

GreenDelta

sustainability consulting + software



openLCA Advanced Training

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GreenDelta GmbH

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Berlin, Germany

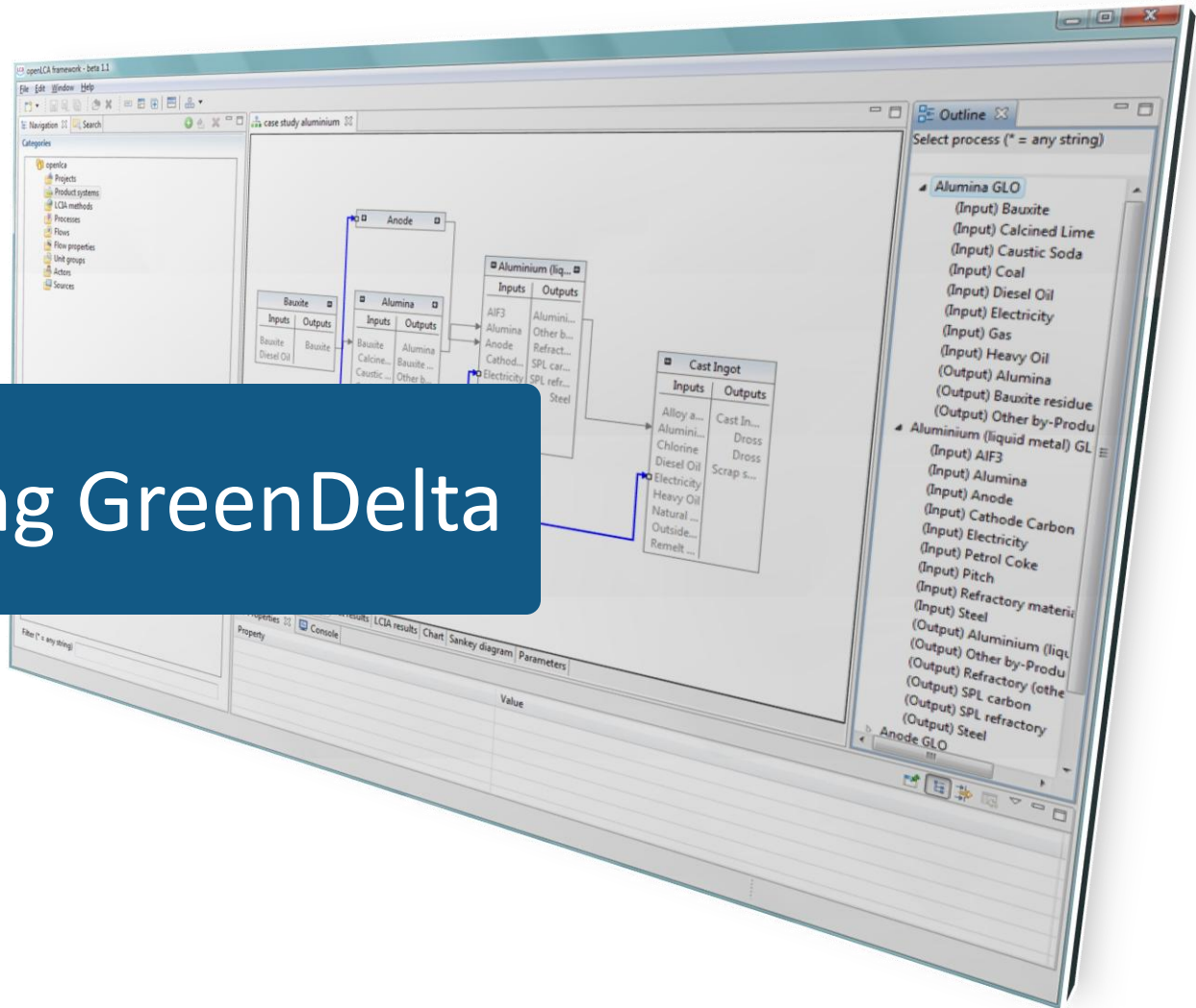
Content

- Introduction to GreenDelta
- Introduction to openLCA
- Functions and features (overview)
- Installation
- First look at the software
- LCA data import
- Elements in the database:
- Creating flows and processes
- Tips and tricks for working with openLCA
- Product systems creation and calculation
- Impact assessment methods creation
- Results analysis and interpretation
- Sensitivity analysis (working with parameters)
- Data export

Content II

- Allocation and system expansion
- Additional (new) features
- Experimental features
- Uncertainty analysis
- Ecoinvent 3
- Life Cycle Costing
- Regionalised LCIA
- Environmental Product Declarations
- Open discussion and question session
- Feedback and closing remarks

Introducing GreenDelta



GreenDelta background

- Founded by Dr. Andreas Citroth 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, 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)

- Crititcal 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 5 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



SIEMENS

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Knoll



CCL LABEL
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SYKE

Finnish Environment Institute



ADEME



Agence de l'Environnement
et de la Maîtrise de l'Energie



Academic Customers



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Swiss Federal Institute of Technology Zurich



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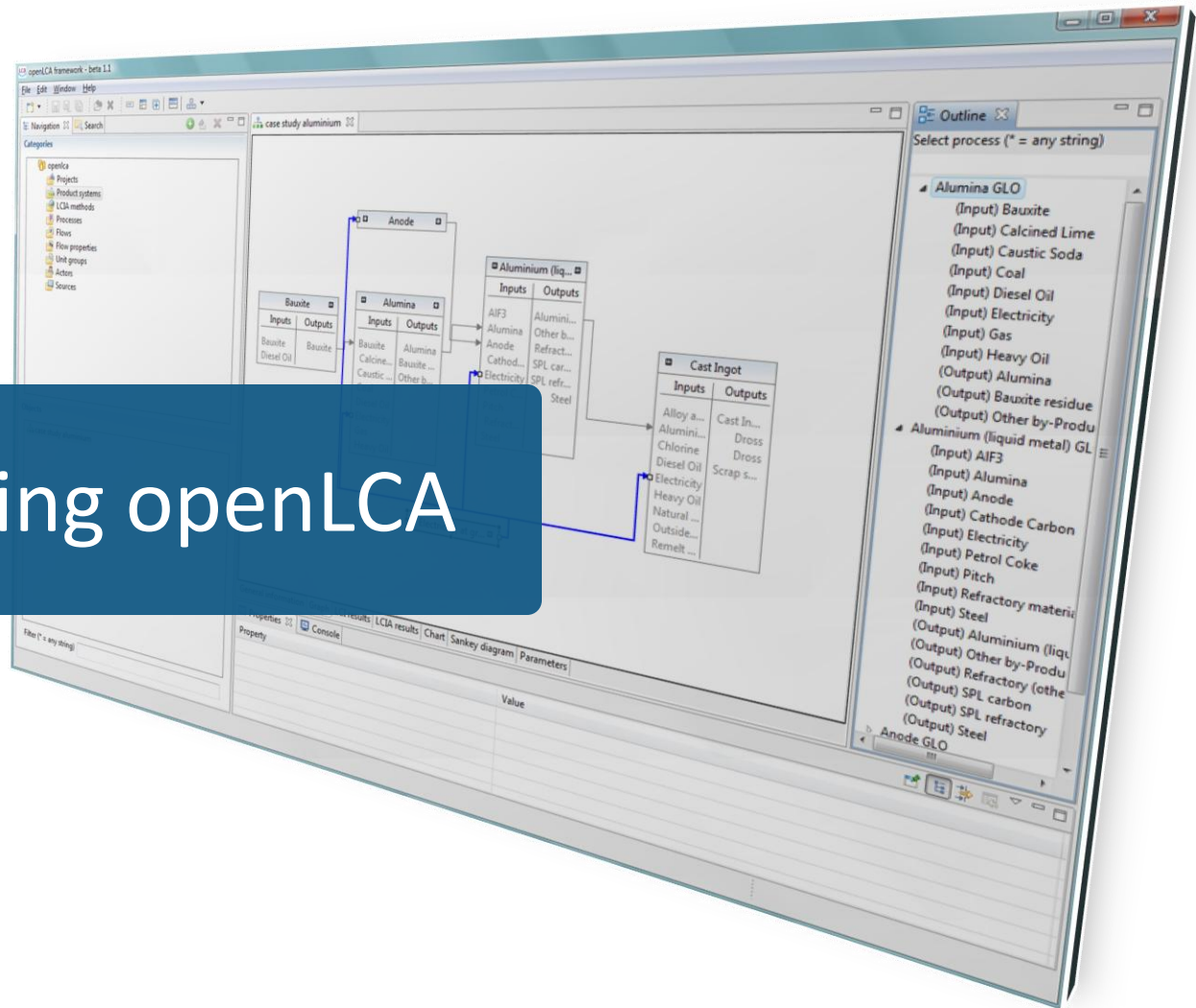
Consultants as Customers



D'APPOLONIA



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)

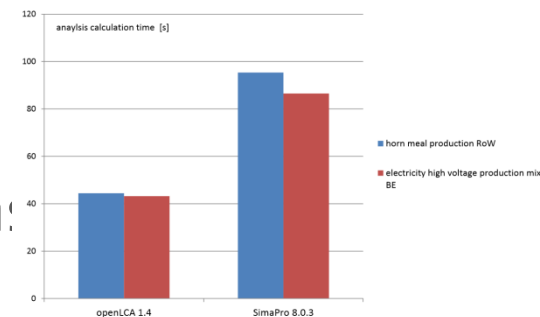
- Life Cycle Assessment, Life Cycle Costing, Social Life Cycle Assessment
- Carbon & Water footprint
- Product Environmental Footprint
- Environmental Product Declarations
- US Environmental Protection Agency's Design for the Environment Label
- Integrated Product Policy

openLCA features overview

- All the features you expect for professional LCA modeling and analysis:

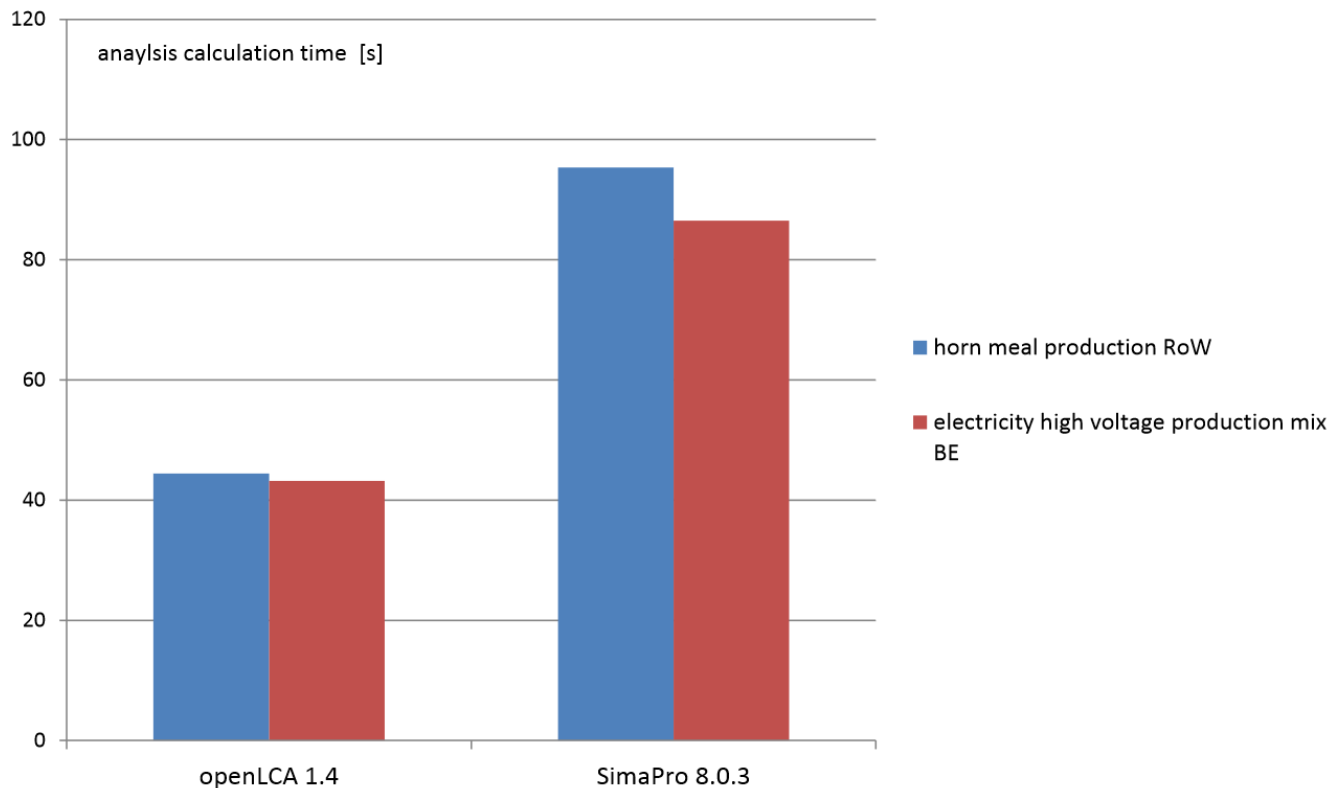
working with and creating smaller and very large product systems, “autoconnect” (as in SimaPro) or by manual connection (as in GaBi); parameters, sensitivity analysis, scripting (Javascript, Python), system expansion and allocation, uncertainty assessment, Monte Carlo Simulation, LCIA calculation with 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 system:



openLCA features overview (II)

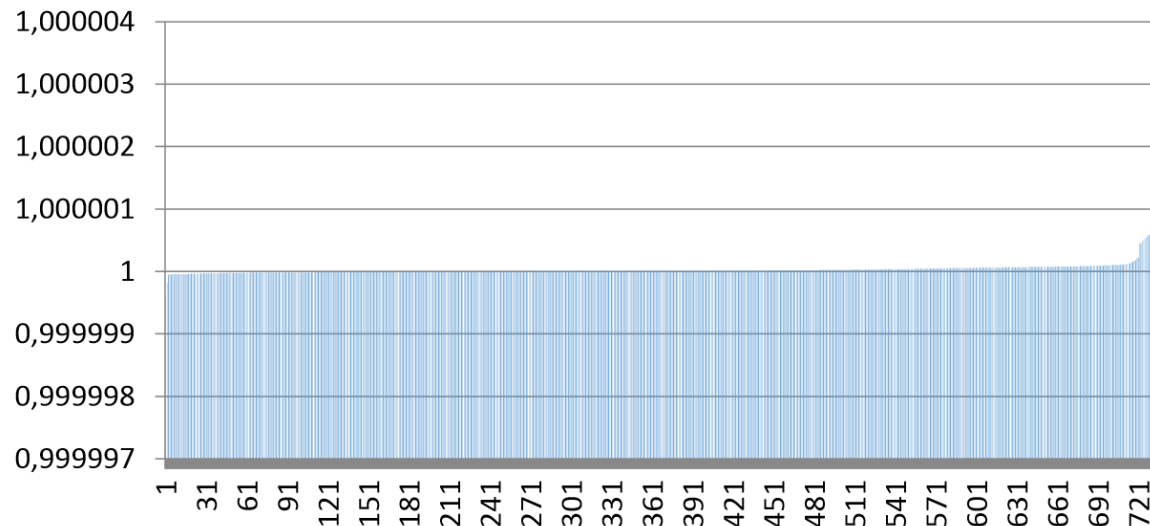
- Fast calculation of large systems: e.g. ecoinvent 3.0



openLCA quality assurance

- External and internal testers
- Beta versions before final release → more user input

ratio SimaPro result to openLCA result, inventory flows, electricity, high voltage, production mix BE, ecoinvent 3.0.1 default allocation model



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

openLCA.org/downloads



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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.

 [RSS feed](#)




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](#).

