - product system
  - project
  - impact method
  - database
Local and global parameters

### Parameters

**Global parameters**

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene_h</td>
<td>0.021</td>
</tr>
<tr>
<td>bucket_volume</td>
<td>1.1</td>
</tr>
<tr>
<td>CH4_h</td>
<td>0.72</td>
</tr>
<tr>
<td>CO_h</td>
<td>150.0</td>
</tr>
<tr>
<td>cycles_min</td>
<td>0.75</td>
</tr>
<tr>
<td>density</td>
<td>1.8</td>
</tr>
<tr>
<td>Dust_h</td>
<td>16.0</td>
</tr>
<tr>
<td>fuel_h</td>
<td>25.5</td>
</tr>
<tr>
<td>load_factor</td>
<td>0.6</td>
</tr>
<tr>
<td>N2O_h</td>
<td>3.0</td>
</tr>
<tr>
<td>NMVOC_h</td>
<td>29.0</td>
</tr>
<tr>
<td>NOx_h</td>
<td>520.0</td>
</tr>
<tr>
<td>sulphur_ppm</td>
<td>200.0</td>
</tr>
<tr>
<td>Toluene_h</td>
<td>0.003</td>
</tr>
<tr>
<td>Xylene_h</td>
<td>0.264</td>
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</table>

**Input parameters**

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
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<tr>
<td>p0</td>
<td>1.0</td>
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<tr>
<td>none</td>
<td>none</td>
</tr>
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**Dependent parameters**

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<thead>
<tr>
<th>Name</th>
<th>Formula</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene_t</td>
<td>Benzene_h<em>load_factor</em>performance*density</td>
<td>4.58181818181818E-4</td>
<td>[24]</td>
</tr>
<tr>
<td>CH4_t</td>
<td>CH4_h<em>load_factor</em>performance*density</td>
<td>0.0157090909090909</td>
<td>[22]</td>
</tr>
<tr>
<td>CO_t</td>
<td>CO_h<em>load_factor</em>performance*density</td>
<td>3.27272727272727</td>
<td>[18]</td>
</tr>
</tbody>
</table>
Inventory calculation

• Calculation of life cycle inventory (using the “matrix method”)

• Results are clearly presented in two tables

• Result can be exported to Excel
Matrix calculation method

> A


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>1</td>
<td>-1.993</td>
<td>-0.6</td>
<td>-3.2</td>
<td>0</td>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>Bauxite</td>
<td>0</td>
<td>1000.000</td>
<td>-2685.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Alumina</td>
<td>0</td>
<td>0.000</td>
<td>1000.0</td>
<td>0</td>
<td>-1925</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Anode</td>
<td>0</td>
<td>0.000</td>
<td>0</td>
<td>1000.0</td>
<td>-441</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aluminium</td>
<td>0</td>
<td>0.000</td>
<td>0</td>
<td>0</td>
<td>1000</td>
<td>-874.0</td>
<td>0</td>
</tr>
<tr>
<td>Ingot</td>
<td>0</td>
<td>0.000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1030.0</td>
<td>0</td>
</tr>
</tbody>
</table>

> B


<table>
<thead>
<tr>
<th></th>
<th>Crude oil [kg]</th>
<th>Bauxite [kg]</th>
<th>CO2 / CO2 equ. [kg]</th>
<th>NOx [kg]</th>
<th>SO2 [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude oil</td>
<td>-1.500000</td>
<td>-1000</td>
<td>0.302000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Bauxite</td>
<td>0.000000</td>
<td>991.000</td>
<td>989.00</td>
<td>9789.00</td>
<td>368.00</td>
</tr>
<tr>
<td>CO2 / CO2</td>
<td>0.0008736</td>
<td>0.00</td>
<td>0.00</td>
<td>0.35</td>
<td>0.29</td>
</tr>
<tr>
<td>NOx</td>
<td>0.0001700</td>
<td>0.00</td>
<td>0.00</td>
<td>1.70</td>
<td>13.40</td>
</tr>
<tr>
<td>SO2</td>
<td>1000.0</td>
<td>0.00</td>
<td>0.00</td>
<td>1000.0</td>
<td>0.00</td>
</tr>
</tbody>
</table>

> t

[,1]

Diesel [kg] 0
Bauxite, at plant [kg] 0
Alumina [kg] 0
Anode [kg] 0
Aluminium [kg] 0
Ingot [kg] 1000

> s

[,1]

Diesel prod. 11.345994
Bauxite mining 4.517378
Alumina prod. 1.682450
Anode prod. 0.385434
Electrolysis 0.874000
Ingot casting 1.000000

> g

[,1]

Crude oil [-17.016950
Bauxite [kg] -4517.376250
CO2 / CO2 equ. [kg] 11138.338062
NOx [kg] 2.556104
SO2 [kg] 21.593111

\[
s = A^{-1} \cdot f
\]

\[
g = B \cdot s
\]
Example: **inventory results**

![Inventory results screenshot](image)

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Sub-category</th>
<th>Unit</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen-3, Tritium</td>
<td>water</td>
<td>ocean</td>
<td>kBq</td>
<td>1.24192</td>
</tr>
<tr>
<td>Esfenvalerate</td>
<td>soil</td>
<td>agricultural</td>
<td>kg</td>
<td>1.11267E-13</td>
</tr>
<tr>
<td>Vanadium</td>
<td>air</td>
<td>unspecified</td>
<td>kg</td>
<td>2.28044E-9</td>
</tr>
<tr>
<td>Aldrin</td>
<td>soil</td>
<td>agricultural</td>
<td>kg</td>
<td>1.90167E-8</td>
</tr>
<tr>
<td>Magnesium</td>
<td>air</td>
<td>low population density, long-term</td>
<td>kg</td>
<td>6.59479E-7</td>
</tr>
<tr>
<td>Uranium</td>
<td>air</td>
<td>unspecified</td>
<td>kg</td>
<td>2.63771E-13</td>
</tr>
<tr>
<td>Metaldehyde</td>
<td>soil</td>
<td>agricultural</td>
<td>kg</td>
<td>5.64073E-9</td>
</tr>
<tr>
<td>Plutonium-238</td>
<td>air</td>
<td>low population density</td>
<td>kBq</td>
<td>4.37936E-13</td>
</tr>
<tr>
<td>Methane, dichlorodifluoro-, CFC-12</td>
<td>air</td>
<td>unspecified</td>
<td>kg</td>
<td>2.87573E-15</td>
</tr>
<tr>
<td>Methyl acrylate</td>
<td>water</td>
<td>surface water</td>
<td>kg</td>
<td>7.93821E-11</td>
</tr>
<tr>
<td>Cidion-ethyl</td>
<td>soil</td>
<td>agricultural</td>
<td>kg</td>
<td>4.60945E-13</td>
</tr>
<tr>
<td>Oils, biogenic</td>
<td>soil</td>
<td>unspecified</td>
<td>kg</td>
<td>7.74856E-8</td>
</tr>
<tr>
<td>o-Xylene</td>
<td>air</td>
<td>high population density</td>
<td>kg</td>
<td>2.23408E-11</td>
</tr>
<tr>
<td>Nitrogen oxides</td>
<td>air</td>
<td>unspecified</td>
<td>kg</td>
<td>0.00018</td>
</tr>
<tr>
<td>Sulfur</td>
<td>water</td>
<td>unspecified</td>
<td>kg</td>
<td>8.21458E-8</td>
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<tr>
<td>Sodium, ion</td>
<td>water</td>
<td>unspecified</td>
<td>kg</td>
<td>0.00032</td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>air</td>
<td>high population density</td>
<td>kg</td>
<td>4.80177E-7</td>
</tr>
</tbody>
</table>

**General information**

**Inventory results**

**LCIA Results**

**Process contributions**

**Process results**

**Flow contributions**

**Contribution tree**

**Grouping**

**Locations**
Impact assessment methods

- There are no impact assessment methods included by default in openLCA, but methods are available for free and can be easily imported.

- It is possible to modify existing impact assessment methods in openLCA (impact categories and flows can be added / deleted; equivalence factors can be altered).

- It is also possible to create new impact assessment methods.
Analysis and interpretation

• In openLCA many functions are available to evaluate the results and to track the origin of environmental effects:
  
  • Various result and influence analyses
  • Sankey Diagram
  • Representation of the spatial distribution of emissions and resource consumption
    – Grouping of processes is possible (e.g. by life cycle phase)
    – ...

**Contribution analyses**

![Inventory results](image)

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</tr>
<tr>
<td>Cinnamoyl-ethyl</td>
<td>soil</td>
<td>agricultural</td>
<td>kg</td>
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</tr>
<tr>
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<td>unspecified</td>
<td>kg</td>
<td>0.00018</td>
</tr>
<tr>
<td>Sulfur</td>
<td>water</td>
<td>unspecified</td>
<td>kg</td>
<td>8.21458E-8</td>
</tr>
<tr>
<td>Sodium, ion</td>
<td>water</td>
<td>unspecified</td>
<td>kg</td>
<td>0.00032</td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>air</td>
<td>high population density</td>
<td>kg</td>
<td>4.80177E-7</td>
</tr>
</tbody>
</table>

**GreenDelta**
Sankey-Diagram

Product system: Bottle production
Impact category: Acidification potential - average Europe
Cut-off: 0.000%

Bottle production
Single amount: 0.000 (0.000%)
Total amount: 5.059E-6 (100.000%)

transport, freight, lorry 3...
Single amount: 5.059E-6 (100.000%)

electricity voltage transfer
Single amount: 0.000 (0.000%)

polyethylene terephthalate
Grouping

Groups
- Other
- transport

Results
- Flows: electricity, medium voltage - 351:Electric power generation, transmission and distribution/3510:Electr...
- Impact categories: Acidification potential - average Europe

<table>
<thead>
<tr>
<th>Group</th>
<th>Amount</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>transport</td>
<td>5.059111008E-6</td>
<td>kg SO2 eq.</td>
</tr>
<tr>
<td>Other</td>
<td>0.0</td>
<td>kg SO2 eq.</td>
</tr>
</tbody>
</table>
Localisation
Uncertainty analyses

.. with Monte-Carlo-Simulation or pedigree approach
Further characteristics

• Separate calculation of costs possible
• Multiple languages
• Automatic error report
• Integrated static and dynamic help
Installation
System requirements

Software, required:

Software, optional:
- Linux (for high performance calculations): libgfortran3

Hardware:
- CPU with 2 GHz or higher
- 1 GB RAM (for analyzing product systems with ~2500 processes, like ecoinvent 2)
- > 3 GB RAM (for analyzing product systems like ecoinvent 3)
- 500 MB free disk space + space for databases (e.g. ecoinvent 3 requires ~250 MB)
Download and installation of openLCA

Download openLCA at http://openlca.org/downloads/

openLCA Version 1.4 is now available! (Release date: June, 2014) We recommend you install this version. Our tests have not shown any issues but should you run into any, please let us know. Thanks in advance!