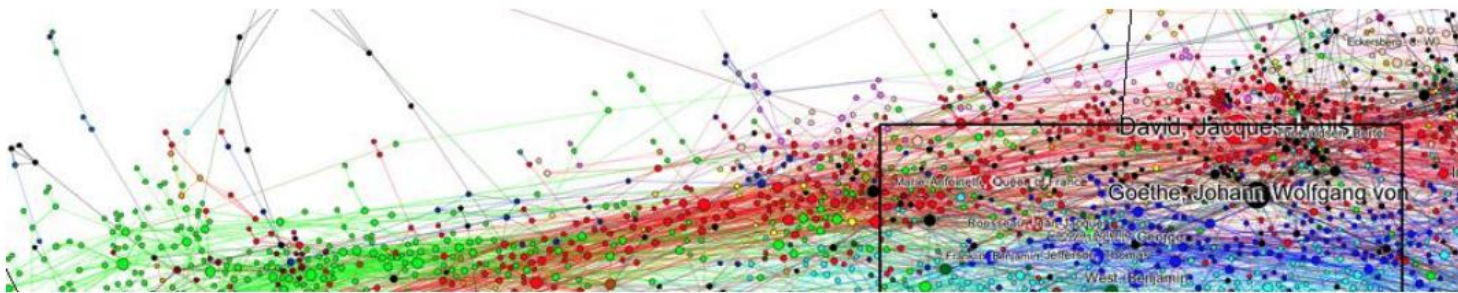
Installation files

 Version 1.4 Windows 64 bit	 Version 1.4 Mac 64 bit	 Version 1.4 Linux 64 bit
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openLCA.org/learnmore



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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.



openLCA.org/services



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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.
- **Adaptions and extensions:** If openLCA (or other LCA software) does not meet your

openLCA.org/forum



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openLCA 1.4	23	73	by aciroth 11 Aug 2014 13:46
Installation	25	103	by aciroth 02 Sep 2014 13:18
Modelling	78	236	by aciroth 27 Aug 2014 16:30
Data and Data Exchange	66	233	by aciroth 23 Aug 2014 09:17
Developer	13	45	by aciroth 26 Jun 2014 17:09
Other	17	52	by MartinaZ 11 Jun 2014 11:19
Version 1.2 test Forum for the July 2010 (+..) test round of openLCA	6	17	by aciroth 01 Jun 2013 12:48

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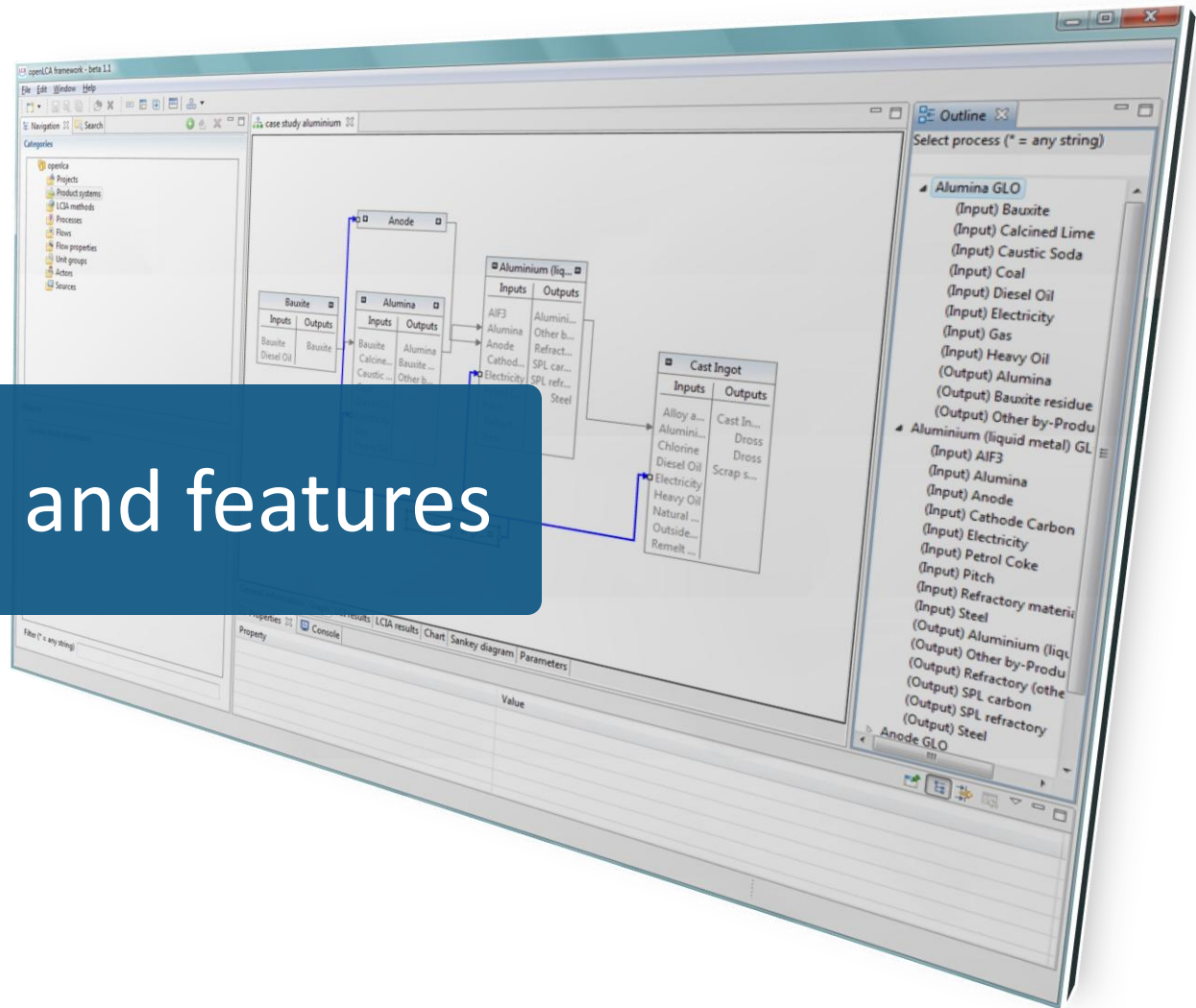
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WHO IS ONLINE

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

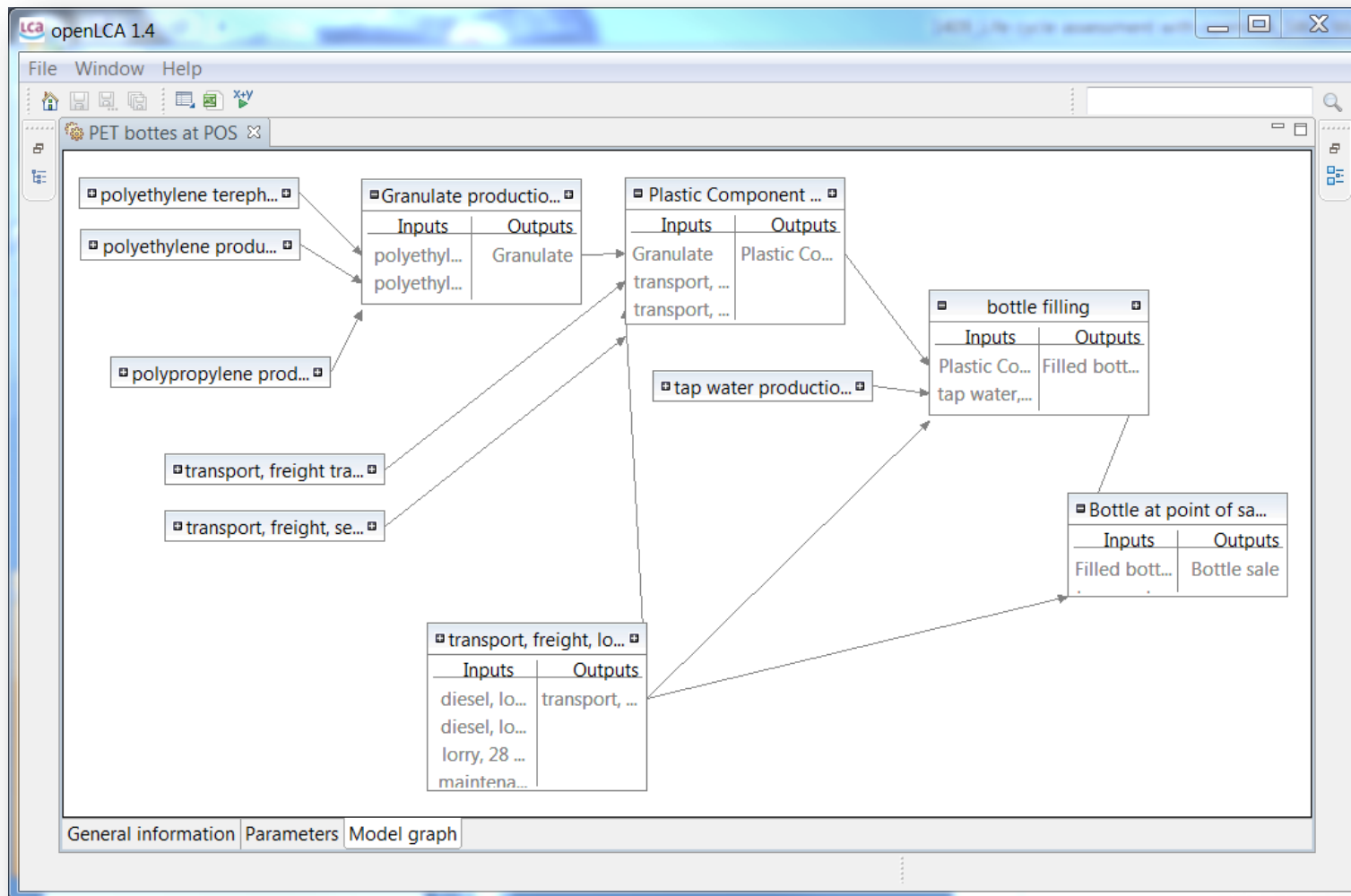


Graphical modeling of product systems

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

The screenshot displays the openLCA 1.4 software interface. The left sidebar shows a navigation tree with categories like Processes, biomass, and others. The main window is titled 'Ethanol, denatured, corn dry mill - RNA' and shows the 'Allocation' tab. The 'Default method' is set to 'Causal'. Below this, there are two sections: 'Physical & economic allocation' and 'Causal allocation'. The 'Physical & economic allocation' section contains a table with columns for Product, Physical, and Economic values. The 'Causal allocation' section contains a table with columns for Flow, Direction, Category, Amount, and two columns for allocation values (distillers ... and Ethanol, ...).

Allocation

Default method: Causal

Calculate default values

Physical & economic allocation

Product	Physical	Economic
Ethanol, denatured, corn dry mill - R...	1.0	1.0
distillers dried grains with solubles, ...	0.01	0.01

Causal allocation

Flow	Direction	Category	Amount	distillers ...	Ethanol, ...
Water, cooling, unspe...	Input	resource/i...	6.23000E4...	0.01	1.0
Gasoline, at refinery - ...	Input	Product fl...	266.00000	0.01	1.0
Energy, output - RNA	Input	Product fl...	3.95000E5...	0.01	1.0
Water, unspecified nat...	Input	resource/i...	1830.0000...	0.01	1.0
Energy, output - RNA	Input	Product fl...	8440.0000...	0.01	1.0
dummy_yeast paste, fr...	Input	Product fl...	60.00000 ...	0.01	1.0
Electricity, at grid, US, ...	Input	Product fl...	3310.0000...	0.01	1.0
Natural gas, combust...	Input	Product fl...	219.00000...	0.01	1.0
Electricity, at grid, US, ...	Input	Product fl...	436.00000...	0.01	1.0

General information | Inputs/Outputs | Administrative information | Modeling and validation | Parameters | Allocation | Costs

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

Excavator, technology mix, 100 kW, Construction - GLO

Parameters

Global parameters

Input parameters

Name	Value
Benzene_h	0.021
bucket_volume	1.1
CH4_h	0.72
CO_h	150.0
cycles_min	0.75
density	1.8
Dust_h	16.0
fuel_h	25.5
load_factor	0.6
N2O_h	3.0
NMVOc_h	29.0
NOx_h	520.0
sulphur_ppm	200.0
Toluene_h	0.003
Xylene_h	0.264

Dependent parameters

Name	Formula	Value	Description
Benzene_t	Benzene_h*load_factor/performance*d...	4.58181818181818E-4	[24] [c
CH4_t	CH4_h*load_factor/performance*densi...	0.0157090909090909	[22] [c
CO_t	CO_h*load_factor/performance*density	3.27272727272727	[18] [c

Preferences

Global parameters

Name	Amount	Uncertainty	Description
p0	1.0	none	

Field Assist

- @Configuration
- Experimental features
- Global parameters
- ILCD Network
- Locations
- Logging
- Number format
- Updates

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
                Diesel prod. Bauxite mining Alumina prod. Anode prod. Electrolysis Ingot casting
Diesel [kg]          1          -1.993          -0.6          -3.2           0           -0.1
Bauxite, at plant [kg] 0          1000.000        -2685.0          0.0           0           0.0
Alumina [kg]         0           0.000          1000.0          0.0          -1925          0.0
Anode [kg]           0           0.000           0.0          1000.0          -441           0.0
Aluminium (liquid metal) [kg] 0           0.000           0.0           0.0          1000          -874.0
Ingot [kg]           0           0.000           0.0           0.0           0          1000.0
```

```
> B
                Diesel prod. Bauxite mining Alumina prod. Anode prod. Electrolysis Ingot casting
Crude oil [kg]       -1.500000           0           0.00           0.00           0.00           0.00
Bauxite [kg]         0.000000          -1000           0.00           0.00           0.00           0.00
CO2 / CO2 equ. [kg] 0.302000           48          991.00          849.00          9789.00          368.00
NOx [kg]             0.000878           0           1.17           0.29           0.35           0.16
SO2 [kg]             0.001700           0           5.30           1.70           13.40           0.29
```

```
> f
                [,1]
Diesel [kg]          0
Bauxite, at plant [kg] 0
Alumina [kg]         0
Anode [kg]           0
Aluminium (liquid metal) [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 [kg]    -17.018990
Bauxite [kg]      -4517.378250
CO2 / CO2 equ. [kg] 11138.388062
NOx [kg]          2.556104
SO2 [kg]          21.593111
```

```
> |
```

$$s = A^{-1} \cdot f$$

$$g = B \cdot s$$

Example: inventory results

openLCA 1.4.1 beta 6

File Window Help

Analysis result of graphic paper production, 100% recycled, alloc. default, S

Inventory results

▸ Inputs

▾ Outputs

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

General information | Inventory results | LCIA Results | Process contribut... | 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

openLCA 1.4.1 beta 6

File Window Help

Analysis result of graphic paper production, 100% recycled, alloc. default, S

Inventory results

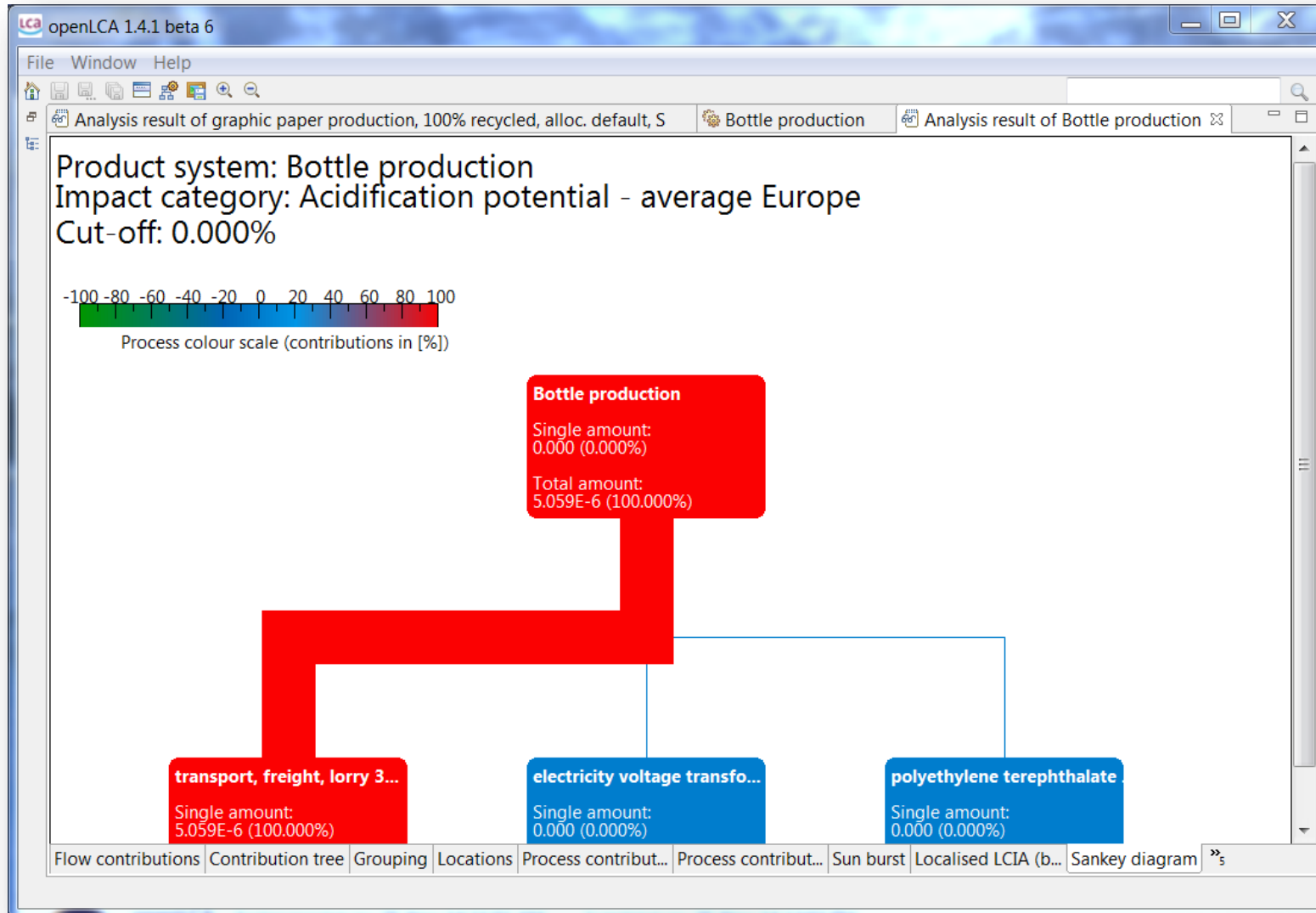
▸ Inputs

▾ Outputs

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General information | Inventory results | LCIA Results | Process contribut... | Process results | Flow contributions | Contribution tree | Grouping | Locations »

Sankey-Diagram



Grouping

The screenshot shows the openLCA 1.4.1 beta 6 software interface. The main window is titled "Grouping" and contains two main sections: "Groups" and "Results".

Groups Section:

- A tree view on the left shows a folder named "transport" under a parent folder "Other".
- The main area displays a selected group: "transport, freight, lorry 3.5-7.5 metric ton, EURO5, alloc. default, U -...".

Results Section:

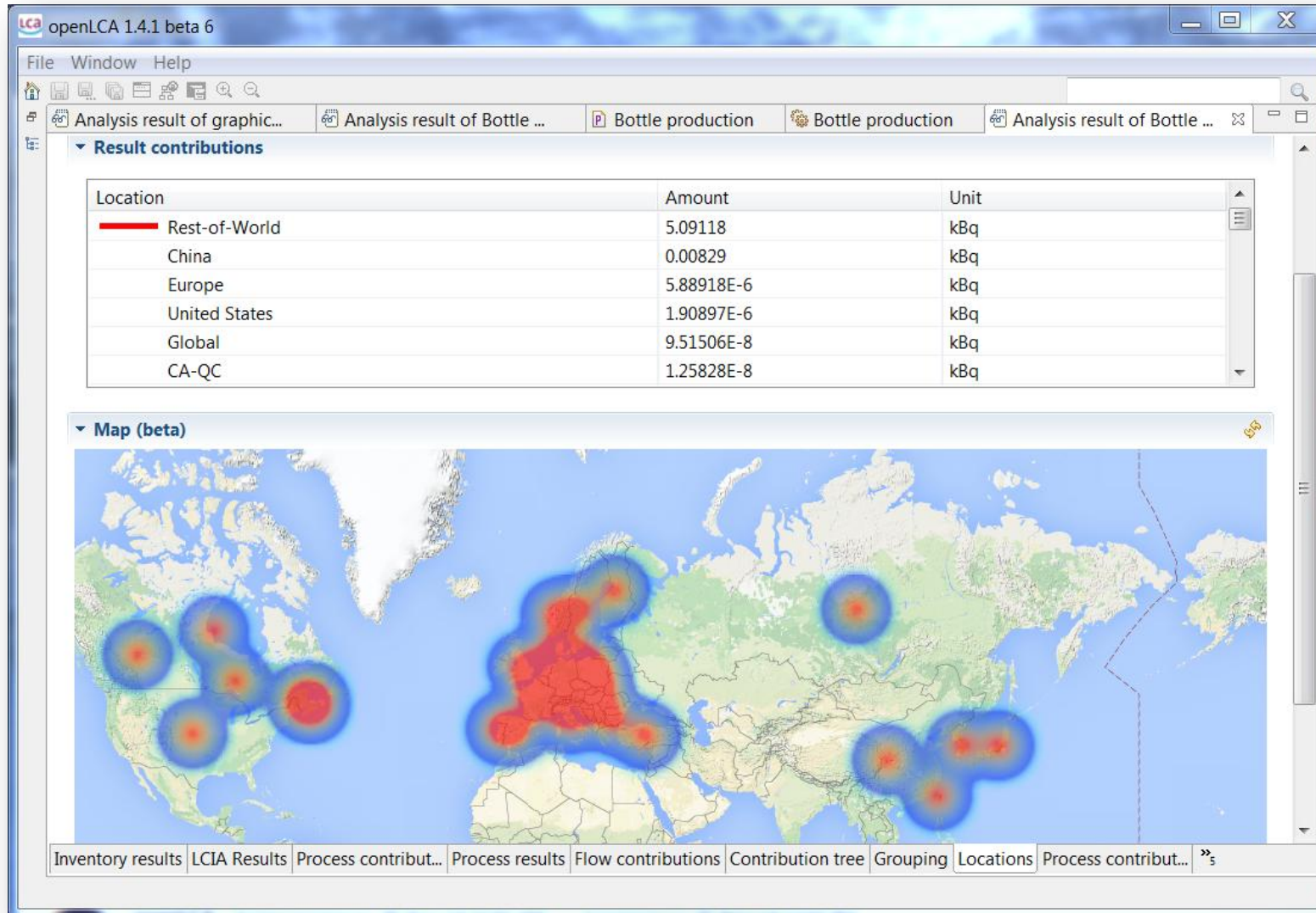
- The "Flows" radio button is selected, and the flow is "electricity, medium voltage - 351:Electric power generation, transmission and distribution/3510:Electr... - CA-ON".
- The "Impact categories" radio button is selected, and the category is "Acidification potential - average Europe".

Results Table:

Group	Amount	Unit
transport	5.059111008E-6	kg SO2 eq.
Other	0.0	kg SO2 eq.

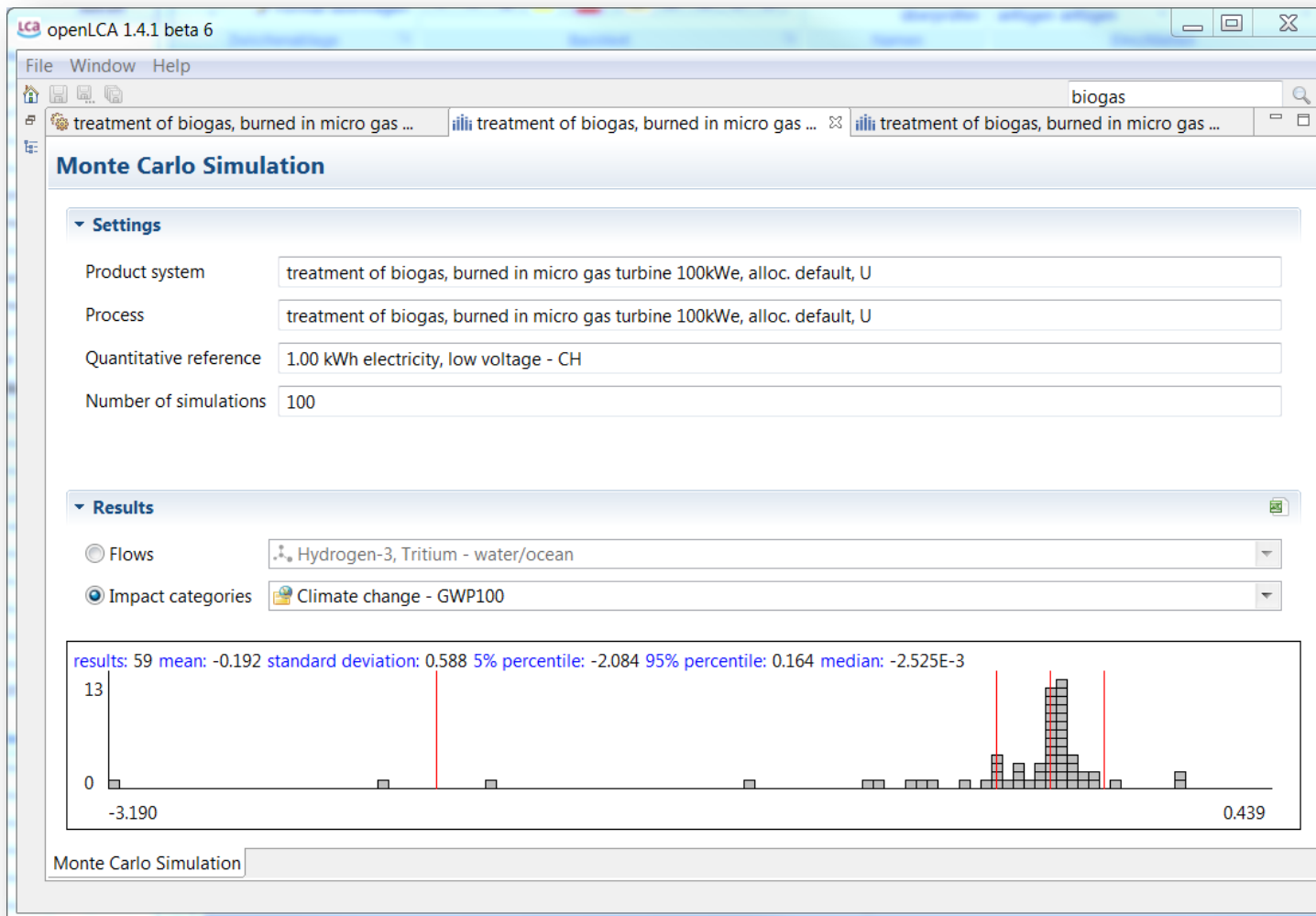
At the bottom of the window, there is a navigation bar with the following tabs: "Flow contributions", "Contribution tree", "Grouping", "Locations", "Process contribut...", "Process contribut...", "Sun burst", "Localised LCIA (b...", "Sankey diagram", and a "»" button.

Localisation



Uncertainty analyses

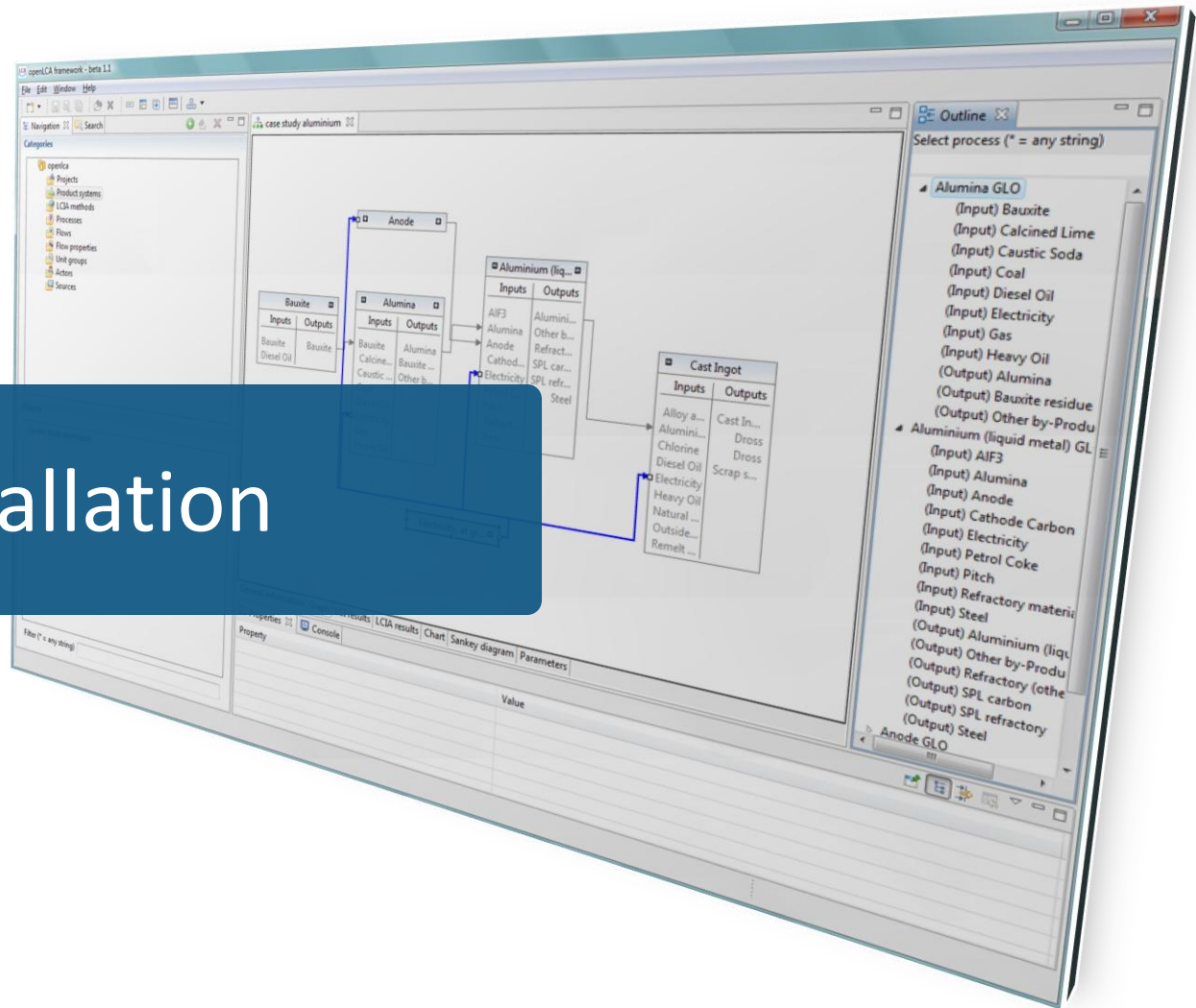
.. with Monte-Carlo-Simulation or pedigree approach



Further characteristics

- Separate calculation of costs possible
- Multiple languages
- Automatic error report
- Integrated static and dynamic help

Installation



System requirements

Software, required:

- Mac OS: Java Development Kit 8 (<http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html>)

Software, optional:

- Windows 64 bit (for modern browser support): Microsoft Visual C++ 2010 Redistributable Package (x64) (<http://www.microsoft.com/de-de/download/details.aspx?id=14632>)
- 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/>

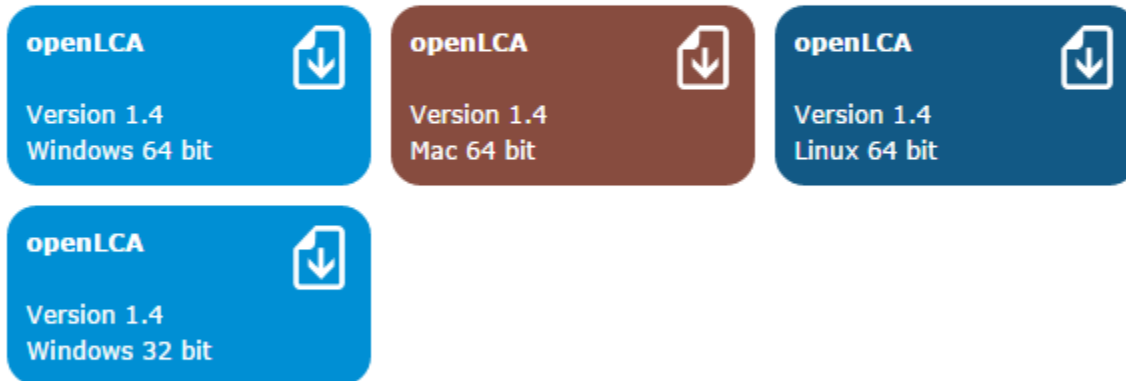
openLCA

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To see video tutorials on openLCA installation, click [here](#).

Installation files



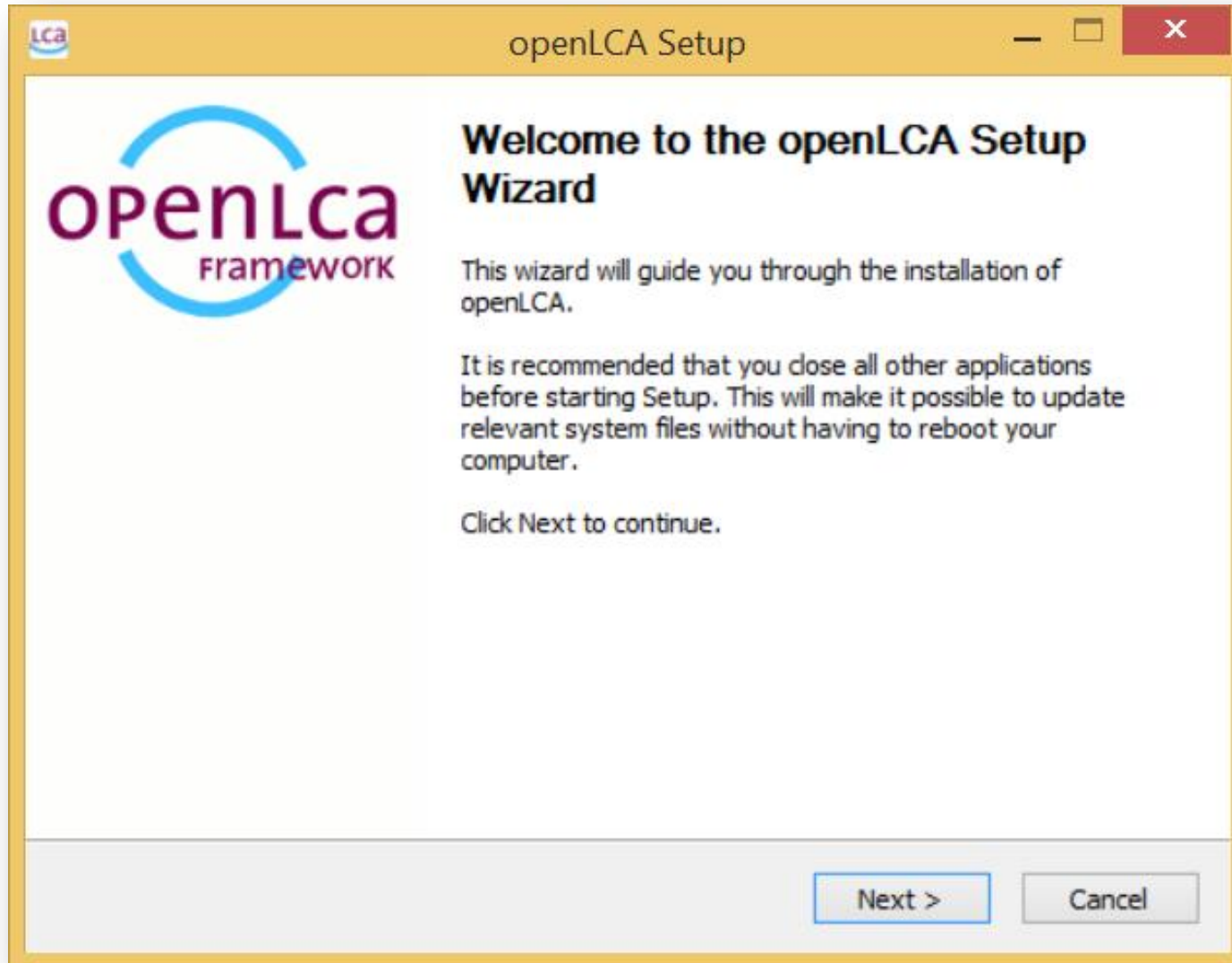
The image shows four download buttons for openLCA Version 1.4. Each button contains the text 'openLCA', 'Version 1.4', and the operating system and bitness. A white download icon is in the top right corner of each button.

- 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

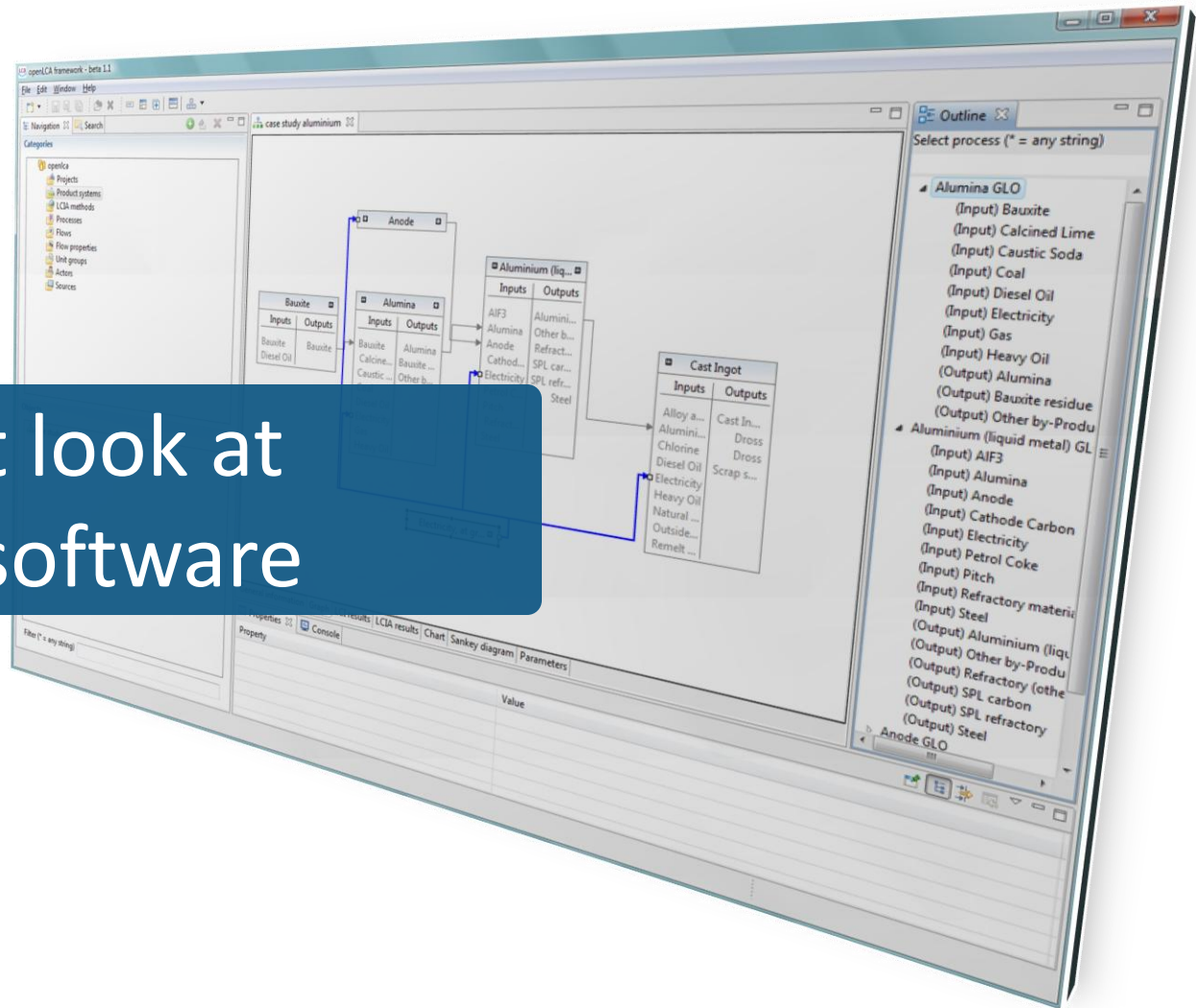
zip files for openLCA - just unzip and run openLCA, no installation needed, several versions of openLCA can be "installed" in parallel:

openLCA 1.4 Windows 64 bit
openLCA 1.4 Windows 32 bit

openLCA installer



First look at
the software



Welcome to openLCA!

openLCA 1.4

File Window Help

Navigation

- bioenergiesdat
- ecoinvent_3_cutoff(1)
- elcd
- gabi_2013_professional
- lca_commons_1.1
- openlca_lcia_methods_1.4
- probas_1
- schulungaugust14students

Welcome

openLca Welcome to openLCA!
Version 1.4 for Windows (64 bit)

High performance Life Cycle Assessment (LCA) and sustainability assessment software. Truly open source. Available for free. Created and maintained since 2006 by GreenDelta, Berlin. www.greendelta.com
Licensed under the Mozilla Public License ([what does this mean?](#)).

GreenDelta

What's new

For the 1.4 version, we completely redesigned and "renovated" openLCA. Results are

- **drastically improved performance** of about 400%
- num
- man

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 zolca-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](#)

method packs are available from the o

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](#)

Community

An increasing number of people are using openLCA. Register in the [forum](#) to share your thoughts, ask questions, read answers and participate in the community.