Important changes include drastically improved performance of about 400%, numerous usability improvements and many new features.

To see video tutorials on openLCA installation, click here.

Installation files

- openLCA Version 1.4 Windows 64 bit
- openLCA Version 1.4 Mac 64 bit
- openLCA Version 1.4 Linux 64 bit
- openLCA Version 1.4 Windows 32 bit

zip files for openLCA - just unzip and run openLCA, no installation needed, several versions of openLCA can be "installed" in parallel:

openLCA 1.4 Windows 64 bit
openLCA 1.4 Windows 32 bit
Welcome to the openLCA Setup Wizard

This wizard will guide you through the installation of openLCA.

It is recommended that you close all other applications before starting Setup. This will make it possible to update relevant system files without having to reboot your computer.

Click Next to continue.
First look at the software
Welcome to openLCA!

What’s new
For the 1.4 version, we completely redesigned and “renovated” openLCA. Results are
- drastically improved performance of about 400%
- more comprehensive data selection
- more manuports

Getting started
When you start openLCA the first time, it does not contain any data. With the new version of openLCA, it is really easy to get started. You can just import a database from an existing zoo-a-file and open it from the navigation on the left side. Then open the database with a simple double click.
This is explained in a video, here

Searching for and downloading data
A broad range of LCA databases are available in openLCA nexus, where you can search for single data sets and also for complete databases, and download them into openLCA. The databases are all fit for openLCA, several databases can be combined.
This is also explained in a video

User Manuals
The online wiki for openLCA provides details about almost all features of openLCA. It is changing over time so check back from time to time.
New introductory and comprehensive manuals are also available online.

Examples
Here are cases that demonstrate how to use openLCA:
Cases for the 1.3 version

Welcome
Main menu functions
Create a new database

Right click on Navigation, select “New database”
Create a new database (II)

Local or remote databases can be created.

Different content available.

Database name

Database type

Database content
Create a new database (III)

The name should be the same as in the remote database.
openLCA overview
Data management in openLCA

• New databases in openLCA are empty at first (with the exception of reference data), but data can be imported easily
• Supported Import und Export formats:
  • EcoSpold1
  • ILCD
  • EcoSpold2
  • Excel
  • SimaPro CSV
  • zolca
• It is possible to use more than one database; databases are independent of one another and only one database is “active” at a time, all of the others are “deactivated”
• It is possible to save own data; every element of the software can be personalised
Import data sets

1. Go to File ➔ Import

2. Choose the data format
Import data sets (II)

3. Select the file from the corresponding directory

4. Add conversion factors for new units
5. Data will be imported in your active database.
**ILCD import**

- Data sets in ILCD must be imported as zip file:
openLCA database import

Right click on Navigation, select “Import database”
openLCA **Nexus**

- Search for and download data

- Search for “provider, country, other location, category, price, and start of validity” oder type search direct into search engine window

- Direct purchase/download of data for use in openLCA
openLCA Nexus

Your source for LCA data sets.

LCA databases
openLCA Nexus contains a broad range of LCA databases, some for free and some for purchase. Data sets can be easily imported into openLCA.

LCA data search
This website contains a powerful search engine for LCA data that allows filtering requested data sets by e.g., database, location or year.

About
Basic idea of the openLCA nexus is to overcome isolated data silos in LCA, by creation of a coherent and consistent LCA data space.
openLCA Nexus

Your source for LCA data sets.

**Free databases**

**ProBas**
ProBas is a German dataset library originally provided by the German Federal Environment Agency (Umweltbundesamt). It includes unit as well as aggregated processes, for the following topics: Energy, Materials & Products, Transportation services and Waste.

**USDA**
LCA database containing agricultural data sets with a US background, plus crosswalks to upstream Ecoinvent v2.2 data sets, provided by the United States Department of Agriculture (USDA).

**Ecoinvent**
A leading LCA database by the ecoinvent centre. We offer a fully valid ecoinvent license.
openLCA Nexus search engine

openLCA Nexus
Your source for LCA data sets.

Search

Data provider
ecoinvent 82

Country
Switzerland 82
Vatican City 36
United Kingdom 36
Ukraine 36
Turkey 36
Sweden 36
Svalbard and Jan Mayens 36
Spain 36
Slovenia 36
Slovakia 36
More...

Other location
Europe 36

Category
agricultural means of production 1
biomass 5
chemicals 3
oil 34
plastics 2
transport systems 27
ventilation 1
Elements in the database
Database elements (I)

- **Flows**: flow of products and materials
- **Flow properties**: i.e. Length, Mass, etc
- **Unit groups**: Groups of units
- **Sources**: Literature
- **Actors**: People who have provided data or modified models
Database elements (II)

**Projects**: comparison of numerous product systems

**Product systems**: process networks (necessary to calculate inventory results and impact assessment)

**LCIA Methods**: can be downloaded at openlca.org/downloads

**Processes**: Production or modification of materials/products
Element structure in openLCA
Creating flows & processes
Flows: Create new flow (I)

1. right click on “Flows” folder, select “create new flow”
Flows: Create new flow (II)

2. Name flow and define flow type and reference flow property. Then click „Finish“.
Flows: Create new flow (III)

3. A new flow window will open up in the editor. Additional flow properties can be added in the “Flow properties” tab, but don’t forget the conversion factor!
Flow: Information & properties

Flow: electricity

General information
- Name: electricity
- Description: 
- Category: Energy carriers and technologies > Electricity
- Version: 0.00.000
- Last change: 
- Infrastructure flow: 
- Flow type: on Product

Used in processes

Additional information
- CAS number: 
- Formula: 
- Location: 

Flow properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Conversion factor</th>
<th>Reference unit</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net calorific</td>
<td>1.0</td>
<td>MJ</td>
<td>1.0 MJ = 1.0 MJ</td>
</tr>
</tbody>
</table>

GreenDelta
1. right click on "Processes" folder, select "create new process"
**Process:** Create new process (II)

2. Name process and select a quantitative reference
3. A new process window will open up in the editor. Description, time, geography, etc. data can be added in the “General Information” tab.
Process: ammonium bicarbonate production

General information

Name: ammonium bicarbonate production
Description: Manufacturing process is considered with consumption of raw materials, energy, as well as infrastructures (excepting emission of waste heat) are not included due to the lack of data. Transport and handling conditions. Inventory refers to 1 kg 100% ammonium bicarbonate. Data for consumption of energy used is von Däniken et al. 1995. This is a dataset that was already contained in ecoinvent database guidelines for version 2 and it may not in all aspects meet the additional requirements of the ecoinvent database guidelines for version 3.
Category: C:Manufacturing > 20:Manufacture of chemicals and chemical products > 201:Manufacture of chemicals
Version: 0.00.000
Last change: 01-Jan-1995 + 03-Dec-2014
Infrastructure process: [ ]
Create product system

Quantitative reference

Quantitative reference: 0° ammonium bicarbonate (RER)

Time

Start date: 01-Jan-1995
End date: 03-Dec-2014
Description: Values based on data from the early 1990s.
**Process: Inputs/Outputs**

4. Additional flows can be added in the “Input/Output” tab.
5. Additional metadata can be included in the “Administrative information” and “Modeling and validation” tabs.
Tips and tricks for working with openLCA
Basic commands

• Open element: double click
• Copy element: right mouse button ➔ copy
• Paste element: right mouse button ➔ paste
• Delete element: right mouse button ➔ delete
• Save element: use saving symbol in the main menu
• Save image: right mouse button ➔ save image
• Minimise/maximise element:
Basic commands

- If you double click on a flow in the process editor it will be opened in a separate window and can be modified:
Basic commands

- Drag and drop flows from the Navigation pane to the Input/Outputs tab in the process editor
- Drag and drop processes from the Navigation pane to the Model Graph in the product system editor
Folder structure

- Divide system and unit processes
- Divide processes from different databases in one openLCA database
- Separate flows and processes that were created on your own

Do not change the folder structure of elementary flows, because otherwise the LCIA cannot find them anymore!
Windows

- Often users have several elements open at the same time; it is recommended to close elements you don´t need.

- To recover "missing" window: go to Window/Show View/Other.