0 items selected

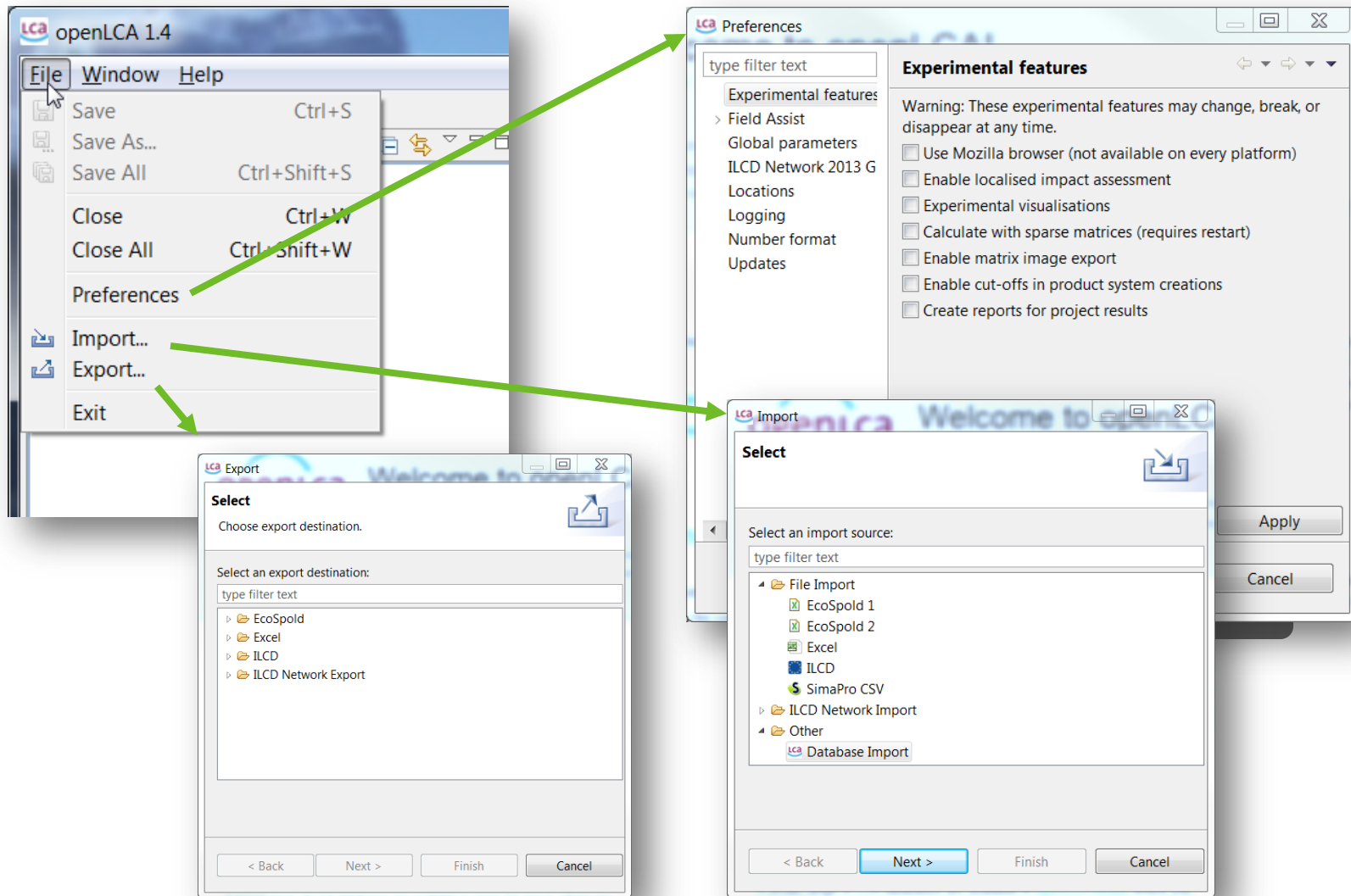
Nexus

Case Studies

Forum

Manuals

Main menu functions



Create a new database

File Window Help

Navigation Welcome

openLCA

Welcome to openLCA!

Version 1.4.1 beta 4 (Windows 64 bit)

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GreenDELTA

- New database
- Import database

What's new

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- numerous usability improvements
- many new features

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User Manuals

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Examples

Community

Welcome

Right click on Navigation, select "New database"

Create a new database (II)

New database
Create a new database

Database name

Database type Local Remote

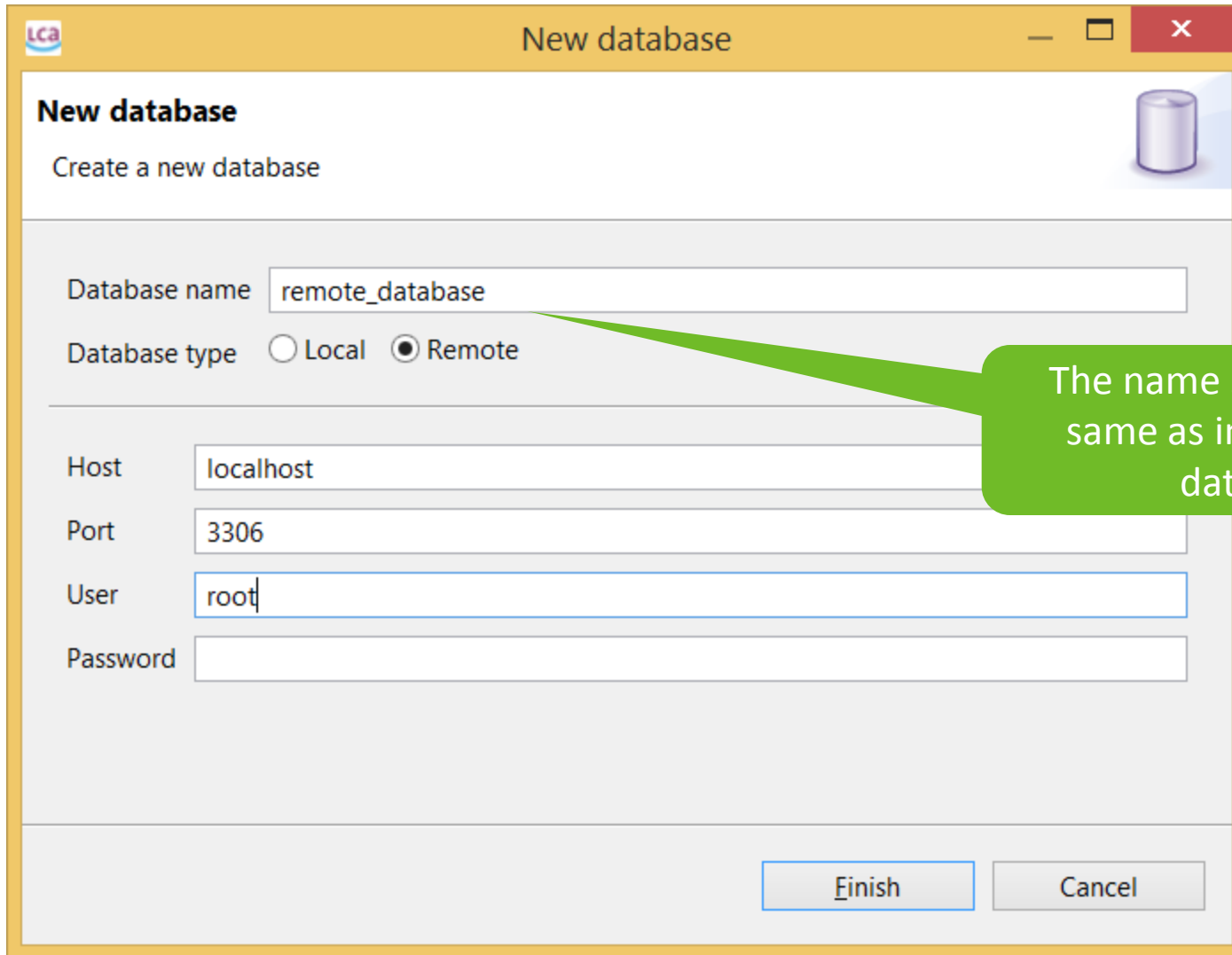
Database content Empty database
 Units and flow properties
 Complete reference data

Finish Cancel

Local or remote databases can be created

Different content available

Create a new database (III)



New database

Create a new database

Database name

Database type Local Remote

Host

Port

User

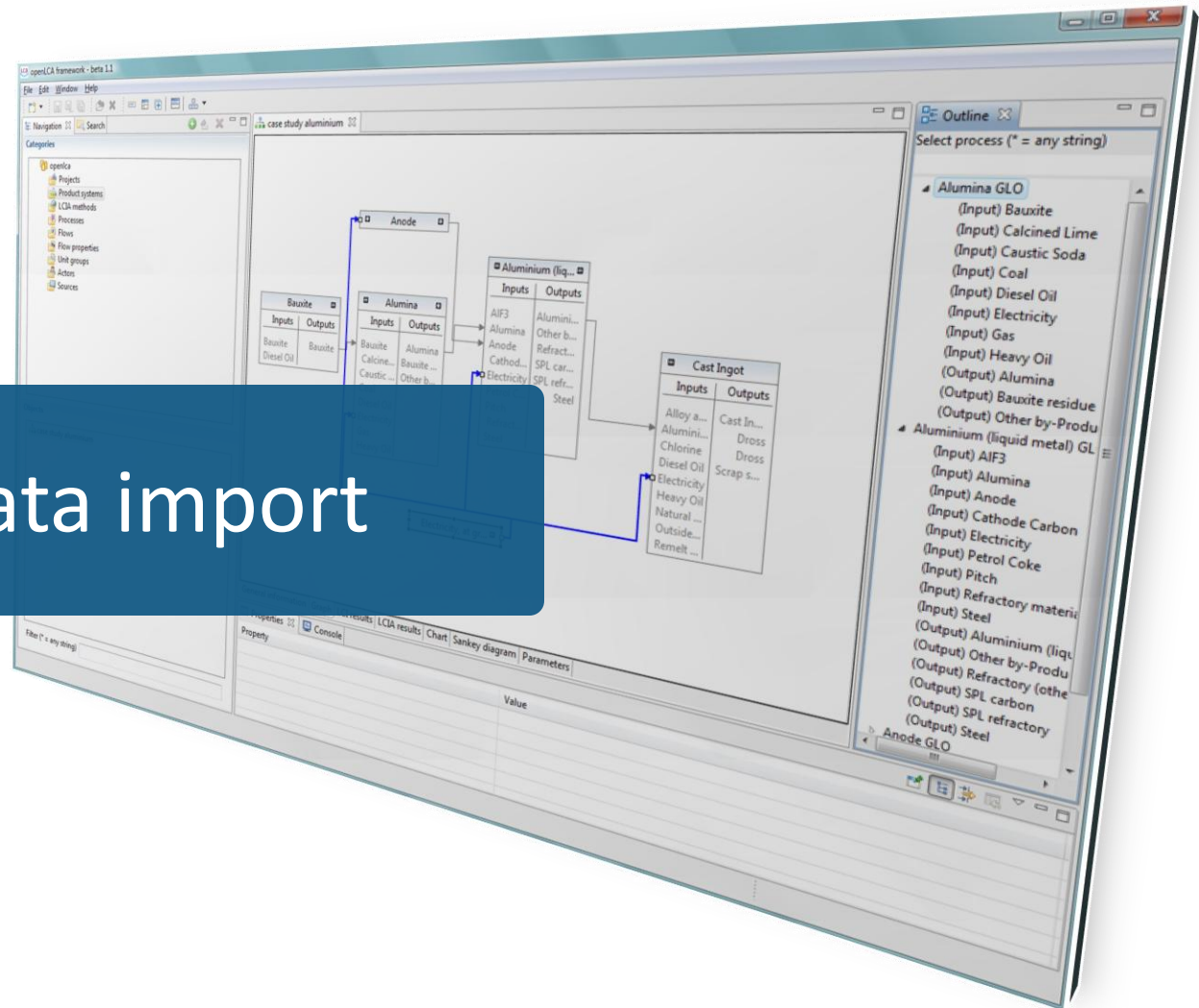
Password

The name should be the same as in the remote database

openLCA overview

The screenshot displays the openLCA 1.4 software interface. The window title is "openLCA 1.4". The menu bar includes "File", "Window", and "Help". The left sidebar contains a "Navigation" tree with categories like "Products", "Impact methods", "Processes", "Flows", "Flow properties", "Unit groups", "Sources", "Actors", and "elcd". A green callout labeled "Main Menu" points to the top menu bar. A green callout labeled "Editor" points to the central workspace area. A green callout labeled "Search" points to the search bar in the top right corner. A green callout labeled "Navigation" points to the left sidebar. The main workspace shows the "Process: market for electricity, low voltage" editor. It includes a "General information" section with fields for "Name" (market for electricity, low voltage), "Description", "Category", "Version", "Last change", and "Infrastructure process". There is a "Create product system" button. Below this is a "Quantitative reference" section with a dropdown menu set to "electricity, low voltage (DE)". The "Time" section has "Start date" (01-Jan-2008) and "End date" (02-Dec-2014) dropdowns, and a "Description" text area. The "Geography" section has a "Location" dropdown set to "Germany". At the bottom, there are tabs for "General information", "Inputs/Outputs", "Administrative information", "Modeling and validation", "Parameters", "Allocation", and "Costs". The status bar at the bottom left shows "0 items selected".

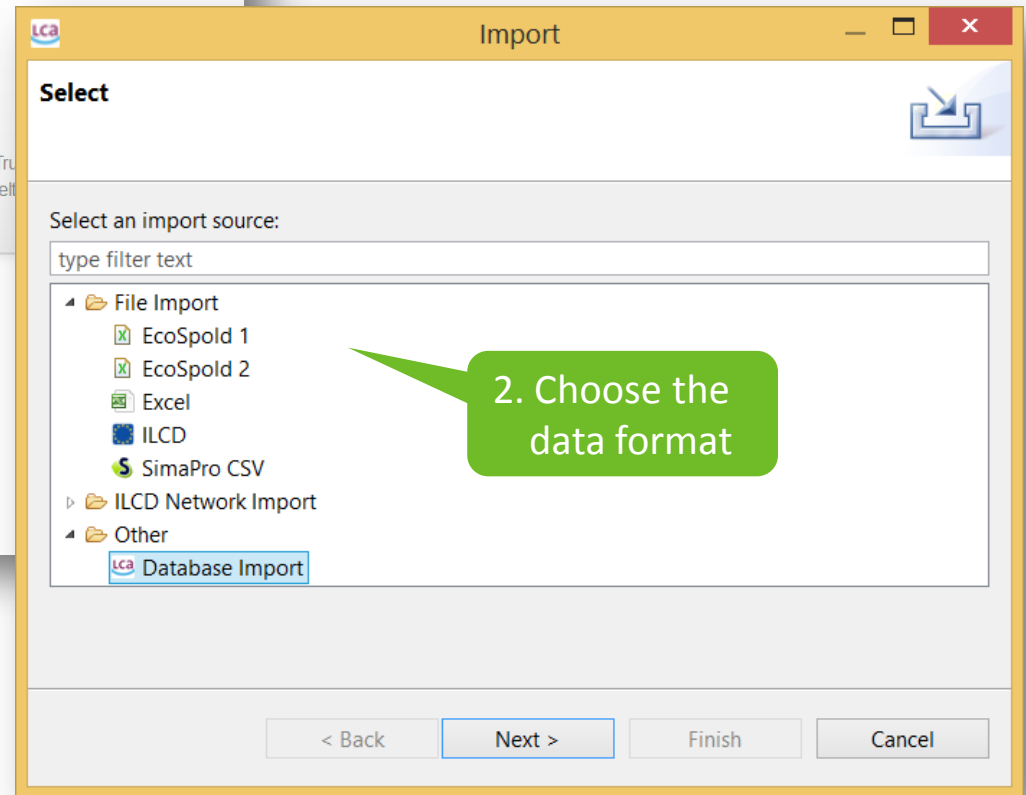
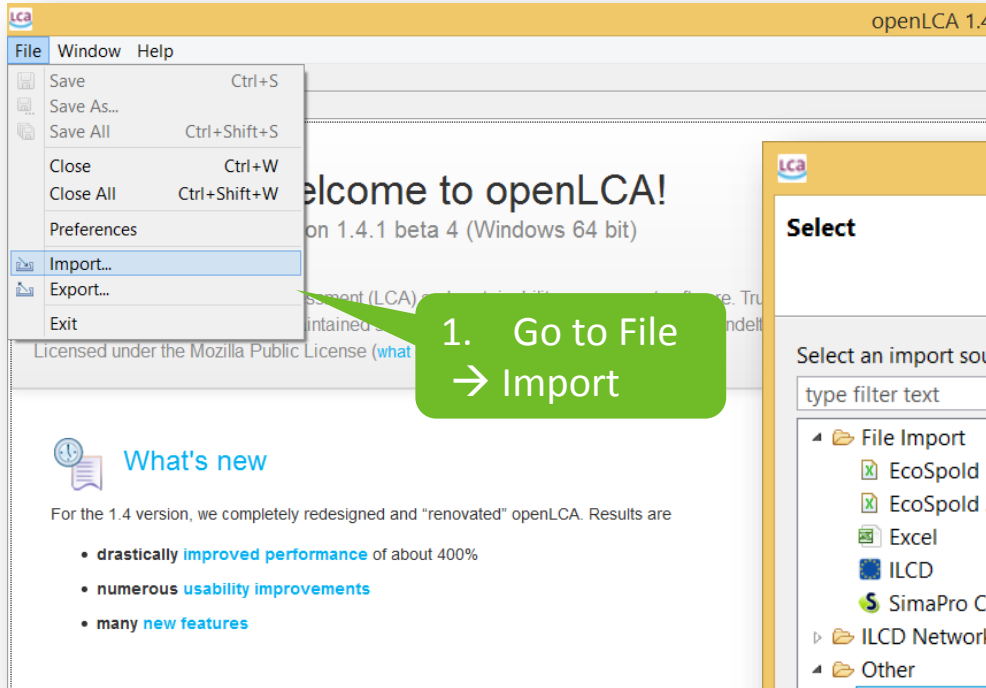
LCA data import



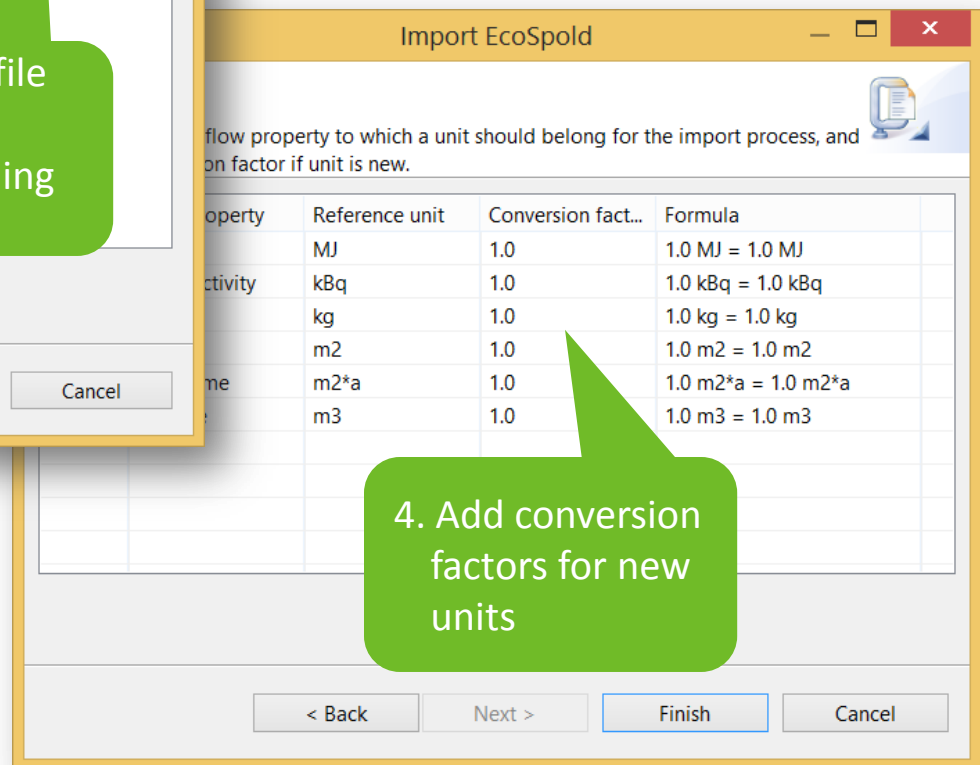
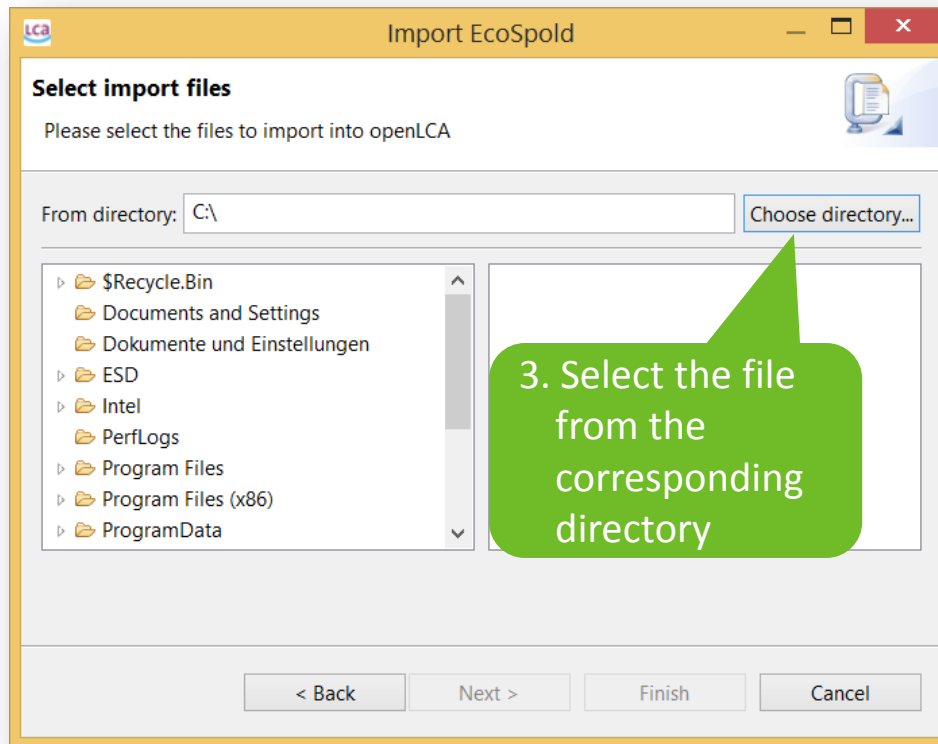
Data management in openLCA

- 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



Import data sets (II)



Import data sets (III)

Assign units

Please select the flow property to which a unit should belong for the import process, and assign a conversion factor if unit is new.

Unit	Flow property	Reference unit	Conversion factor	Formula
MJ	Energy	MJ	1.0	1.0 MJ = 1.0 MJ
kBq	Radioactivity	kBq	1.0	1.0 kBq = 1.0 kBq
kg	Mass	kg	1.0	1.0 kg = 1.0 kg
m2	Area	m2	1.0	1.0 m2 = 1.0 m2
m2*a	Area*time	m2*a	1.0	1.0 m2*a = 1.0 m2*a
m3	Volume	m3	1.0	1.0 m3 = 1.0 m3

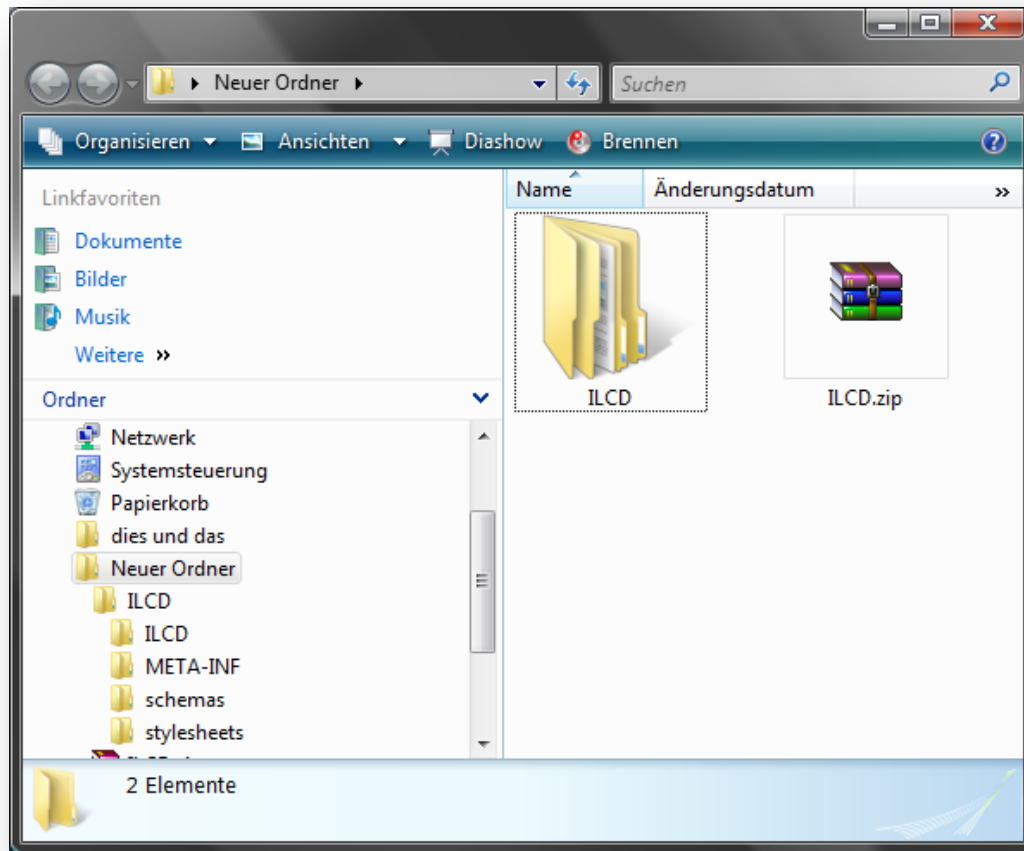
Import EcoSpold 01 data sets: ecospold01/lcia_method_363634a5-ef5c-4ac7-9a32-...

< Back Next > Finish

5. Data will be imported in your active database

ILCD import

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



openLCA database import

openLCA 1.4.1 beta 4

File Window Help

Navigation Welcome

openLca Welcome to openLCA!
Version 1.4.1 beta 4 (Windows 64 bit)

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Licensed under the Mozilla Public License ([what does this mean?](#)).

GreenDelta

New database
Import database

What's new

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- **numerous usability improvements**
- **many new features**

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This is also explained in a [video](#)

LCIA method packs are available from the openLCA [download page](#)

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

Community

Welcome

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 fur use in openLCA

openLCA Nexus

The screenshot shows a web browser window with the URL <https://nexus.openlca.org>. The browser's address bar and navigation buttons are visible at the top. Below the browser window, the website's header includes navigation links: openLCA Nexus, Databases, LCA data search, FAQs, About, Register, Login, a shopping cart icon with '0', and a link to Go to openLCA.org.

The main content area features the openLCA nexus logo on the left. To its right is the heading "openLCA Nexus" followed by the tagline "Your source for LCA data sets." Below this is a search input field with a purple "Search" button.

Three content cards are arranged horizontally below the search bar:

- LCA databases**: A card with a blue header. The text states: "openLCA Nexus contains a broad range of LCA databases, some for free and some for purchase. Data sets can be easily imported into openLCA." A blue "Browse databases" button is at the bottom.
- LCA data search**: A card with a purple header. The text states: "This website contains a powerful search engine for LCA data that allows filtering requested data sets by e.g. database, location or year." A purple "Search data sets" button is at the bottom.
- About**: A card with an orange header. The text states: "Basic idea of the openLCA nexus is to overcome isolated data silos in LCA, by creation of a coherent and consistent LCA data space." An orange "Read more" button is at the bottom.

The footer contains copyright information: © GreenDelta GmbH 2014, with links for Imprint, Terms & Conditions, EULA, Privacy Policy, and Cookie Policy. The GreenDelta logo is positioned in the bottom right corner of the footer.

openLCA Nexus

The screenshot shows a web browser window with the URL `nexus.openlca.org/dataproviders`. The page title is "openLCA Nexus: The source for LCA data sets". The navigation bar includes "openLCA Nexus", "Databases", "LCA data search", "FAQs", "About", "Register", "Login", a shopping cart icon with "0", and "Go to openLCA.org".

The main content area features the openLCA Nexus logo and the tagline "Your source for LCA data sets." Below this, there are three tabs: "All", "Free databases", and "For purchase databases".

On the left side, there is a "Data providers" section with a list of links: bioenergiedat, ELCD, NEEDS, ProBas, USDA, ecoinvent, GaBi, LC-Inventories.ch, Ökobaudat, and Social Hotspots.

The main content area displays three database entries:

- ProBas** (Umweltbundesamt): 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. A "new" badge is present. A green "Browse" button is located at the bottom right of the entry.
- USDA**: LCA database containing agricultural data sets with a US background, plus crosswalks to upstream Ecoinvent v.2.2 data sets, provided by the United States Department of Agriculture (USDA). A "new" badge is present. A green "Browse" button is located at the bottom right of the entry.
- ecoinvent**: A leading LCA database by the ecoinvent centre. We offer a fully valid ecoinvent license. A red circular logo is partially visible on the left.

openLCA Nexus



www.LC-Inventories.ch



BIOENERGIE DAT

openLCA Nexus search engine

openLCA Nexus

Databases

LCA data search

FAQs

About

Register

Login

🛒 0

Go to openLCA.org



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

82 datasets in 28 ms

disposal, flexible duct, aluminum/PET, DN of 125 (Switzerland)

Data provider: ecoinvent

Category: waste management/building demolition

Version (internal): 1.0 Location: Switzerland

flexible duct, aluminum/PET, DN of 125, at plant (Europe)

Data provider: ecoinvent

Category: ventilation/production of components

Version (internal): 1.0 Location: Europe

polyethylene terephthalate, granulate, amorphous, at plant (Europe)

Data provider: ecoinvent

Category: plastics/polymers

Version (internal): 1.0 Location: Europe

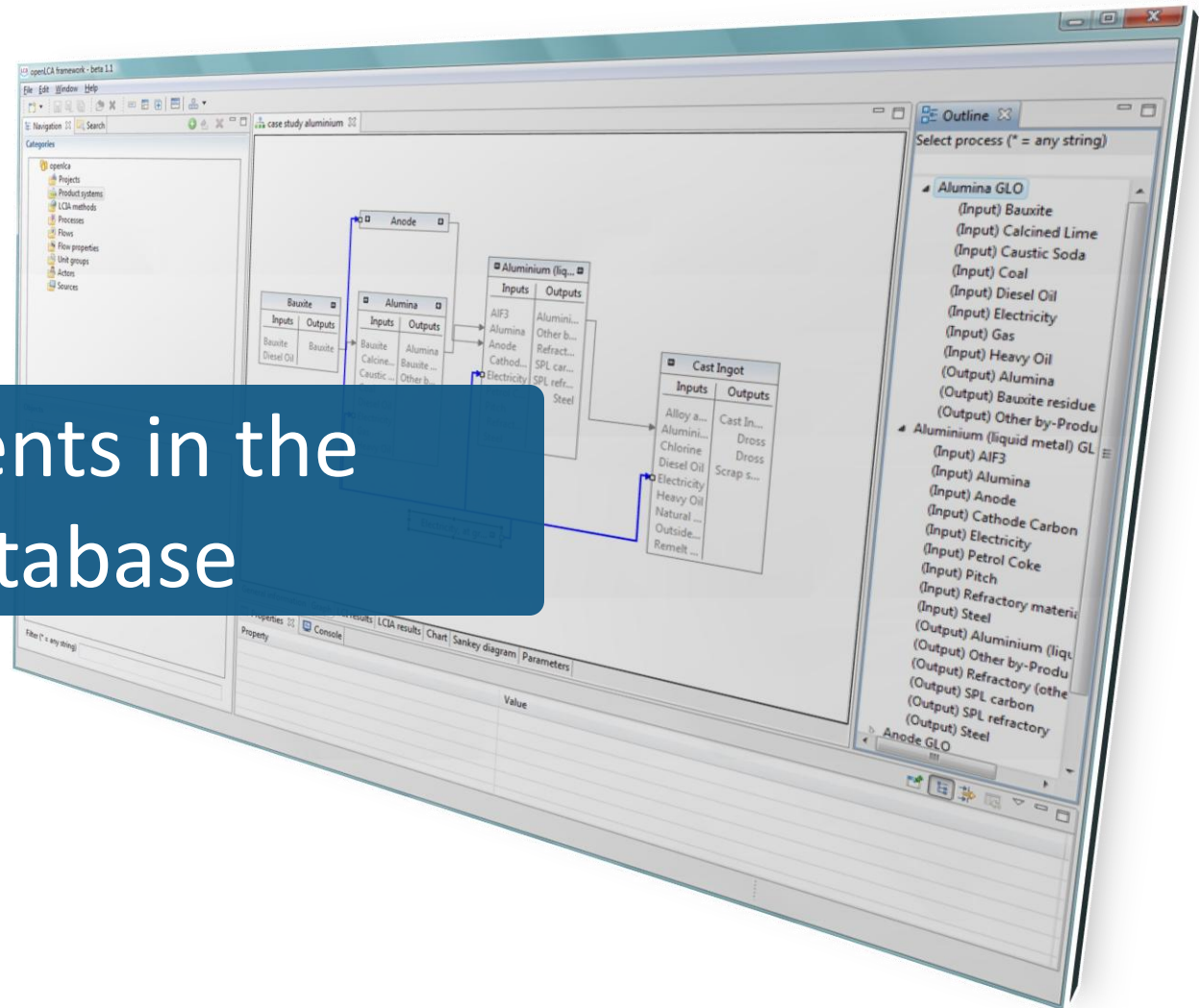
polyethylene terephthalate, granulate, bottle grade, at plant (Europe)

Data provider: ecoinvent

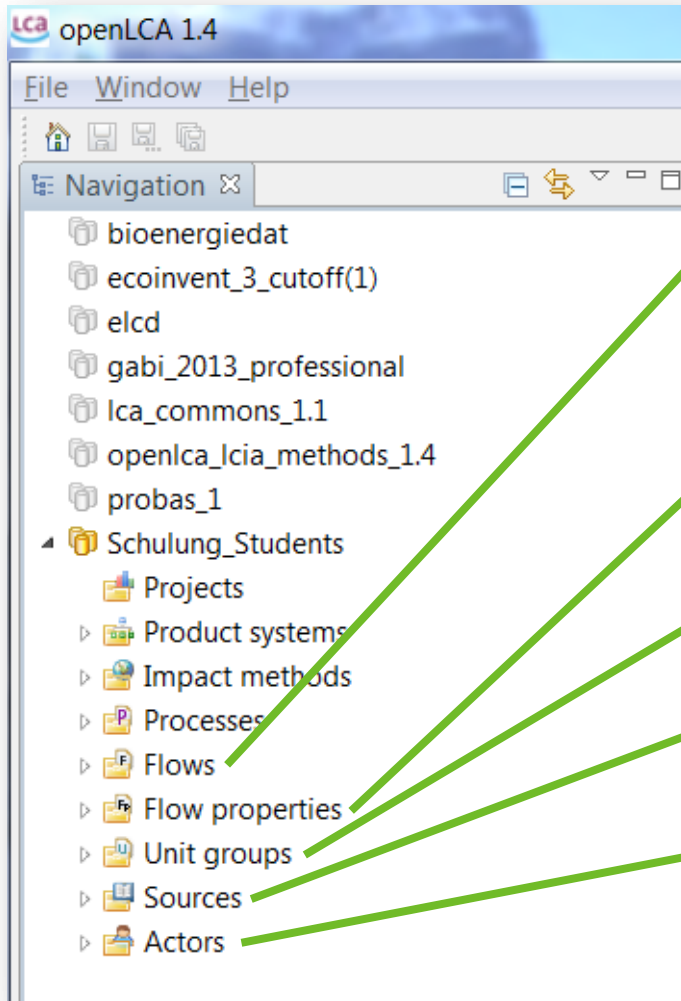
Category: plastics/polymers

Version (internal): 1.0 Location: Europe

Elements in the database



Database elements (I)



Flows: flow of products and materials

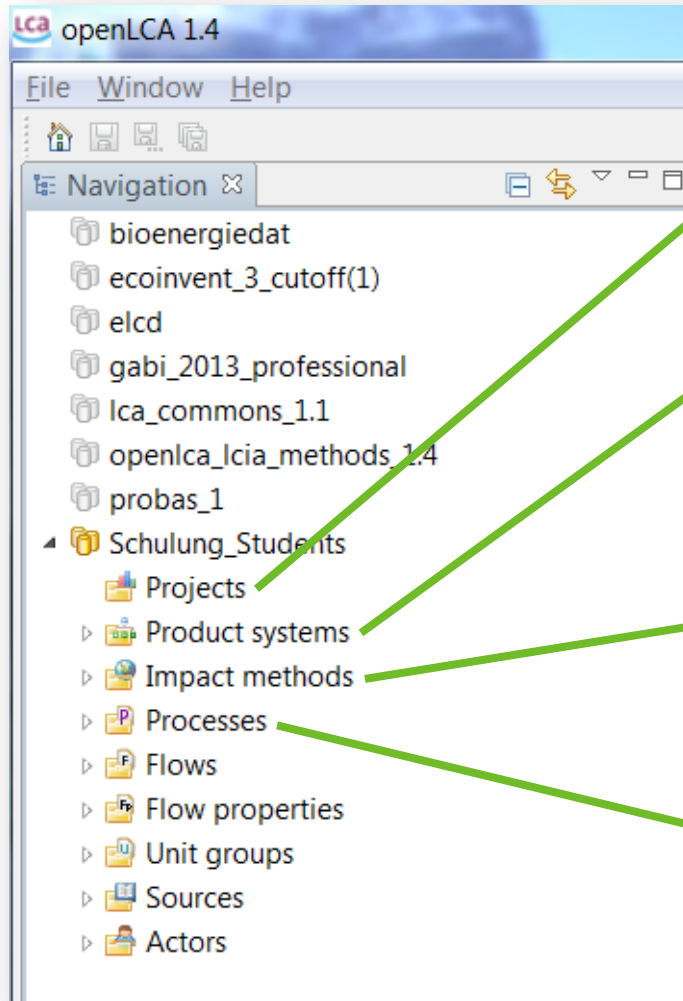
Flow properties: i.e. Length, Mass, etc

Unit groups: Groups of units

Sources: Literature

Actors: People who have provided data or modified models

Database elements (II)



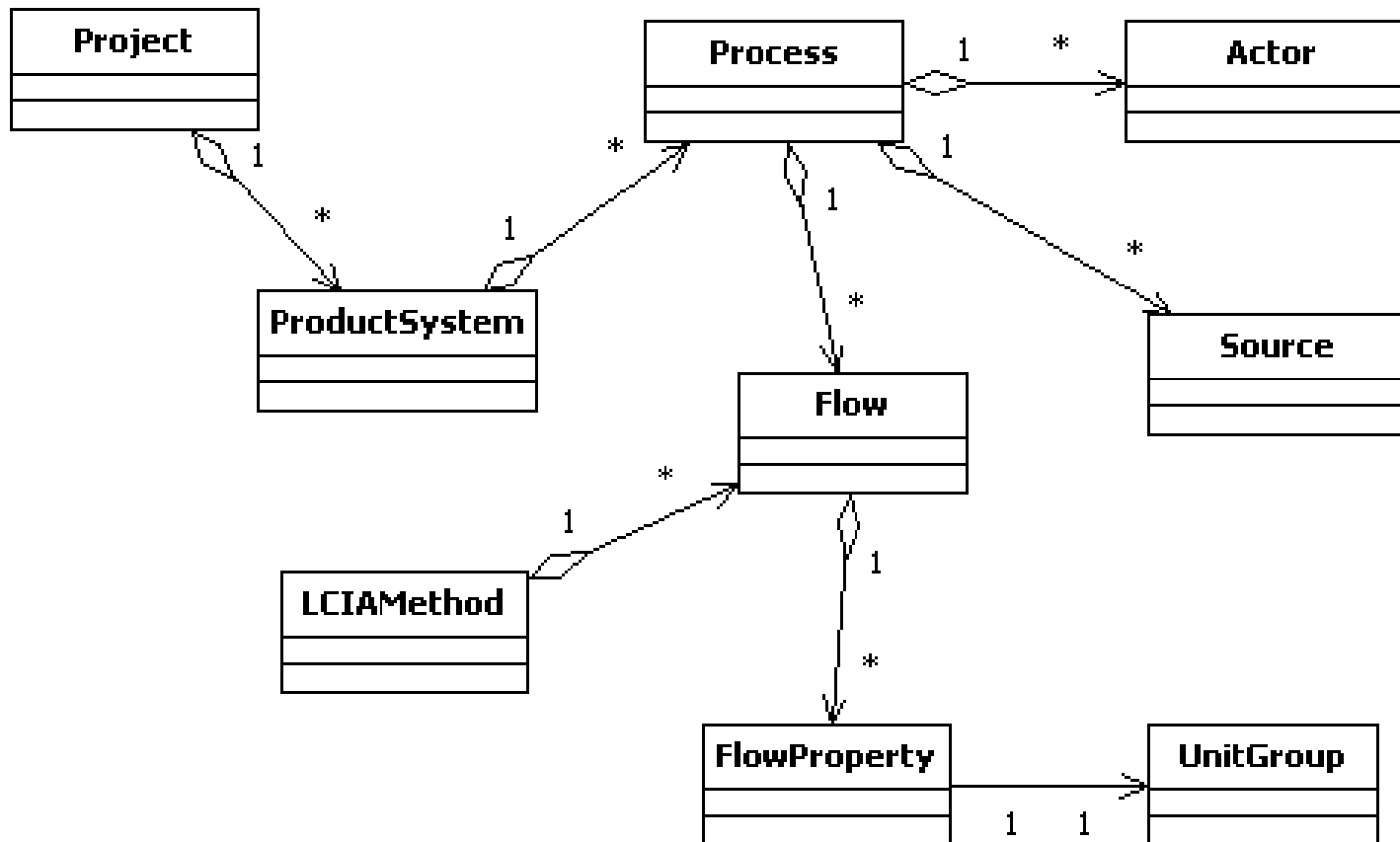
Projects: comparison of numerous product systems

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