- It is also possible to change the position of a window.
Search

- Search any element from the database

Write the key words for the search
The “add new” editors contain a filter for facilitating the search of the desired element. Use the “Filter” when adding new flows to a process, select the reference process in a product system, etc.
Numbers

• Use always a point for floating point numbers, a comma is not accepted (=> 1.5 instead of 1,5)
• Under File/Preferences/Number format you can choose the number format of results
Modeling with **product flows**

- Use different flow names for one flow that “hikes“ through your product system.
Modeling with **product flows**

- The default provider can be set for each exchange
Modeling of waste

• "Reverse direction": Usual (production processes) is that donations to another process are something of value for the receiving process

• Disposal processes aim to eliminate the receiving flow

→ Model according to the "value flow direction":

Disposal as a service counter to the direction of material flow
Modeling of waste (II)

instead of...

Production process \[\rightarrow\] waste \[\rightarrow\] Disposal process

... make it like this

Disposal process \[\rightarrow\] waste \[\rightarrow\] Production process
Product systems creation & calculation
Product system: Creation

1. Click on "Create product system" in the General information tab.
2. Name the product system and select a reference process

3. Select the modeling options preferred
Product system: General information
Product system: Model graph
Product system: Model graph (II)

Right click on the editor to see further options

Select “Outline” from other views in the “Window” menu
1. Click on “Calculate” in the General information tab.
2. Select calculation properties and click on Calculate.
Product system: Calculation (III)

3. Check the tabs for inventory results, LCIA results, Contributions, etc.
Impact assessment methods
Impact assessment methods: Creation

1. right click on “Impact assessment methods” folder, select “New LCIA method”

2. Name method (Description optional)
Impact assessment methods: Creation (II)

3. Click on “+” to add new impact categories
Impact assessment methods: Creation (III)

4. Click on “+” to add new characterisation factors

5. Select desired elementary flows
Impact assessment methods: Creation (IV)

6. Add value for the factor (parameters can be used as in processes!)
Impact assessment methods: Creation (V)

7. Click “+” to add new normalization/weighting set

8. Click on the set name to automatically add the impact categories of the method
Result analysis and interpretation
Analysis functions

- To run the analysis functions the product system needs to be recalculated.
- Click the calculation button in the General Information tab of the Product System, select an LCIA method and check „Analysis“.

![Image of Calculation properties window]
Analysis: Flow & Impact contributions

Specify what you want to see & the results are shown in the diagram

You can either look at "hot spots", or the "sum of the contributions"
### Analysis: process contributions

#### Flow contributions

<table>
<thead>
<tr>
<th>Contribution</th>
<th>Process</th>
<th>Amount</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.86%</td>
<td>Ethylene oxide, at plant - RNA</td>
<td>0.00022</td>
<td>kg</td>
</tr>
<tr>
<td>09.83%</td>
<td>Polyethylene terephthalate, resin, at plant - RNA</td>
<td>2.8861E-5</td>
<td>kg</td>
</tr>
<tr>
<td>06.78%</td>
<td>Natural gas, extracted - RNA</td>
<td>1.9900E-5</td>
<td>kg</td>
</tr>
<tr>
<td>03.05%</td>
<td>Natural gas, at extraction site - RNA</td>
<td>8.9579E-6</td>
<td>kg</td>
</tr>
<tr>
<td>01.84%</td>
<td>Crude oil, extracted - RNA</td>
<td>5.3916E-6</td>
<td>kg</td>
</tr>
<tr>
<td>01.38%</td>
<td>Crude oil, at production - RNA</td>
<td>4.0453E-6</td>
<td>kg</td>
</tr>
<tr>
<td>00.66%</td>
<td>Sulfur, at plant - RNA</td>
<td>1.9302E-6</td>
<td>kg</td>
</tr>
<tr>
<td>00.43%</td>
<td>Hydrochloric acid, at plant - RNA</td>
<td>1.2712E-6</td>
<td>kg</td>
</tr>
<tr>
<td>00.10%</td>
<td>Polyvinyl chloride, resin, at plant - RNA</td>
<td>2.8704E-7</td>
<td>kg</td>
</tr>
<tr>
<td>00.07%</td>
<td>Polyethylene, linear low density, resin, at plant - RNA</td>
<td>2.0406E-7</td>
<td>kg</td>
</tr>
</tbody>
</table>

#### Impact contributions

<table>
<thead>
<tr>
<th>Impact category</th>
<th>Process</th>
<th>Amount</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>climate change - GWP 100a</td>
<td>Hot rolled sheet, steel, at plant - RNA</td>
<td>108.58189</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td></td>
<td>Electricity, bituminous coal, at power plant - US</td>
<td>62.85205</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td></td>
<td>Transport, combination truck, diesel powered - US</td>
<td>34.61704</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td></td>
<td>Natural gas, combusted in industrial boiler, at hydrocracker, f_</td>
<td>25.50830</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td></td>
<td>Soda powder, at plant - RNA</td>
<td>21.27902</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td></td>
<td>Manganese oxide</td>
<td>14.53002</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td></td>
<td>Ethylene oxide, at plant - RNA</td>
<td>13.15162</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td></td>
<td>Transport, train, diesel powered - US</td>
<td>10.08440</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td></td>
<td>Electricity, natural gas, at power plant - US</td>
<td>7.88966</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td></td>
<td>Lithium manganese oxide</td>
<td>7.25964</td>
<td>kg CO2-Eq</td>
</tr>
</tbody>
</table>
**Analysis: process results**

### Process results

#### Flow results

**Process** Battery pack (S1)

<table>
<thead>
<tr>
<th>Contribution</th>
<th>Flow</th>
<th>Upstream to</th>
<th>Direct contrib.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Dummy, Chemicals...</td>
<td>3.54816E-5</td>
<td>0.00000</td>
<td>kg</td>
</tr>
<tr>
<td>100%</td>
<td>Dummy, Disposal, s...</td>
<td>0.02947</td>
<td>0.00000</td>
<td>kg</td>
</tr>
<tr>
<td>100%</td>
<td>Carbon dioxide, in...</td>
<td>0.28262</td>
<td>0.00000</td>
<td>kg</td>
</tr>
<tr>
<td>100%</td>
<td>Gasoline, combusted</td>
<td>4.55712E-5</td>
<td>0.00000</td>
<td>kg</td>
</tr>
<tr>
<td>100%</td>
<td>Diesel, combusted L</td>
<td>0.02613</td>
<td>0.00000</td>
<td>kg</td>
</tr>
<tr>
<td>100%</td>
<td>Liquefied petroleum...</td>
<td>3.97621E-5</td>
<td>0.00000</td>
<td>kg</td>
</tr>
<tr>
<td>100%</td>
<td>Dummy, Disposal, s...</td>
<td>0.11025</td>
<td>0.00000</td>
<td>kg</td>
</tr>
<tr>
<td>100%</td>
<td>Limestone, in ground</td>
<td>0.932010</td>
<td>0.00000</td>
<td>kg</td>
</tr>
<tr>
<td>100%</td>
<td>Dummy, Disposal, s...</td>
<td>0.00000</td>
<td>0.00000</td>
<td>kg</td>
</tr>
</tbody>
</table>

#### Impact assessment results

**Process** Cathode, lithium-ion battery

<table>
<thead>
<tr>
<th>Contribution</th>
<th>Impact category</th>
<th>Upstream total</th>
<th>Direct impact</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.44%</td>
<td>climate change - GWP 500a</td>
<td>75.20372</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>23.01%</td>
<td>climate change - GWP 100a</td>
<td>75.38599</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>21.90%</td>
<td>climate change - GWP 20a</td>
<td>75.54843</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
</tbody>
</table>
Analysis: flow contributions

```
<table>
<thead>
<tr>
<th>Contribution</th>
<th>Flow</th>
<th>Amount</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>94.05%</td>
<td>Carbon dioxide, fossil</td>
<td>38.18672</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.82%</td>
<td>Methane, fossil</td>
<td>9.17675</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.62%</td>
<td>Carbon dioxide, fossil</td>
<td>7.25964</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.62%</td>
<td>Carbon monoxide, fossil</td>
<td>1.97769</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.32%</td>
<td>Dinitrogen monoxide</td>
<td>1.06065</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Methane, tetrachloro-, R-10</td>
<td>0.00841</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Ethane, 1,1,2-tetrafluoro-, HFC-134a</td>
<td>0.00385</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Methane, chlorotrifluoro-, CFC-13</td>
<td>0.00351</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Methane, dichloro-, HCFC-30</td>
<td>4.69266E-5</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Methane, dichlorodifluoro-, CFC-12</td>
<td>6.98862E-7</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Methane, monochloro-, R-40</td>
<td>1.27158E-7</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Chloroform</td>
<td>3.26649E-8</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Methane, bromo-, Halon 1001</td>
<td>1.47638E-8</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>NMVOC, non-methane volatile organic compounds</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Nitrate</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Ethane, 1,2-dibromo-</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Sulfide</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Petroleum coke, at refinery - RNA</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Detergents, oil</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Phenanthrenes, alkyld, unspecified</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Chrysene</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Ethane, 1,1,1-trichloro-, HCF-140</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>TOC, Total Organic Carbon</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Beryllium</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Anthracene</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>0.00%</td>
<td>Phosphorus trichloride</td>
<td>0.00000</td>
<td>kg CO2-Eq</td>
</tr>
</tbody>
</table>
```

GreenDelta
Analysis: contribution tree
Analysis: grouping

Add new groups and move (right click on process name) processes to them
Analysis: locations

If you don’t see any points in the map, click “reload”
Analysis: Sankey diagram

Click here to set the diagram options
Sensitivity analysis
Sensitivity analysis

“systematic procedures for estimating the effects of the choices made regarding methods and data on the outcome of a study”

(ISO 14040)

• Are results stable if you change specific aspects?
  – What happens if you expand your system boundaries?
  – What happens if you use other allocation methods?
  – What happens if you change your assumptions?
  – ...

GreenDeLTA
Modeling with parameters

- Useful for sensitivity analyses ➔ What impact does one aspect have when I change its value?
- Useful for preliminary data: data can be changed easily at the end of your study
- Create different versions of your life cycle by changing the input values
- Reduces the likelihood of calculation errors
Modeling with parameters

• Enter calculation rules instead of concrete values → more flexibility

• Available on process, product system, LCIA method, project and database level

• Local and global parameters → parameters can overwrite each other!

• Parameters can be linked to other parameters (i.e. dependent parameters) → Loops are not allowed
Process: Parameters
Process: Parameters (II)

In the image, the software interface of openLCA 1.4 is shown with various parameters listed. The parameters include:

- Global parameters:
  - D1A: 200.0, none
  - D1B: 200.0, none
  - D1C: 50.0, none
  - NB: 1000.0, none
  - WEB: 0.065, none
  - WFB: 1.065, none
  - WHDPE: 0.004, none
  - WPET: 0.06, none
  - WPP: 0.001, none
  - WW: 1.0, none

- Input parameters:

The interface also includes a Preferences window with options for experimental features, global parameters, and other configurations. The window is not fully visible in the image.
**Process:** Parameters (III)

### Inputs

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow proper...</th>
<th>Unit</th>
<th>Amount</th>
<th>Uncertainty</th>
<th>Default proc...</th>
<th>Pedigree un...</th>
</tr>
</thead>
<tbody>
<tr>
<td>kerosene</td>
<td>Energy carriers and...</td>
<td>Mass</td>
<td>kg</td>
<td>Spez_Verbr</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>cargo</td>
<td>Transport services/...</td>
<td>Mass</td>
<td>kg</td>
<td>1.0</td>
<td>none</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

### Outputs

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow proper...</th>
<th>Unit</th>
<th>Amount</th>
<th>Uncertainty</th>
<th>Avoided proc...</th>
</tr>
</thead>
<tbody>
<tr>
<td>cargo</td>
<td>Transport services/...</td>
<td>Mass</td>
<td>kg</td>
<td>(5.0E-5 * Spez_Verbr) * 1.0</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.016321 * Spez_Verbr) * 1.0</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

[Click here to change the formula view](#)
Parameter rules

• Parameter names...
  ... must be written with small characters.
  ... must be one word.
  ... cannot contain special characters.
  ... cannot have more than 255 characters.

• Parameter formulas...
  ... can contain single values, simple equations, or complex functions including logical expressions.
  ... do not contain units, so please add them in the comment field.
  ... cannot have more than 255 characters.

• The amount of parameters is, theoretically, not limited.
• Use point (.) instead of comma (,) for the decimal numbers.
Parameters: checking formulas

- For complex formulas must use a certain format (e.g. Tan(a), trunc(c), etc.). Use the formula interpreter to find errors.

Select “Formula Interpreter” in “Window” menu
Product system: Parameters

1. Click here to add parameters from processes used in the product system.

2. Select the parameters you want to modify their value.
3. Change the values as desired; the new value it will only affect to the specified process.
1. Right click on the Projects folder and select “Create new project”
2. Name the project and select “Finish”.

**Project:** Creation (II)
3. A new tab with the project will appear in the editor window. Click on the green button to select different variants.
Comparative assessments: Projects

- Same or different product systems can be compared using Variants.

<table>
<thead>
<tr>
<th>Name</th>
<th>Product system</th>
<th>Allocation method</th>
<th>Flow</th>
<th>Amount</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>Bottle at POS</td>
<td>Economic</td>
<td>Bottle sale</td>
<td>1000.0</td>
<td>Item(s)</td>
</tr>
<tr>
<td>Case 2</td>
<td>Bottle at POS</td>
<td>Physical</td>
<td>Bottle sale</td>
<td>2500.0</td>
<td>Item(s)</td>
</tr>
<tr>
<td>Case 3</td>
<td>Bottle at POS</td>
<td>Causal</td>
<td>Bottle sale</td>
<td>7500.0</td>
<td>Item(s)</td>
</tr>
</tbody>
</table>

Compare allocation methods.
Change variant target amounts.
Comparative assessments: **Projects**

- Same or different product systems can be compared using **Variants**

- **Change the values of the parameters per variant**
- **Add parameters used in the product system**
Comparative assessments: Projects

Select the LCIA method and impact categories you are interest in.
Comparative assessments: Projects

Once every variable is set, click “Report” to calculate results.

The contribution of different processes can be compared.

<table>
<thead>
<tr>
<th>Process</th>
<th>Report name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode, lithium-ion battery</td>
<td>Anode, lithium-ion battery</td>
<td></td>
</tr>
</tbody>
</table>
1. Text descriptions for each sections can be added

2. The type of component to display in each section can be selected (e.g. tables, graphs)
Project: **Report sections**

New sections can be added

Or delete existing ones
Example: Project report

<table>
<thead>
<tr>
<th>Variant</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variant1</td>
<td></td>
</tr>
<tr>
<td>Variant2</td>
<td></td>
</tr>
</tbody>
</table>

**Selected LCIA Categories**

The table below shows the LCIA categories of the selected LCIA method of the project. Only the LCIA categories that are selected to be displayed are shown in the report. Additionally, a user friendly name and a description for the report can be provided.

<table>
<thead>
<tr>
<th>LCIA category</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>climate change - GWP 100a</td>
<td>kg CO2-Eq</td>
<td></td>
</tr>
<tr>
<td>climate change - GWP 20a</td>
<td>kg CO2-Eq</td>
<td></td>
</tr>
<tr>
<td>climate change - GWP 500a</td>
<td>kg CO2-Eq</td>
<td></td>
</tr>
</tbody>
</table>

**LCIA Results**

This table shows the LCIA results of the project variants. Each selected LCIA category is displayed in the rows and the project variants in the columns. The unit is the unit of the LCIA category as defined in the LCIA method.

<table>
<thead>
<tr>
<th>LCIA category</th>
<th>Variant1</th>
<th>Variant2</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>climate change - GWP 100a</td>
<td>-1.35354e+2</td>
<td>-9.02359e+1</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>climate change - GWP 20a</td>
<td>-1.38358e+2</td>
<td>-9.22388e+1</td>
<td>kg CO2-Eq</td>
</tr>
<tr>
<td>climate change - GWP 500a</td>
<td>-1.33922e+2</td>
<td>-8.92811e+1</td>
<td>kg CO2-Eq</td>
</tr>
</tbody>
</table>
Example: **Project report**

Single Indicator Results

The following chart shows the single results of each project variant for the selected indicator. You can change the selection and the chart is dynamically updated.

![Single Indicator Results Chart](image)

Process Contributions

This chart shows the contributions of the selected processes in the project setup to the variant results of the selected LCIA category. As for the single indicator results, you can change the selection and the chart is dynamically updated.

![Process Contributions Chart](image)
Data export
EcoSpold export

EcoSpold 1
• Processes
• Impact assessment methods

EcoSpold 2
• Processes
ILCD export

- Actors
- Flow properties
- Flows
- LCIA methods
- Processes
- Product systems
- Sources
- Unit groups
Excel export

- Processes
- Quick results
- Analysis results
- Monte Carlo simulation results
- Product systems:
  - Elementary flows
  - Product flows
  - LCIA factors
Other export formats

CSV-Matrix
• Graph of a product system

Images
• Diagrams

HTML
• Project report

openLCA script (.zolca)
• Complete databases
Example: process export (I)

1. Select “Export” in File
2. Select format
Example: **process export (II)**

3. Select the directory where data will be stored

4. Select the processes to export
Example: process export (III)

In the selected directory a folder with the name of the export format is created. For instance, Desktop\EcoSpold01\processes
Export openLCA database

1. Right click on the database name and select “Export database”

2. Select the directory and name for the .zolca file
Using an **ILCD network database**

- Useful if more than one person is working on one study.

- Data is uploaded into a database on a server and can be downloaded from each user with access to the server.
1. Go to File ➔ Import

2. Choose “ILCD Network import”

3. Select the server connection and the processes to import
ILCD network database: export

1. Go to File → Export

2. Choose “ILCD Network Export”

3. Select the server connection and the elements to export
Tips and tricks for working with openLCA (II)
Errors

- It is possible to report all errors in a log file automatically.
- To do so go to file/preferences/logging and check „All“.

The log file is rewritten every time openLCA is restarted!
Language

• openLCA is available in Bulgarian, Chinese, English, French, German, Italian and Spanish
• Change it under File/Preferences/@Configuration.
• once you change the language, restart the program to activate it
Memory usage

- Some databases required higher memory usage (e.g. ecoinvent 3) for the calculations.
- Change it under File/Preferences/@Configuration.
openLCA-data directory

• The openLCA-data folder is automatically created under in your user/Documents folder
• The directory can be edited in the 'openLCA.ini' file contained in the openLCA folder with a text editor in the following way:
Further practicing
Excercise 6: Modeling
LCA of PET bottles

Goal: Conduct an LCA of PET water bottles produced and consumed in Germany from cradle to point of sale

FU: 1,000 1-litre still water bottles

Production chain:
1. Plastic granulate production:
   - polyethylene terephthalate granulate (PET) for the bottle (bottle grade, RER)
   - Polyethylene high density granulate (PE-HD) for the lid (RER)
   - Polypropylene granulate (PP) for the labels (RER)
2. Transport of PET, HDPE and PP granulates for further processing (Transport A)
3. Production of a PET pre-form bottle, the HDPE lid and the PP label from the respective granulates produced in step 1.
4. Transport of bottle preform, lid and label to bottle-filling location (Transport B)
5. Blow PET preform, fill with water and attach lid and label
6. Transport of the filled water bottle to retailers (Transport C)
Excercise 6: Modeling
LCA of PET bottles

Supply chain and system boundary:
Excercise 6: Modeling LCA of PET bottles

Case-study assumptions (I):

- For the production of the bottles, lids and labels, it is assumed that 100% of the respective input granulate is utilized in forming the final product, without waste.