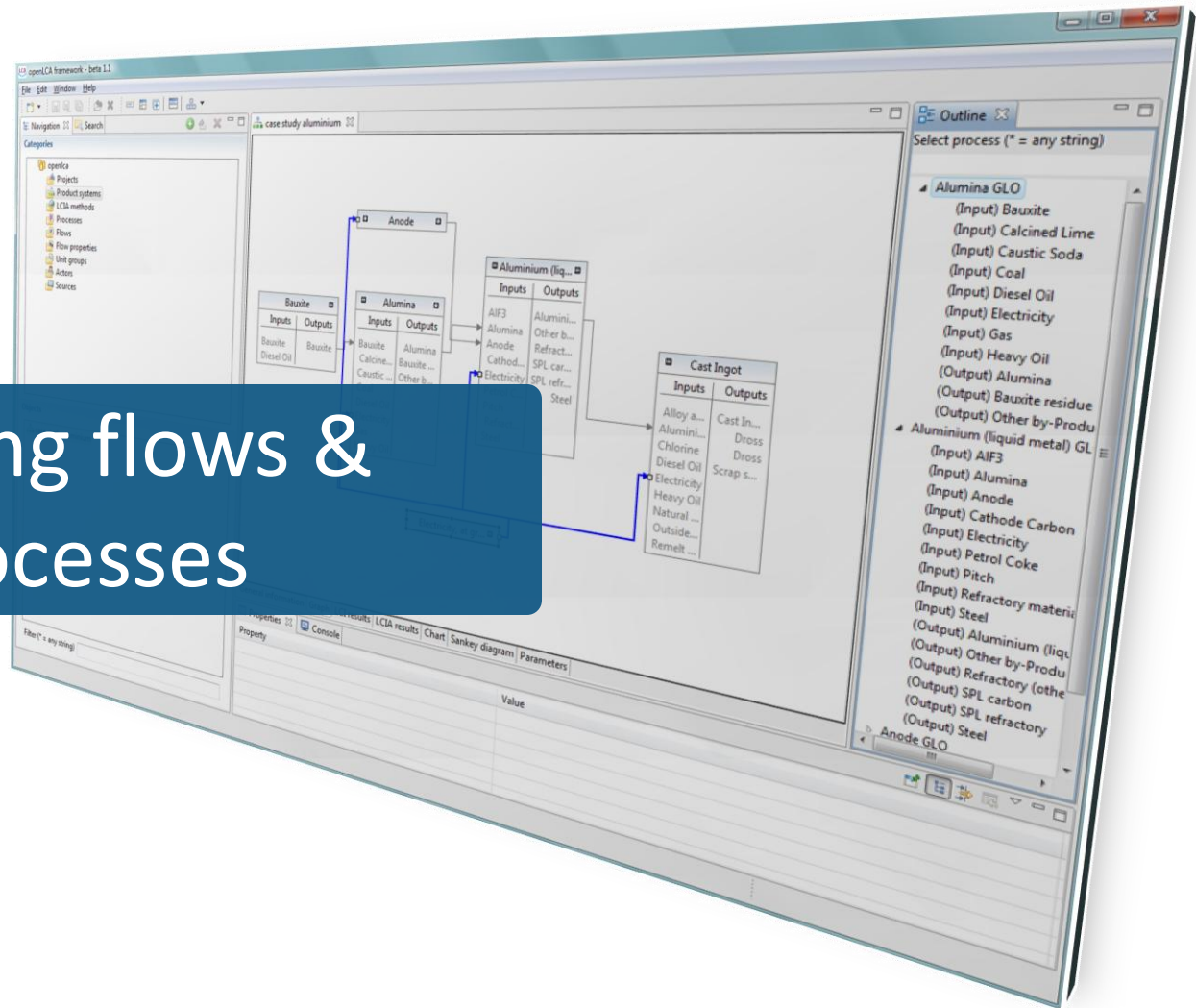
LCIA Methods: can be downloaded at openlca.org/downloads

Processes: Production or modification of materials/products

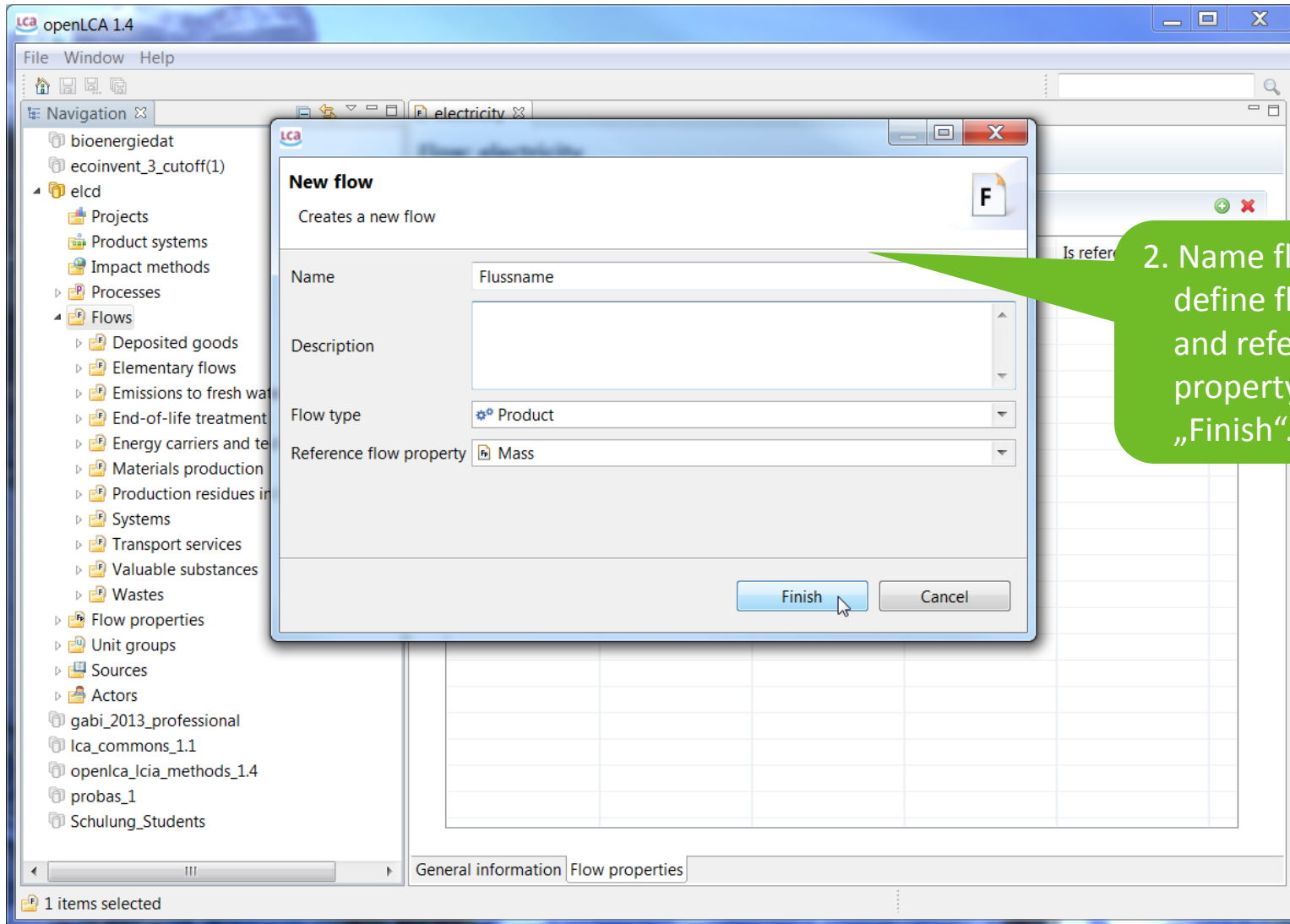
Element structure in openLCA



Creating flows & processes



Flows: Create new flow (II)



Flows: Create new flow (III)

The screenshot shows the openLCA 1.4 interface. On the left, the 'Navigation' pane shows a tree view with 'Flows' selected, and a context menu is open with 'Create new flow' highlighted. The main window displays the 'Flow: electricity' editor. The 'Flow properties' tab is active, showing a table with the following data:

Name	Conversion factor	Reference	Formula	Is reference
Net calorific v...	1.0	MJ	1.0 MJ = 1.0 MJ	

At the bottom of the editor, there are tabs for 'General information' and 'Flow properties'. The status bar at the bottom left indicates '1 items selected'.

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!

Process: Create new process (I)

1. right click on "Processes" folder, select "create new process"

Welcome to openLCA!

What's new

Getting started

Searching for and downloading data

User Manuals

1 items selected

Process: Create new process (II)

New process
Creates a new process

Name:

Description:

Create a new product flow for the process

Filter:

Quantitative reference:

- SU:Water transport
- S1:Air transport
 - S11:Passenger air transport
 - S12:Freight air transport
 - transport, freight, aircraft
 - transport, freight, aircraft
 - transport, freight, aircraft
 - transport, freight, aircraft
 - transport, freight, aircraft - GLO
 - transport, freight, aircraft - RER

Cancel Finish

2. Name process and select a quantitative reference

Welcome to openLCA!
mac OS (x86_64)

and sustainability assessment software. Truly open source.
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[does this mean?](#)

GreenDelta

400%

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](#)

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This is also explained in a [video](#)

LCIA method packs are available from the openLCA [download page](#)

Welcome

1 Items selected

Process: Create new process (III)

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: Inputs/Outputs

The screenshot displays the openLCA 1.4 software interface. The main window is titled "Process: ammonium bicarbonate production - RER". It features a navigation pane on the left with a tree view containing "bioenergiedat", "ecoinvent_3_cutoff(1)", "Projects", "Product systems", "Impact methods", "Processes", "Flows", and "Flow properties". The main area shows a table of inputs for the process. A dialog box titled "Flows" is open, showing a filter set to "carbon" and a content list with categories like "C:Manufacturing", "E:Water supply, sewerage, waste management and remediation activities", "Elementary flows", and "L:Real estate activities". A green callout bubble points to a plus icon in the top right corner of the "Inputs" table, indicating where to add new flows.

Flow	Category	Flow pr...	Unit	Amount	Uncerta...	Default ...	Pedigre...
electricity, mediu...	351:Electric p...	Energy	kWh	0.01094...	lognor...	market ...	
electricity, mediu...	351:Electric p...	Energy	kWh	8.53695...	lognor...	market ...	
electricity, mediu...	351:Electric p...	Energy	kWh	0.00247...	lognor...	market ...	
	351:Electric p...	Energy	kWh	0.00589...	lognor...	market ...	
	351:Electric p...	Energy	kWh	0.01287...	lognor...	market ...	
	351:Electric p...	Energy	kWh	0.00370...	lognor...	market ...	
	351:Electric p...	Energy	kWh	0.04495...	lognor...	market ...	
	351:Electric p...	Energy	kWh	0.03091...	lognor...	market ...	
	351:Electric p...	Energy	kWh	0.00825...	lognor...	market ...	

4. Additional flows can be added in the "Input/Output" tab.

Process: Administrative Info. & Modeling and validation

The image shows a software interface with two overlapping panels. The background panel is titled 'Administrative information' and contains the following fields:

- Intended application
- Data set owner
- Data generator: Maggie C
- Data documentor: Maggie C
- Publication: Althaus H
- Access and use restrictions
- Project

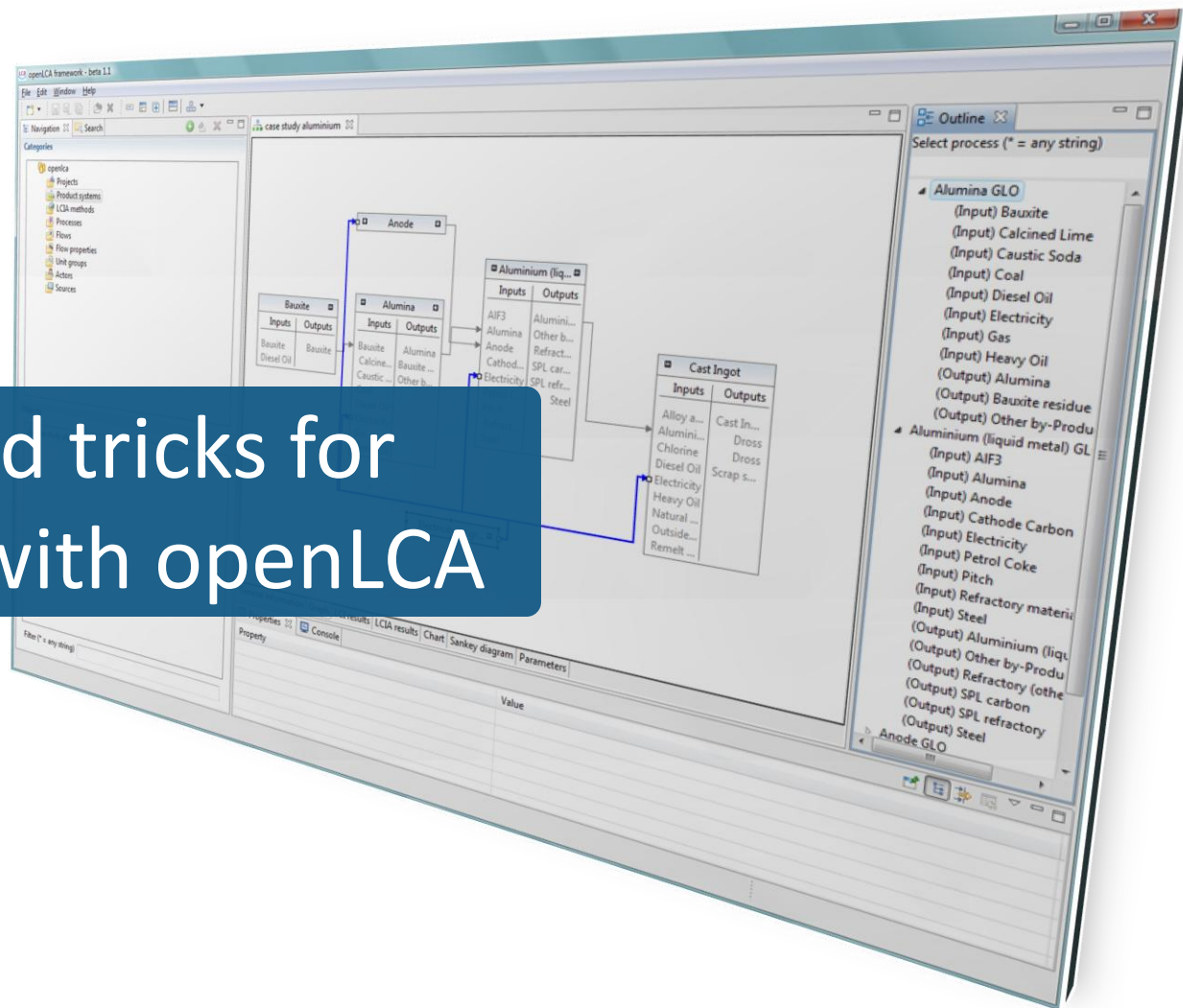
The foreground panel is titled 'Modeling and validation' and contains the following fields:

- Process type: Unit process
- LCI method
- Modeling constants
- Data completeness
- Data selection

At the bottom of the interface, there are tabs for: General information, Inputs/Outputs, Administrative information, Modeling and validation, Parameters, Allocation, and Process costs.