<table>
<thead>
<tr>
<th></th>
<th>PET</th>
<th>HDPE</th>
<th>PP</th>
<th>Empty bottle</th>
<th>Water</th>
<th>Full bottle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>60g</td>
<td>4g</td>
<td>1g</td>
<td>65g</td>
<td>1kg</td>
<td>1.065kg</td>
</tr>
</tbody>
</table>

- Water used to fill bottles (ELCD database): “surface water at a water purification plant (RER)”

- Information on the amount of energy required to run the machines which produce the PET pre-forms, PP labels, HDPE lids as well as those required to make the final PET bottles and add the lid, label and fill with water is not available and will be ‘ignored’ for modeling purposes.
Excercise 6: Modeling LCA of PET bottles

Case-study assumptions (II):

- Transport (ELCD database): “Euro 0, 1, 2, 3, 4 mix, 22 t total weight, 17.3 t max payload – RER”

<table>
<thead>
<tr>
<th>Transport</th>
<th>Amount</th>
<th>Weight transported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport A</td>
<td>200km</td>
<td>0.065kg</td>
</tr>
<tr>
<td>Transport B</td>
<td>200km</td>
<td>0.065kg</td>
</tr>
<tr>
<td>Transport C</td>
<td>50km</td>
<td>1.065kg</td>
</tr>
</tbody>
</table>
Excercise 6: Modeling LCA of PET bottles

**Task**: Model the supply chain of PET water bottles from cradle to gate using the ELCD database:

a) Create separate unit processes for each of the six steps of the production chain

b) Create one process containing all of the flows in the production chain

c) Create product systems from a) and b), respectively, and compare the model graphs

Before starting the task, download the ELCD database from openLCA Nexus, as well as the openLCA LCIA method pack available at openlca.org/downloads and import them both into openLCA.
Excercise 6: Modeling
LCA of PET bottles – Model graphs

VS.
Excercise 6: Modeling
LCA of PET bottles

d) Calculate the product system using the LCIA method ReciPe Midpoint (H) and the normalization/weighting set “Europe ReciPe Midpoint (H)”

- What’s the climate change impact of the product system relative to the total annual impact of CC per person in Europe? Check values also for terrestrial acidification & ionising radiation.

- Which impact category has the highest contribution to the overall impact of the production of PET water bottles in Germany?

- How do the normalized impacts of the product system change considering the impact of the total European population in the year 2000 in each impact category (instead of impacts/person/year)?
Excercise 6: Modeling
LCA of PET bottles

e) Calculate the product system using the LCIA method “ReciPe Endpoint (H)” and the normalization/weighting set “Europe ReciPe H/A” (hierarchist perspective; average weighting set)

• What’s the impact of the product system in the endpoint categories “human health”, “ecosystems” and “resource availability”?

• What’s the impact of the product system in the endpoint categories “human health”, “ecosystems” and “resource availability”? How is the ionising radiation impact of PET bottle production in Germany expected to affect “human health”?

• To which endpoint indicator does the product system cause the highest damage after normalization and weighting? Does this result change when an egalitarian or an individual perspective is used (with the average weighting set) instead of a hierarchist view? (resources)
Allocation and system expansion
Multi-output processes

• Multi-output processes occur quite often
  • cow (milk, leather, meat)
  • Co-generation (heat, power)
  • Chloralkali electrolysis (natriumhydroxide, chloric gas, hydrogen)

• Usually you need processes with one output for LCAs
• Two strategies:
  • Avoiding Allocation: System expansion
  • Elementary flows and products from multi-output processes mathematically divided into multiple processes (= allocation)
Allocation

“partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems”

(ISO 14040)

– Which allocation methods are possible?

  • physical allocation
  • causal allocation
  • economic allocation
Example: **co-generation**

### Allocation

**Default method**
- None

- Calculate default values

#### Physical & economic allocation

<table>
<thead>
<tr>
<th>Product</th>
<th>Physical</th>
<th>Economic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity, at grid, US - RNA (2.00 MJ)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Heat, onsite boiler, hardwood mill, average, SE - RNA (1.00 MJ)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

#### Causal allocation

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur dioxide</td>
<td>Output</td>
<td>air/high po...</td>
<td>0.50000 kg</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Carbon dioxide, fossil</td>
<td>Output</td>
<td>air/high po...</td>
<td>2.00000 kg</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Crude oil, at production...</td>
<td>Input</td>
<td>Product flo...</td>
<td>3.00000 kg</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>
System expansion (I)

• System expansion --> We assume that heat produced elsewhere outside the product system will be substituted via the heat produced by our modelled product system.

• The “co-generation” product system is thus “credited” with the avoided impacts of the alternative heat-producing process “Heat, gas heating”, i.e. the environmental impacts of the process “Heat, gas heating” will be subtracted from the overall environmental impact of co-generation ⇒ only impacts related to “electricity” generation will appear in the LCIA results.
System expansion (II)

- biogas 2 TJ
- active coal 72.2 kg
- heat (from gas heating) 0.6 TJ

= biogas CHP plant (gross)
  + electricity 1 TJ
  + heat 0.6 TJ

= heat bonus process
  + heat 0.6 TJ

= biogas CHP plant (net)
  + electricity 1 TJ
  + credit note heat bonus process 0.6 TJ
System expansion in openLCA

A process providing the avoided product flow should exist!

Check the box of “Avoided product” for the by-product.
System expansion vs. allocation – model graphs

Model Graph 1: Product system “Co-generation” without system expansion

Model Graph 2: Product system “Co-generation” with system expansion
Additional (new) features in openLCA
Element usage

- Available for any element of the database.
- Results can be filtered.
Multiple windows view

- Select Window/Open in New Window to open a new openLCA window
- You can work in parallel within the same database
Developer tools

- SQL Query Browser, JavaScript and Python editors.
Experimental features in openLCA
Experimental features

They can be activated under File/Preferences/Experimental features
Product system statistics

- Available in the product system editor
- Provides information on the number of processes, the process links, etc.

### General statistics:

- **Number of processes**: 81
- **Number of process links**: 230
- **Connected graph / can calculate?**: yes
- **Technology matrix**: 81 x 81
- **Reference process**: Battery pack (S1)
# Product system Statistics (II)

## Processes with highest in-degree (linked inputs):

<table>
<thead>
<tr>
<th>Number of input links</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Lithium carbonate</td>
</tr>
<tr>
<td>8</td>
<td>Battery cell, lithium-ion battery (S1)</td>
</tr>
<tr>
<td>7</td>
<td>Ethylene dichloride-vinyl chloride monomer, at plant</td>
</tr>
<tr>
<td>7</td>
<td>Electricity, at Grid, US, 2008</td>
</tr>
<tr>
<td>7</td>
<td>Ethylene, at plant</td>
</tr>
</tbody>
</table>

## Processes with highest out-degree (linked outputs):

<table>
<thead>
<tr>
<th>Number of output links</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>Electricity, at Grid, US, 2008</td>
</tr>
<tr>
<td>18</td>
<td>Transport, train, diesel powered</td>
</tr>
</tbody>
</table>
Experimental visualisations: **HTML Graph**

- Available in the product system editor.
- It provides visual representation of the process links in the product system.
Experimental visualisations: **Treemap**

- Available in the quick results and analysis editors.
- It visually represents the direct process contributions per flow and impact category.
Experimental visualisations: **Bubble chart**

- Available in the quick results and analysis editors.
- It visually represents the direct process contributions per flow and impact category.
Experimental visualisations: Sun burst

- Available in the analysis editor.
- It visually represents the total process contributions per flow and impact category.
Other experimental features

• Spare matrix calculation: calculates with a different, sparse matrix approach; saves some memory but is still experimental.

• Localised impact assessment:
  – New features in the impact method editor are added to deal with shape files.
  – A new calculation option is shown in the “Calculation properties” menu:
Uncertainty analysis in openLCA
Types of uncertainty

• Data uncertainties
  • Uncertainties through measurements and estimations
  • Uncertainties through the use of non-ideal data sets (region, technology, time period)
  • Uncertainties of consumer behaviour regarding use and disposal of products
  • ...
• Uncertainties in LCIAM due to lack of scientific knowledge
  • ...

Data uncertainty: basics I

• It is basically not possible to measure error-free.

• But: Data uncertainty is in contrast to other uncertainties quite easy to handle with statistical methods (e.g. Monte Carlo simulation, Pedigree approach, interval calculations, with fuzzy logic approach or the Gaussian error propagation formulas)

→ Measurements have a distribution; the scope is defined as standard deviation.
Data uncertainty: basics II

Results have also a standard deviation and a mean as well as an average:

- The median is the mean value (for 100 samples the 50th sample is the median).

- The mean is the arithmetic average of all samples.
Uncertainty distribution

- Log-normal distribution
- Normal distribution
- Triangle distribution
- Uniform distribution
The Monte Carlo simulation (I)

– Simulation varies entry data of the model calculation randomly according to the uncertainty distribution.

– An uncertainty distribution for the calculation result is provided.

• By a breakdown of the value ranges in individual intervals and the alternate drawing from different intervals, a more uniform distribution of the results is achieved, thereby reducing the number of iterations required.

• Nevertheless, several thousand iteration passes are usually required.
The Monte Carlo simulation (II)

– First, uncertainty data are added to all flows in the processes (Distribution, standard deviation, min / max, etc.); only for the reference output no uncertainty distribution is assumed.
  • Uncertainty data can be defined also for parameters and LCIA characterisation factors

– Then, in the calculation window the Monte Carlo simulation can be selected and the number of simulations can be entered.