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:

The screenshot shows the openLCA framework 1.2 interface. The main window is titled "Process: Chlor-alkali electrolysis, average production mix, at plant (openlca4students)". The "Allocation" section shows the "Allocation method" set to "Causal". The "Inputs (Formula view)" table is displayed below, showing a list of input flows with their respective categories, flow types, flow properties, units, resulting amounts, and uncertainty distribution types. The "Outputs (Formula view)" table is also visible, showing a list of output flows with their respective categories, flow types, flow properties, units, resulting amounts, and uncertainty distribution types.

Flow	Category	Flow type	Flow property	Unit	Resulting amount	Uncertainty distribution type
Bituminous coal, co...	Produc...	Product...	Mass	kg	0.0244	No distribution
Dummy_Dis...	Location: US	Principal incineration	Mass	kg	0.00123	No distribution
Dummy_Dis...	Category: Product and Waste Flows		Mass	kg	0.00171	No distribution
Dummy_Electr...	Produc...	Product...	Energy	k...	0.32187	No distribution
Electricity, at grid, US	Produc...	Product...	Energy	k...	0.72973	No distribution
Natural gas, combust...	Produc...	Product...	Volume	m ³	0.10681	No distribution
Residual fuel oil, com...	Produc...	Product...	Volume	L	0.0019194	No distribution
Sodium chloride, at p...	Produc...	Product...	Mass	kg	0.893	No distribution

Flow	Category	Flow type	Flow property	Unit	Resulting amount	Uncertainty distribution type
Benzene	air/uns...	Elemen...	Mass	kg	1.9208E-8	No distribution
BOD5, Biological Oxy...	water/...	Elemen...	Mass	kg	2.329E-4	No distribution
Carbon dioxide, biog...	air/uns...	Elemen...	Mass	kg	6.3967E-5	No distribution

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

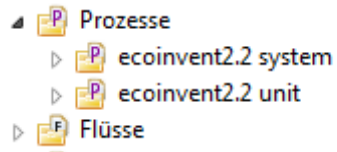
The screenshot displays the GreenDelta software interface. On the left is the 'Navigation' pane, which contains a tree view of project elements. The 'Flows' folder is expanded, and the flow 'Ethanol, denatured, forest residues, thermochem - RNA' is selected. On the right is the 'Process: newprocess' editor. It has two tabs: 'Inputs' and 'Outputs'. The 'Inputs' tab is active and shows a table with one row containing the selected flow. The 'Outputs' tab is also active and shows a table with one row containing 'Heat'.

Flow	Category	Flow prop...	Unit	Amount	Uncertainty	Default pr...	Pedigree u...
Ethanol, denatured, forest residues, thermochem - RNA							

Flow	Category	Flow prop...	Unit	Amount	Uncertainty	Avoided p...	Pedigree u...
Heat		Energy	MJ	1.0	none		

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

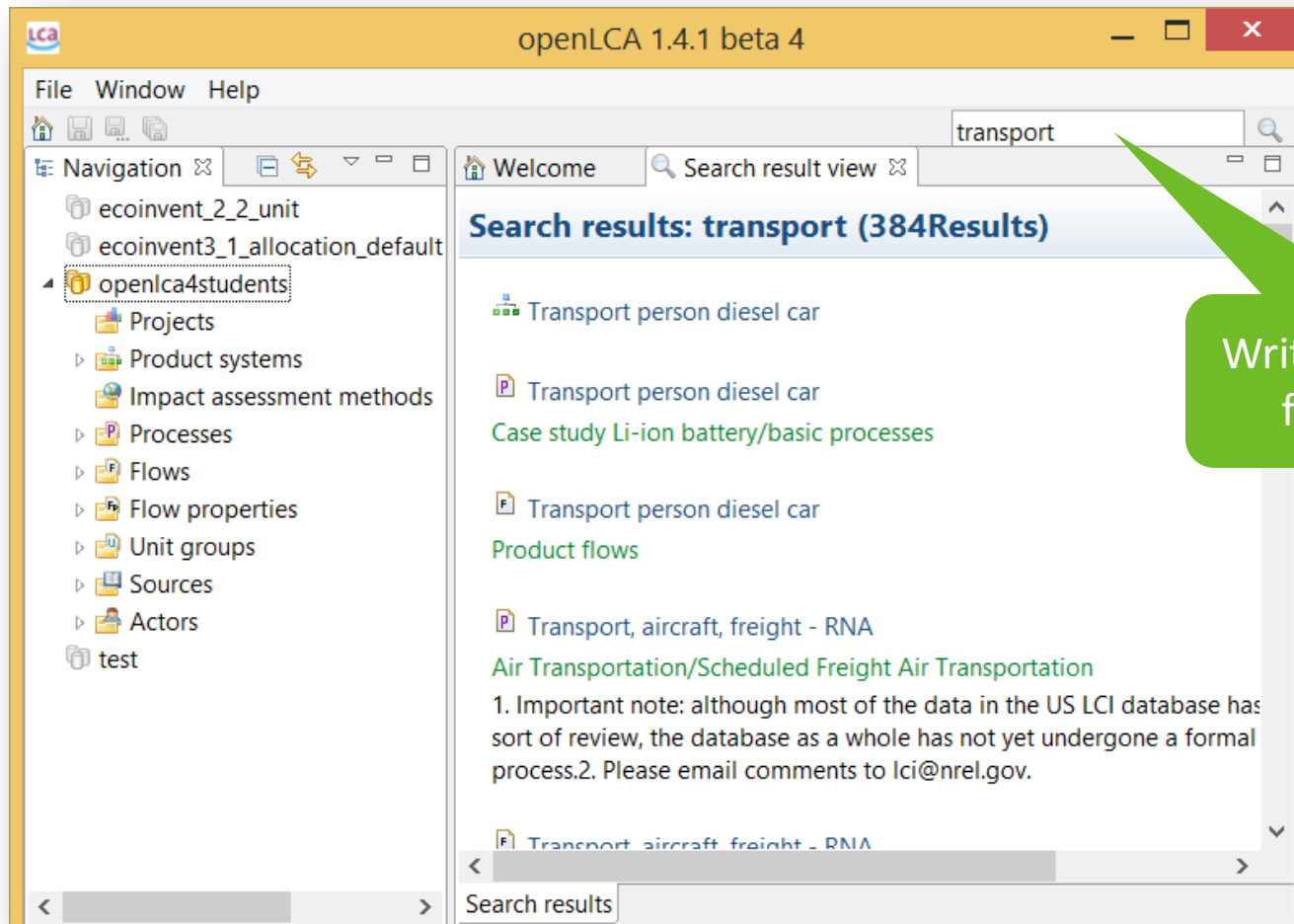
Do not change the folder structure of elementary flows, because otherwise the LCIA cannot find them anymore!

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

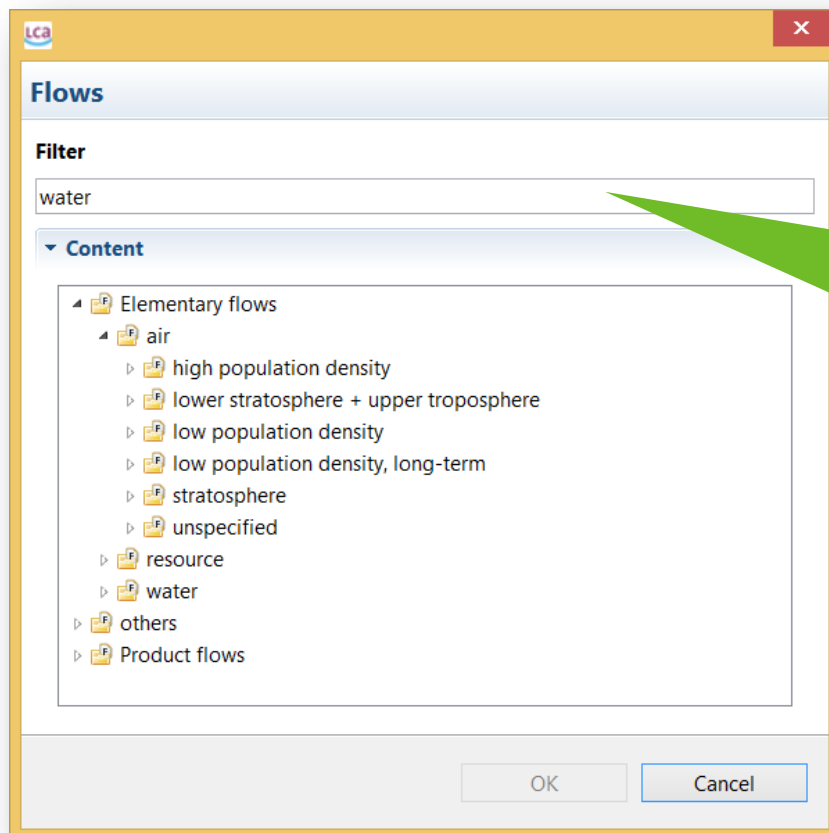
- Search any element from the database



Write the key words
for the search

Filter

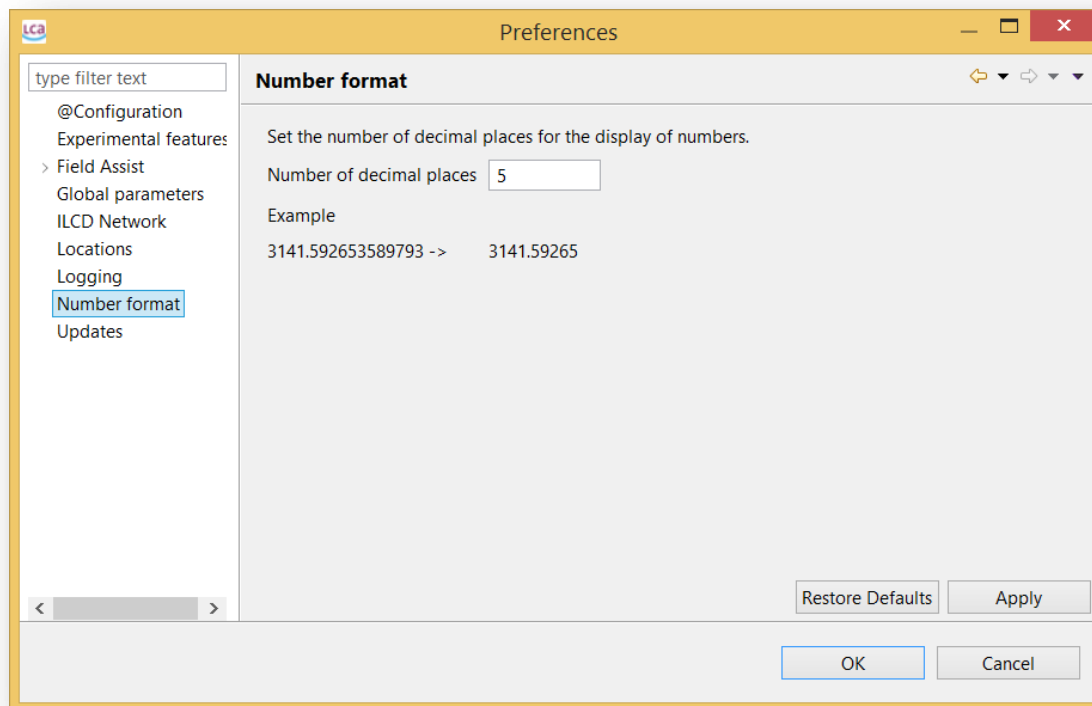
- The “add new” editors contain a filter for facilitating the search of the desired element



Use the “Filter” when adding new flows to a process, select the reference process in a product system, etc.

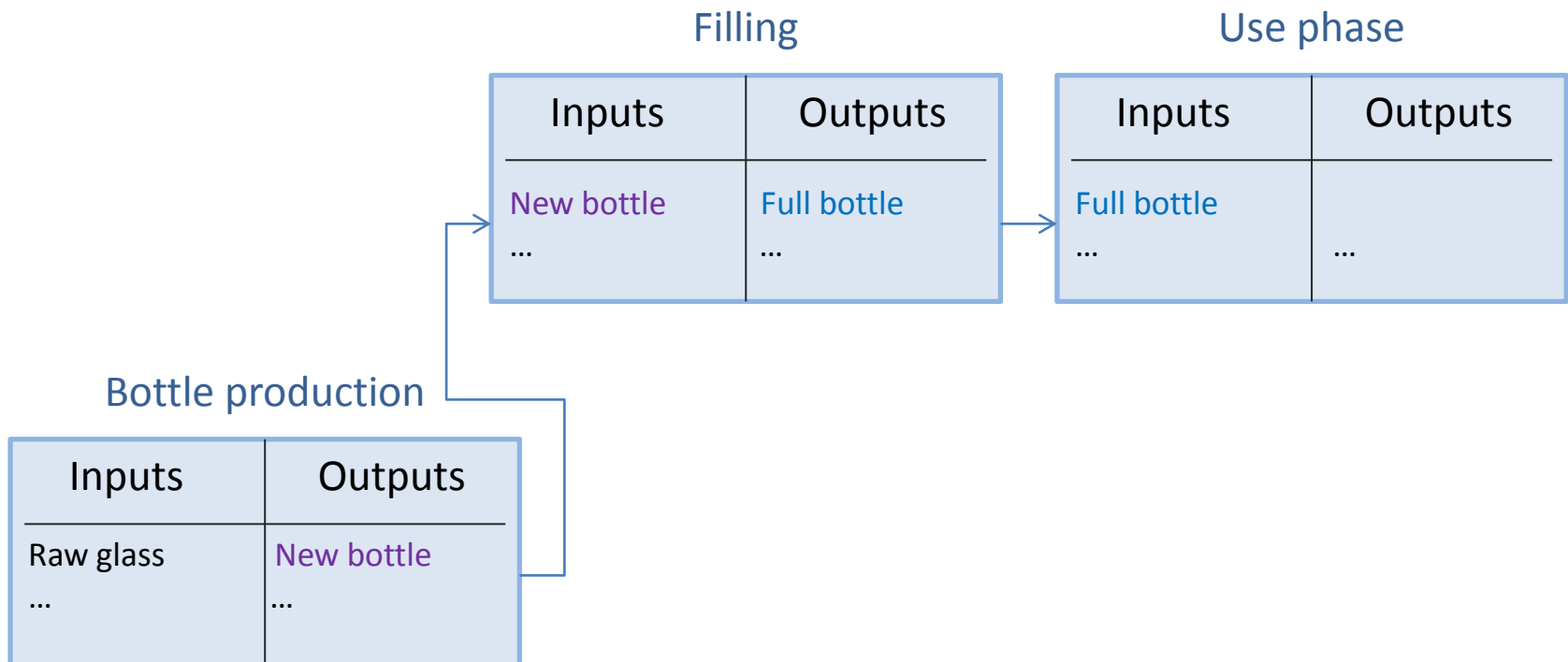
Numbers

- 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

openLCA 1.4.1 beta 4

*Transport, aircraft, freight - RNA

Process: Transport, aircraft, freight

Inputs

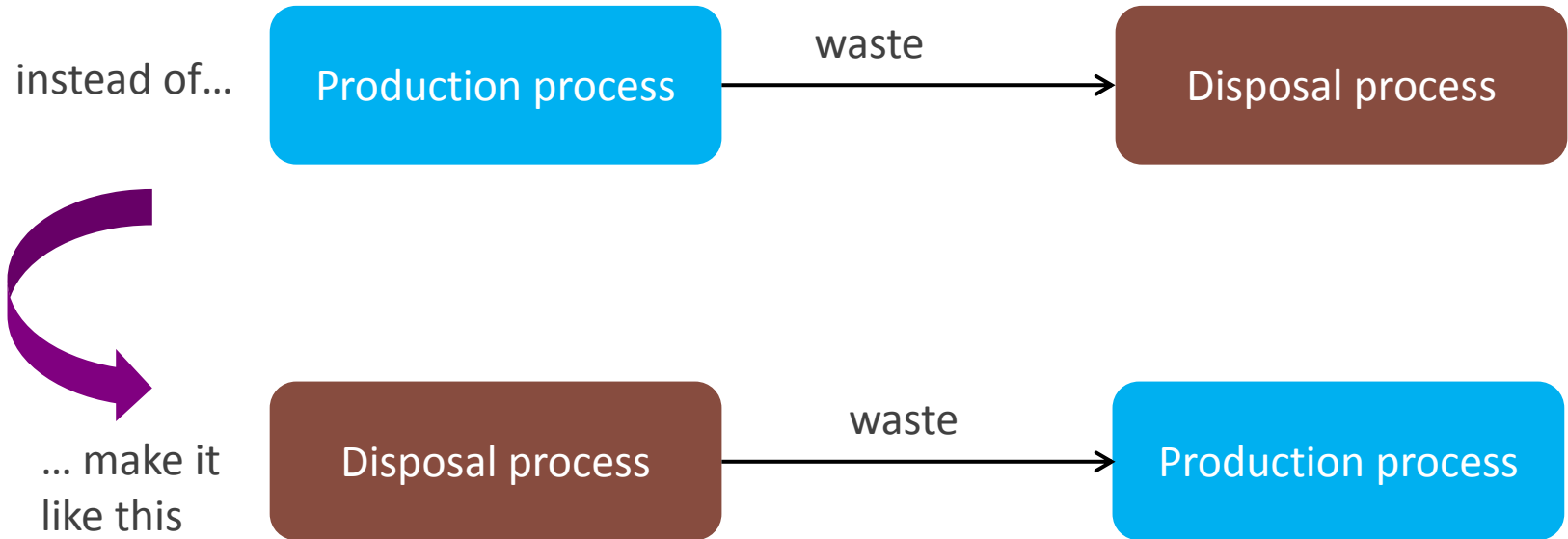
Flow	Category	Flow proper...	Unit	Amount	Uncertainty	Default provider	Pedigree un...
* Kerosene, at refinery - RN...	Product flows	Volume	L	0.41991972...	none	None	
						None	
						Petroleum refining, at refinery - RNA	
						Crude oil, in refinery - RNA	

Modeling of waste

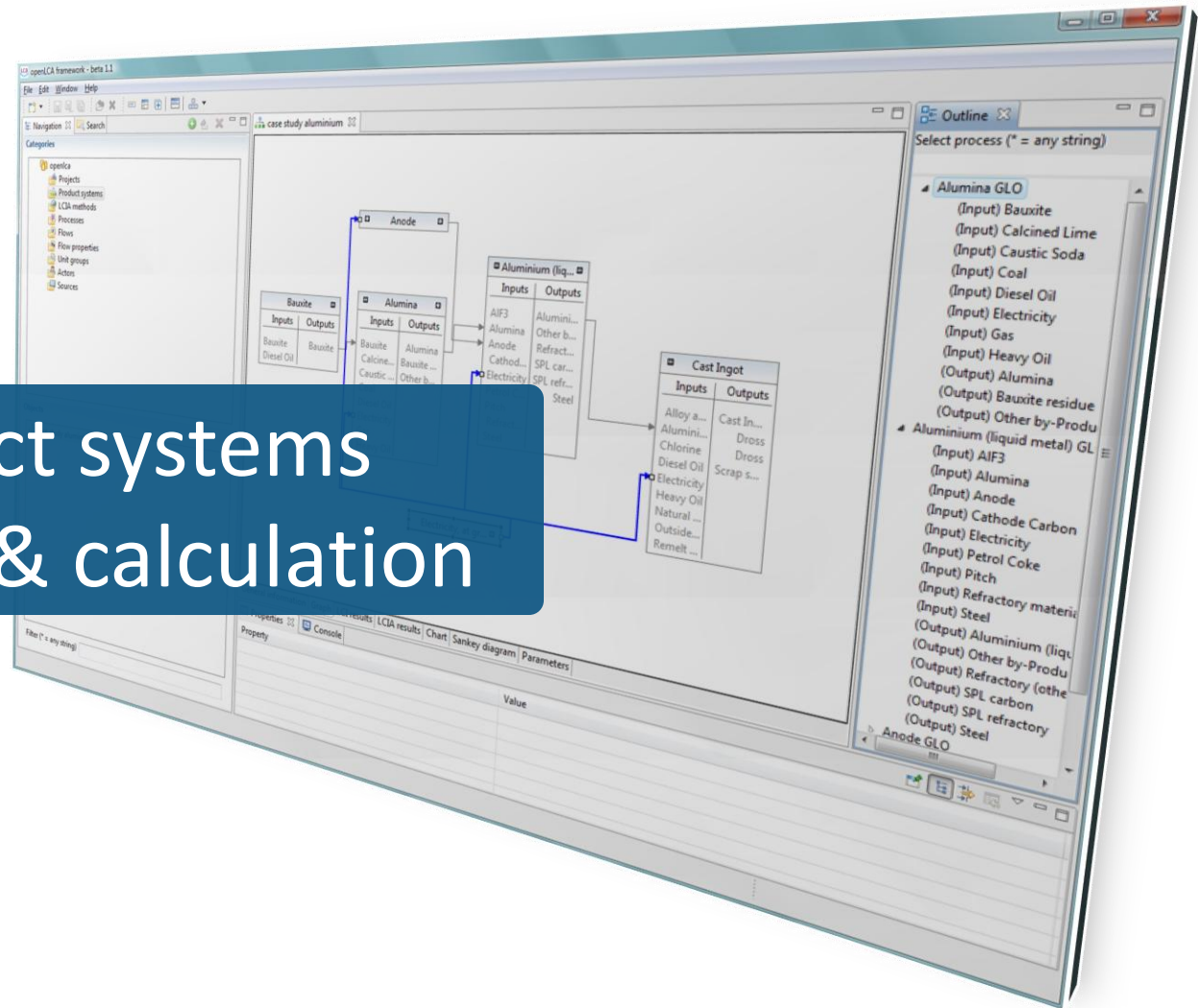
- "Reverse direction": Usual (production processes) is that donations to another process are something of value for the receiving process
- Disposal processes aim to eliminate the receiving flow
 - Model according to the "value flow direction":

Disposal as a service counter to the direction of material flow

Modeling of waste (II)



Product systems creation & calculation



Product system: Creation