– Uncertainties are calculated for each flow or impact category.
Adding uncertainty information

1. Select “Edit” in the uncertainty field

2. Define the values of the distribution
Starting the Monte Carlo simulation

1. Open a product system and click the calculation button
2. Select “Monte Carlo Simulation”, the impact method and the number of iterations
3. Click “Start” to run the simulation

4. While the simulation runs, results for each flow and impact category can be shown.
Results

5 Results can be exported as Excel.
The Pedigree approach in ecoinvent

• Developed by Weidema and Wesnaes in 1996 as part of their NUSAP scheme to estimate all kinds of uncertainty

• A pedigree illustrates key aspects in a matrix:
  – Columns represent pedigree criteria
  – Lines represent qualitative characterisations of each criteria by expressing different levels of data quality or uncertainty

• Quantitative scores are assigned to each qualitative description

• The pedigree matrix was transferred in 1996 by Weidema / Wesnaes on the application in LCA.
The Pedigree approach in ecoinvent

<table>
<thead>
<tr>
<th>Relevant criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>2</td>
</tr>
<tr>
<td>Completeness</td>
<td>3</td>
</tr>
<tr>
<td>Time</td>
<td>2</td>
</tr>
<tr>
<td>Geography</td>
<td>5</td>
</tr>
<tr>
<td>Technology</td>
<td>4</td>
</tr>
</tbody>
</table>

Qualitative descriptors

GreenDELTa
The Pedigree approach in ecoinvent

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>1.00</td>
<td>1.05</td>
<td>1.10</td>
<td>1.20</td>
<td>1.50</td>
</tr>
<tr>
<td>Completeness</td>
<td>1.00</td>
<td>1.02</td>
<td>1.05</td>
<td>1.10</td>
<td>1.20</td>
</tr>
<tr>
<td>Time</td>
<td>1.00</td>
<td>1.03</td>
<td>1.20</td>
<td>1.20</td>
<td>1.50</td>
</tr>
<tr>
<td>Geography</td>
<td>1.00</td>
<td>1.01</td>
<td></td>
<td>1.10</td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>1.00</td>
<td></td>
<td>1.50</td>
<td>1.50</td>
<td>2.00</td>
</tr>
</tbody>
</table>

Default uncertainty factors
The Pedigree matrix in openLCA

1. Click “Edit” to add or modify the Pedigree uncertainty

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow proper...</th>
<th>Unit</th>
<th>Amount</th>
<th>Uncertainty</th>
<th>Avoided pr...</th>
<th>Pedigree un...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerosene, at refinery - RN</td>
<td>Product flows</td>
<td>Volume</td>
<td>L</td>
<td>0.4199197...</td>
<td>none</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow proper...</th>
<th>Unit</th>
<th>Amount</th>
<th>Uncertainty</th>
<th>Avoided pr...</th>
<th>Pedigree un...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport, aircraft, freight</td>
<td>Product flows</td>
<td>Volume</td>
<td>L</td>
<td>0.0010461...</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow proper...</th>
<th>Unit</th>
<th>Amount</th>
<th>Uncertainty</th>
<th>Avoided pr...</th>
<th>Pedigree un...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrocarbons, unspecified</td>
<td>air/unspecified</td>
<td>Mass</td>
<td>kg</td>
<td>0.00441023...</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow proper...</th>
<th>Unit</th>
<th>Amount</th>
<th>Uncertainty</th>
<th>Avoided pr...</th>
<th>Pedigree un...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon monoxide, fossil</td>
<td>air/unspecified</td>
<td>Mass</td>
<td>kg</td>
<td>1.05264715...</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow proper...</th>
<th>Unit</th>
<th>Amount</th>
<th>Uncertainty</th>
<th>Avoided pr...</th>
<th>Pedigree un...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide, fossil</td>
<td>air/unspecified</td>
<td>Mass</td>
<td>kg</td>
<td>0.00536646...</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
</tbody>
</table>
The Pedigree matrix in openLCA

2. Click in the different fields to rate the data quality, add a basic uncertainty and click „OK“
Basic uncertainty

- Developed by the ecoinvent centre:

<table>
<thead>
<tr>
<th>Basic uncertainty</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy requirement</td>
<td>1.05</td>
</tr>
<tr>
<td>Transportation services</td>
<td>2.00</td>
</tr>
<tr>
<td>Infrastrukture</td>
<td>3.00</td>
</tr>
<tr>
<td>CO2 in air</td>
<td>1.05</td>
</tr>
<tr>
<td>PM2.5 of combustion</td>
<td>3.00</td>
</tr>
<tr>
<td>Heavy metal in water</td>
<td>5.00</td>
</tr>
<tr>
<td>Radionuclides in water</td>
<td>3.00</td>
</tr>
</tbody>
</table>
Calculation of Pedigree uncertainty

• So far the pedigree matrix is only used for documentation purposes!

• In later openLCA versions the pedigree values will be used to determine all uncertainty parameters to run a Monte Carlo simulation (Distribution, standard deviation, min / max, etc.)

• Derived uncertainties can then be calculated using the Monte Carlo simulation.
ecoinvent 3
Ecoinvent 3 Overview

• Third version of the ecoinvent database, developed by the Swiss ecoinvent Centre, with technical modifications respect to version 2:
  
  – Data format

  – Market modeling

  – Around 8000 “Activity” data sets (former process data sets)
Ecoinvent 3, **Details**

- Data format
- Market modeling
- New data?
- Consequences for openLCA
Ecoinvent 3, **Data format**

- In ecoinvent 2, Ecopsold 1:
  - No parameters,
  - Only two languages,
  - Usually process = product
  - No IDs, processes were identified by location, time, unit and name
  - It only had processes and metadata
  - Each flow had only one unit

- Ecospold 2;
  - Parameters
  - Different data sets (Activity, flow, etc.)
  - Unique IDs
  - “Intelligence” in data format
EcoSpold 2

This is a dataset transferred from ecoSpold v1 / ecoinvent database version 2. It may not in all aspects fulfill the requirements of the original database version.

Data from a leading titan zinc plate producer in Germany. Applicable for Europe.

Induction furnace for all the pre-alloying and melting steps, roll stands with 5 rolling pairs for the rolling step. Coils.

Macroeconomic Scenario: Normal
EcoSpold 2

- Flow properties (before only in ILCD format): water content, etc., different units possible
EcoSpold 2

- Flow properties: details for each process data set
  - e.g.: Flow: “Tin, ion”; Summary: water content (o), C content (o), etc. (!)
• Flow properties: details for each process data set
  – Auto generated flow properties “EcoSpold01Allocation_undefined_xy“
EcoSpold 2: “Intelligence” in data format

Child and parent data sets:

• “parent data set: a dataset referred to by a child dataset as the dataset from which field values in the child dataset are to be inherited to the extent defined, i.e. parent datasets serve as basis of their associated child datasets. “ (ecoinvent.org)

• “Only geographical inheritance is allowed in the ecoinvent v3 database, i.e. some regional datasets (such as Brazilian soybean production) might be modelled as a child dataset of the global dataset. “ (ecoinvent.org)
EcoSpold 2: “Intelligence” in data format

Child and parent data sets:
• “In child datasets values can be set to relate to the corresponding value in the parent dataset. When such a related value is changed in the parent dataset it is automatically changed in the child dataset as well.”
• “it is automatically changed” → better: it is meant to be automatically changed.
• Idea: save space; avoid redundancies.
• In current ecoinvent database: values for all the child data sets present; redundancies exist → (possible) task for software developers: keep redundant information consistent
Ecoinvent 3 market modeling

• Basically, products are not exchanged directly between processes, but through a market
  – Advantage: more flexible modeling of process chains
  – However, the current version is linked → flexibility lost
  – But...different default “system models”:
    “system model; a model describing how activity data sets are linked to form product systems. A system model may determine factors such as whether to use allocation (and which type of allocation) or substitution [...], or whether to use average or marginal suppliers. It may also affect how by-product treatments are assessed.”
  – Originally two system models: “Allocation, ecoinvent default” and “Consequential, substitution, long-term”.
• From version 3.0.1 also “cut-off” model.
Ecoinvent 3 market modeling

Figure 4.2. A market activity with its intermediate exchanges. Texts in brackets are not part of the name of the exchange.

(ecoinventory methodology report p.17)
Ecoinvent 3 market modeling

- Example for the difference between each system model:
  - Direct link: Consequential model
  - Market: Attributional / default model

(ecoinvent.org)
Ecoinvent 3: e.g. market for banana

### Process: market for banana

#### Inputs

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow property</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>transport, freight, inland waterway</td>
<td>502: Inland water transport</td>
<td>Goods transport</td>
<td>t*km</td>
</tr>
<tr>
<td>transport, freight train - RoW</td>
<td>491: Transport via railways</td>
<td>Goods transport</td>
<td>t*km</td>
</tr>
<tr>
<td>transport, freight train - CH</td>
<td>491: Transport via railways</td>
<td>Goods transport</td>
<td>t*km</td>
</tr>
<tr>
<td>transport, freight train - CN</td>
<td>491: Transport via railways</td>
<td>Goods transport</td>
<td>t*km</td>
</tr>
<tr>
<td>transport, freight, lorry, unspecif...</td>
<td>492: Other land transport</td>
<td>Goods transport</td>
<td>t*km</td>
</tr>
<tr>
<td>transport, freight, sea, transocean...</td>
<td>501: Sea and coastal water transport</td>
<td>Goods transport</td>
<td>t*km</td>
</tr>
<tr>
<td>transport, freight train - Europe ...</td>
<td>491: Transport via railways</td>
<td>Goods transport</td>
<td>t*km</td>
</tr>
<tr>
<td>transport, freight train - US</td>
<td>491: Transport via railways</td>
<td>Goods transport</td>
<td>t*km</td>
</tr>
<tr>
<td>banana - GLO</td>
<td>012: Growing of perennial crops</td>
<td>Mass</td>
<td>kg</td>
</tr>
</tbody>
</table>

#### Outputs

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow property</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>banana - GLO</td>
<td>012: Growing of perennial crops</td>
<td>Mass</td>
<td>kg</td>
</tr>
</tbody>
</table>
Ecoinvent 3: e.g. banana production

### Process: banana production

#### Inputs

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow property</th>
<th>Unit</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>ammonium nitrate, as N - GLO</td>
<td>201: Manufacture of basic fertilizers</td>
<td>Mass</td>
<td>kg</td>
<td>0</td>
</tr>
<tr>
<td>electricity, low voltage - ASCC</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>5</td>
</tr>
<tr>
<td>electricity, low voltage - AT</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>4</td>
</tr>
<tr>
<td>electricity, low voltage - AU</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>1</td>
</tr>
<tr>
<td>electricity, low voltage - BA</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>6</td>
</tr>
<tr>
<td>electricity, low voltage - BE</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>6</td>
</tr>
<tr>
<td>electricity, low voltage - BG</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>2</td>
</tr>
<tr>
<td>electricity, low voltage - BR</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>3</td>
</tr>
<tr>
<td>electricity, low voltage - CA-AB</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>2</td>
</tr>
<tr>
<td>electricity, low voltage - CA-BC</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>5</td>
</tr>
<tr>
<td>electricity, low voltage - CA-MB</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>3</td>
</tr>
<tr>
<td>electricity, low voltage - CA-NB</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>1</td>
</tr>
<tr>
<td>electricity, low voltage - CA-NF</td>
<td>351: Electric power generation</td>
<td>Energy</td>
<td>kWh</td>
<td>-</td>
</tr>
</tbody>
</table>

#### Outputs

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow property</th>
<th>Unit</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>banana - GLO</td>
<td>012: Growing of perennial forage crops</td>
<td>Mass</td>
<td>kg</td>
<td>1</td>
</tr>
<tr>
<td>Ammonia</td>
<td>Air/low population densities</td>
<td>Mass</td>
<td>kg</td>
<td>1</td>
</tr>
<tr>
<td>Nitrogen oxides</td>
<td>Air/low population densities</td>
<td>Mass</td>
<td>kg</td>
<td>2</td>
</tr>
<tr>
<td>Dinitrogen monoxide</td>
<td>Air/low population densities</td>
<td>Mass</td>
<td>kg</td>
<td>1</td>
</tr>
<tr>
<td>Zinc</td>
<td>Soil/agricultural</td>
<td>Mass</td>
<td>kg</td>
<td>-</td>
</tr>
</tbody>
</table>

(ecoinvent 3.1 allocation default)
Ecoinvent 3 System models

– Common rules:
  • By-products/wastes identified as materials for treatment are moved to the input with negative sign.
  • Intermediate inputs without activity link specified, are linked to the local market activity data set.
  • Data sets with “combined” products are divided into an equivalent number of data sets.
  • For “joint” products:
    → Allocation (partitioning)
    → System expansion (substitution)
Ecoinvent 3 Allocation model

- Divide the data sets into new activities according to the allocation factor
After allocation, all activities producing the same marketable by-product yielded from a treatment activity get aggregated and are grouped into a single dataset.
Ecoinvent 3 Substitution model

- All by-products are moved to the input side with negative sign

- All inputs and outputs are linked to their corresponding market activities
Ecoinvent 3 Cut-off model

– Based on the Recycled Content, or Cut-off, approach.
– Primary (first) production of materials is always allocated to the primary user of a material.
– If a material is recycled, the primary producer does not receive any credit for the provision of any recyclable materials. As a consequence, recyclable materials are available burden-free to recycling processes, and secondary (recycled) materials bear only the impacts of the recycling processes.
– Furthermore, producers of wastes do not receive any credit for recycling or re-use of products resulting out of any waste treatment.

e.g.: recycled paper? Waste incineration?
EcoInvent 3 Cut-off model (II)

– All technosphere flows are classified as:
  • ordinary by-product (treated just as common products, but they are not reference)
  • recyclable material ("Materials with no or little economic value that can serve as the input or resource for a recycling activity"), or
  • waste ("Materials with no economic value, and no interest in their collection without compensation")

Ecoinvent 3 Cut-off model (III)

– Waste products handling: by-product is burden-free

Ecoinvent 3 Cut-off model (IV)

- Handling of recyclable materials: negative input (=output) of a dummy process recycled content cut-off

Ecoinvent 3 Cut-off model (V)

- Handling of recyclable materials: when used in markets, markets get additional transport effort as usual

Ecoinvent 3 New data

- (very few: some international data; water data)

- Data updates
  - e.g. electricity mixes, transport
Ecoinvent 3 Consequences for openLCA

• Much larger systems
  → Optimization of performance in product systems (open, create new): before 2 min, now 10s
  → Optimization of the calculation (Background: matrix inversion, memory use, speed)
• modeling corrections (correct some links; uncertainty information)
• (openLCA structure adapts well already)
Life Cycle Costing in openLCA
Motivation of LCC

- LCC gives an overview over all costs that arise through the entire life cycle of a product.
- 2 perspectives: manufacturer and consumer
- Important for goods that entail high costs through maintenance (e.g. car or train) or for the comparison of different products
- LCC can be used for the calculation of eco-efficiency
**Example: The consumer perspective**

<table>
<thead>
<tr>
<th></th>
<th>Opel Corsa</th>
<th>Fiat Punto</th>
<th>Citroen Advance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purchase price</strong></td>
<td>10,945 €</td>
<td>10,890 €</td>
<td>10,9990 €</td>
</tr>
<tr>
<td><strong>Costs per year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy price</td>
<td>1,977 €</td>
<td>2,164 €</td>
<td>1,936 €</td>
</tr>
<tr>
<td>Taxes, insurance, etc.</td>
<td>1,753 €</td>
<td>1,911 €</td>
<td>1,527 €</td>
</tr>
<tr>
<td>Operating costs</td>
<td>909 €</td>
<td>964 €</td>
<td>998 €</td>
</tr>
<tr>
<td>Repair costs</td>
<td>352 €</td>
<td>490 €</td>
<td>318 €</td>
</tr>
<tr>
<td><strong>Total yearly costs</strong></td>
<td>4,991 €</td>
<td>5,529 €</td>
<td>4,779 €</td>
</tr>
</tbody>
</table>
Scope of LCC

LCC in openLCA

• Two possibilities:
  1. Costs are treated as environmental impacts (costs are emissions)
     » Costs are considered as elementary flows
  2. Use of the costs tab in the process editor
     » Only cost categories can be considered

The costs tab option is currently only included for process documentation purposes → No calculation is available!
Option 1: Costs as elementary flows

- In a first step, specific or general cost flows are defined (e.g. [(material costs) for PET], [(labour costs) for engineers], [(transport costs) for road transportation], etc.).

- These cost flows are assigned to processes (treated as emissions).

- It is recommended to create a new impact assessment method which adds up the cost flows. Different cost categories (impact categories) can be defined (e.g. manufacturing costs, transport costs, disposal costs, ...).
Option 1: Procedure in openLCA (I)

- Creation of costs flows as elementary flows
Option 1: **Procedure in openLCA (II)**

- Adding costs flows to processes (outputs)

**Process: Blade, steel LCC**

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow proper...</th>
<th>Unit</th>
<th>Amount</th>
<th>Uncertainty</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steel, billets, at plant - US</strong></td>
<td>Product flows</td>
<td>Mass</td>
<td>g</td>
<td>2</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td><strong>Electricity, at grid, CN</strong></td>
<td>Product flows</td>
<td>Energy</td>
<td>kWh</td>
<td>0.05</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

**Outputs**

<table>
<thead>
<tr>
<th>Flow</th>
<th>Category</th>
<th>Flow proper...</th>
<th>Unit</th>
<th>Amount</th>
<th>Uncertainty</th>
<th>Avoided</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blade, steel LCC</strong></td>
<td>Product flows</td>
<td>Number of ...</td>
<td>Item(s)</td>
<td>1</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td><strong>Energy costs</strong></td>
<td>LCC</td>
<td>Market valu...</td>
<td>EUR</td>
<td>0.2*0.05</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td><strong>Personnel costs</strong></td>
<td>LCC</td>
<td>Market valu...</td>
<td>EUR</td>
<td>0.004</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td><strong>Material costs</strong></td>
<td>LCC</td>
<td>Market valu...</td>
<td>EUR</td>
<td>0.02*0.90</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>
Option 1: **Procedure in openLCA (III)**

- Creation of an impact assessment method

### Impact categories

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Reference unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy costs</td>
<td></td>
<td>EUR</td>
</tr>
<tr>
<td>Material costs</td>
<td></td>
<td>EUR</td>
</tr>
<tr>
<td>Personnel costs</td>
<td></td>
<td>EUR</td>
</tr>
<tr>
<td>Transport costs</td>
<td></td>
<td>EUR</td>
</tr>
</tbody>
</table>

### Impact assessment method: LCC

#### Impact factors

<table>
<thead>
<tr>
<th>Impact category</th>
<th>Category</th>
<th>Flow property</th>
<th>Unit</th>
<th>Factor</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy costs</td>
<td>LCC</td>
<td>Market value US 2000, bulk prices</td>
<td>EUR/EUR</td>
<td>1.0</td>
<td>none</td>
</tr>
</tbody>
</table>
Option 1: Procedure in openLCA (IV)

- Calculate the product system costs results with the new LCIA method
Option 2: Costs tab in the process editor

- Cost categories are defined on the process level. Values are assigned to these cost categories.

1. Add a cost to the process
2. Select the cost category and introduce amount
Regionalisation in openLCA
Regionalised LCIA is model sophistication

• Commonly, in Life Cycle Assessment (LCA), the impact assessment (LCIA) is performed ignoring any regional differences.

• Differences in the inventory are considered as far as possible (e.g., different processes for electricity generation, in different countries...)

• There are good reasons for considering a regional variation in the impact assessment, but this adds complexity

→ When does this make sense?
Good reasons for regionalised LCIA

• Withdrawal of 1l of water for agriculture
Good reasons for regionalised LCIA

- Fine particles emissions to air

source: Berserkerus, GPL, Peking smog (left); Petra, CC0, sand storm, Jordania (right)
When does regionalised LCIA make sense?

Error
(= difference from reality)

Model sophistication, complexity
When does regionalised LCIA make sense?

Model sophistication, complexity

Error
(= difference from reality)

Errors due to ignoring / simplifying reality
When does regionalised LCIA make sense?

Errors due to misconceiving reality (sampling errors, misspecification of the model, others)

Error (= difference from reality)

Model sophistication, complexity
When does regionalised LCIA make sense?

Error (= difference from reality)

Model sophistication, complexity

Overall error

Errors due to misconceiving reality (sampling errors, misspecification of the model, others)

Errors due to ignoring / simplifying reality
When does regionalised LCIA make sense?

Error (= difference from reality)

Overall error

Errors due to misconceiving reality (sampling errors, misspecification of the model, others)

Errors due to ignoring / simplifying reality

Model sophistication, complexity

Ideal model complexity
When does regionalised LCIA make sense?

Error (\(=\) difference from reality)

- Errors due to misconceiving reality (sampling errors, misspecification of the model, others)
- Errors due to ignoring / simplifying reality

Overall error

Model sophistication, complexity

Ideal model complexity

**Pragmatic approach**

- In a pragmatic view, a regionalised LCIA makes sense in the following cases
  
a. Large regional differences in impacts of the same elementary flow; this is impact category-specific (climate change – noise, toxicity, water)
  
b. Low errors / “easy” implementation of the regional differences in impacts in the LCIA model,
  
c. Low error in the specification of the regionalised inventory (for GWP, CH can always be used as a location..)
  
d. Relevance of these regional differences especially for effort specifying the models, applying the models and collecting suitable inventory information needs to be considered.
Regionalised LCIA methods in openLCA

- Idea:
  → Parameterization of LCIA methods
Parameterization of LCIA methods

• Formulas for calculating the characterisation factors (CFs) can be defined
  – Input and dependent parameters can be used as in the process data sets.
Shapefiles containing regional characteristics

- Regional characteristics affecting the CFs can be defined with parameters:
  
  e.g. population density, precipitation variability, etc.

- Data for those characteristics is contained in shapefiles, which can be imported to openLCA

- Parameters are extracted during the shapefile import

- Shapefiles are stored in the database

`Shape file parameters`

- Location: C:\Users\Cristina\openLCA-data-1.4\databases\regionalised_example\olca_...`

  - Import...

  - Evaluate for existing locations

GreenDElTa
Shapefiles containing regional characteristics
Binding shapefiles and LCIA method parameters

- Parameters of shapefiles can be bound to input parameters.
- Default value of parameters is used for normal calculations and formula evaluation.
- In regionalized assessment, the parameter value derived from the shapefile is used for the formula evaluation.

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Uncertainty</th>
<th>Description</th>
<th>External source</th>
</tr>
</thead>
<tbody>
<tr>
<td>ratio_biom</td>
<td>1.0</td>
<td>none</td>
<td></td>
<td>ecoregions_ratio_biom</td>
</tr>
<tr>
<td>Ecofactor</td>
<td>610.0</td>
<td>none</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Extension of locations in openLCA (I)

Traditional approach:
- A list of locations available under File/Preferences/Locations.
- The geographic information of the locations was limited to a pair of latitude, longitude data.
- The processes could only used locations from the pre-defined list.
Extension of locations in openLCA (II)

New approach:

– The list of locations available in the database is shown in File/Edit locations.

– KML data can be added to each location (polygons, lines, points):
  • Import of kmz/xml files with geographic data.
  • Write the coordinates in the “Text editor”.

Example:

<table>
<thead>
<tr>
<th>Location</th>
<th>KML</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switzerland</td>
<td>Polygon [8.60,47.77 ... 8.60,47.77] (location)</td>
<td>European average values</td>
</tr>
</tbody>
</table>
Extension of locations: KML editor (map)
Extension of locations: **KML editor** (text)
Calculation framework

Linking of process locations and LCIA methods spatial units

- GeoTools libraries integrated in openLCA
  - The intersection between shapefiles features and process geometries is calculated.

→ A weighted mean calculated for each regional parameter

\[
\frac{\left(p(F_1) \times L(F_1) + p(F_2) \times L(F_2) \ldots\right)}{L}
\]

\[
\frac{\left(p(F_1) \times A(F_1) + p(F_2) \times A(F_2) \ldots\right)}{A}
\]
Calculation framework

Regionalised LCIA calculation:

• Creation of a regionalised result matrix for the inventory (GR)

• Creation of a regionalised LCIA matrix (CR)

• Creation of the regionalised LCIA result (RR)

\[ RR = CR \times GR \]
Regionalised LCIA: Calculation procedure

- Select the “Regionalised LCIA” option in the calculation properties window:

  → The impact method select must contain regionalised impact factors

![Calculation properties window](image)
Regionalised LCIA: **Calculation procedure**

- To reduce the calculation time for complex systems, it is recommended to evaluate the intersections with the existing database locations when the impact method is defined:

![Shape file parameters](image)

<table>
<thead>
<tr>
<th>Name</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f_c$ Critical F</td>
<td>0.004</td>
<td>1646.6</td>
</tr>
<tr>
<td>$f_c$ Current F</td>
<td>0.0</td>
<td>761.0</td>
</tr>
<tr>
<td>$f_c$ Ecofactor</td>
<td>0.0</td>
<td>2.0E7</td>
</tr>
<tr>
<td>$f_c$ Normalizat</td>
<td>2.614</td>
<td>2.614</td>
</tr>
</tbody>
</table>
Regionalised LCIA: **Results (I)**
Regionalised LCIA: **Results (II)**

### Locations

- **Flows**
  - Manganese - air/low population density

- **Impact categories**
  - total - Water resources

### Result contributions

<table>
<thead>
<tr>
<th>Location</th>
<th>Process</th>
<th>Amount</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin America and the Caribbean</td>
<td>copper, primary, at refinery</td>
<td>1.79256E-9</td>
<td>kg</td>
</tr>
<tr>
<td></td>
<td>copper concentrate, at beneficiation</td>
<td>3.21146E-10</td>
<td>kg</td>
</tr>
<tr>
<td></td>
<td>hard coal, at mine</td>
<td>3.21146E-10</td>
<td>kg</td>
</tr>
<tr>
<td></td>
<td>hard coal, at regional storage</td>
<td>3.21146E-10</td>
<td>kg</td>
</tr>
<tr>
<td>Europe</td>
<td></td>
<td>4.06805E-10</td>
<td>kg</td>
</tr>
<tr>
<td>Global</td>
<td></td>
<td>2.99522E-10</td>
<td>kg</td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
<td>2.85524E-10</td>
<td>kg</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td>7.65524E-11</td>
<td>kg</td>
</tr>
<tr>
<td>Poland</td>
<td></td>
<td>5.91038E-11</td>
<td>kg</td>
</tr>
<tr>
<td>Spain</td>
<td>ignite, burned in power plant</td>
<td>2.05723E-11</td>
<td>kg</td>
</tr>
<tr>
<td></td>
<td>natural gas, burned in power plant</td>
<td>2.05723E-11</td>
<td>kg</td>
</tr>
<tr>
<td></td>
<td>electricity, production mix ES</td>
<td>2.05723E-11</td>
<td>kg</td>
</tr>
<tr>
<td></td>
<td>hard coal, burned in power plant</td>
<td>2.03072E-11</td>
<td>kg</td>
</tr>
<tr>
<td></td>
<td>electricity, natural gas at power plant</td>
<td>2.03072E-11</td>
<td>kg</td>
</tr>
</tbody>
</table>

*Inventory results | LCIA Results | Process contributions | Result map | Locations*
Environmental Product Declarations
# Environmental labeling according to ISO

<table>
<thead>
<tr>
<th></th>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information</strong></td>
<td>Qualitative</td>
<td>Qualitative / quantitative</td>
<td>Quantitative</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>Special products</td>
<td>All products and services</td>
<td>All products and services</td>
</tr>
<tr>
<td><strong>Quality check</strong></td>
<td>Verification of eco-labeling body</td>
<td>None</td>
<td>Third-party certification</td>
</tr>
<tr>
<td><strong>Receiver</strong></td>
<td>Consumers</td>
<td>Consumers/professional purchasers</td>
<td>Professional purchasers</td>
</tr>
</tbody>
</table>

Environmental Product Declaration (EPD)

• A declaration based on Life Cycle Assessment

• A verified document that reports environmental data of products based on life cycle assessment (LCA) in accordance with the international standard ISO 14025 (Type III Environmental Declarations)

• According to EN 15804:2012, an EPD

  “communicates verifiable, accurate, non-misleading environmental information for products and their applications, thereby supporting scientifically based, fair choices and stimulating the potential for market-driven continuous environmental improvement”

• The information may cover different life cycle phases.
What is the EN 15804 for?

- To ensure that the EPDs of construction products are derived, verified and presented in a harmonized way
- EN 15804 compliant EPD can report performance against the indicators for 17 life cycle modules:

Thank you!

Contact

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