The screenshot displays the GreenDelta software interface for creating a product system. The left sidebar shows a navigation tree with categories like 'Ecoinvent', 'Projects', 'Product systems', 'International production', 'Impact methods', 'Processes', 'Flows', 'Actors', and 'Ecoinvent'. The main window is titled 'Process: Case 1' and contains several tabs: 'General information', 'Quantitative reference', and 'Time'. The 'General information' tab is selected and shows fields for 'Name' (Case 1), 'Description', 'Version' (00.00.024), 'Last change' (2014-09-08T14:46:13+0200), and 'Infrastructure process' (unchecked). A green callout bubble points to a button labeled 'Create product system' located below the 'Infrastructure process' field. At the bottom of the window, there is a 'Text editor' button and a 'Description' field. The bottom status bar shows the following tabs: 'General information', 'Inputs/Outputs', 'Administrative information', 'Modeling and validation', 'Parameters', 'Allocation', and 'Costs'.

1. Click on “Create product system” in the General information tab

Product system: Creation (II)

2. Name the product system and select a reference process

3. Select the modeling options preferred

Product system: General information

The screenshot shows a software window titled "Product system: Case 1". The window has a menu bar with "Welcome", "New Process", and "Case 1". Below the menu bar, there is a section for "General information" with the following fields:

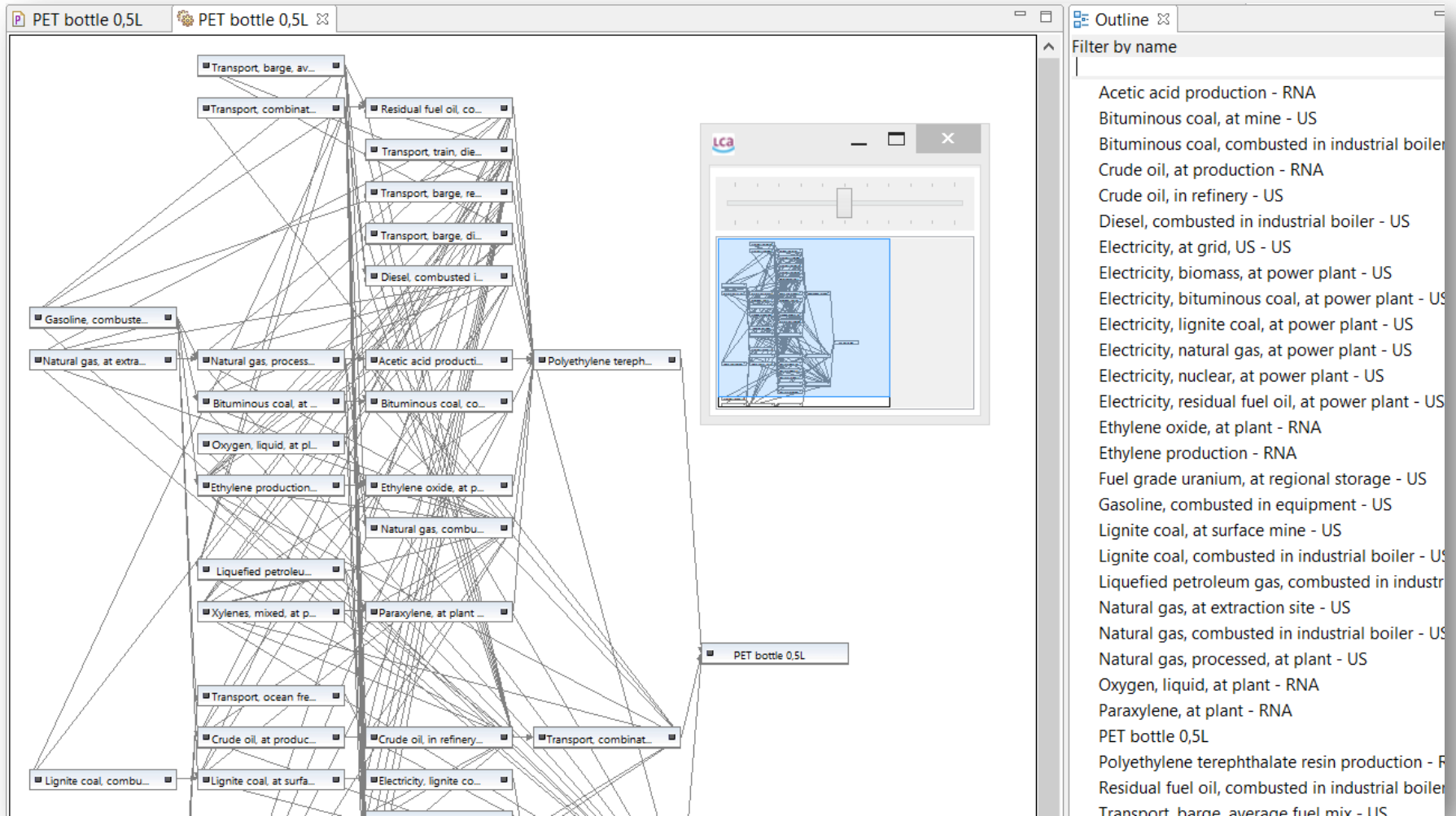
- Name: Case 1
- Description: (empty text area)
- Version: 00.00.000 (with up/down arrows)
- Last change: (empty text area)
- Calculate: (button)

Below the "General information" section is a "Reference" section with the following fields:

- Process: Case 1
- Product: filled water bottle, point of sale
- Flow property: Number of items
- Unit: Item(s)
- Target amount: 1000.0

At the bottom of the window, there are tabs for "General information", "Parameters", and "Model graph".

Product system: Model graph



Product system: Calculation

The screenshot displays the Ecoinvent software interface. On the left is a navigation tree with categories like 'Projects', 'Product systems', 'International production', 'Impact methods', 'Processes', 'Flows', and 'Actors'. The 'Processes' category is expanded, showing various activity codes (A-S) and 'Case 1'. The main window is titled 'Product system: Case 1' and has a 'General information' tab selected. This tab contains fields for 'Name' (Case 1), 'Description', 'Version' (00.00.000), and 'Last change'. A 'Calculate' button is located below the 'Last change' field. A green callout box with a white border points to this button, containing the text: '1. Click on “Calculate” in the General information tab.' Below the 'General information' tab are 'Parameters' and 'Model graph' tabs. On the right side of the interface is an 'Outline' panel with a search bar and a list of product names, such as '1,1-difluoroethane production, HFC-152a -', '2-butanol production by hydration of butene', and 'acetic acid production, product in 98% solution'.

1. Click on “Calculate”
in the General
information tab.

Product system: Calculation (II)

2. Select calculation properties and click on Calculate.

Calculation properties
Please select the properties for the calculation

Allocation method: None

Impact assessment method: CML, 2001 (baseline)

Normalization/weighting set: [Empty]

Calculation type:
 Quick results
 Analysis
 Monte Carlo Simulation

Number of iterations: 100

Buttons: Save as default, Reset, Cancel, Calculate

Navigation tree:
Ecoinvent
Projects
Product systems
Case 1
Case 2
Case 3
International production
market for electricity, low voltage
market for electricity, low voltage
Impact methods
Processes
A: Agriculture, forestry and fishing
B: Mining and quarrying
C: Manufacturing
CCL Meerane Label Production
D: Electricity, gas, steam and air conditioning supply
E: Water supply; sewerage, waste management and remediation activities
F: Construction
G: Wholesale and retail trade; repair of motor vehicles
H: Transportation and storage
J: Information and communication
L: Real estate activities
M: Professional, scientific and technical activities
N: Administrative and support service activities
Recycled Content cut-off
S: Other service activities
Case 1
Case 2
Case 3
International production
New Process
Flows
Flow properties
Unit groups
Sources
Actors
Ecoinvent
probas
schulungaugust14students
test

Product list (partial):
ethane production, HFC-152a -
ethane production, HFC-152a -
cyclopentane to generic market
production - RoW
production - RER
butan to generic market for sol
production by hydration of buten
production by hydration of buten
production by hydration of buten
2-butanol production by hydration of buten
2-methyl-2-butanol production - RER
2-methyl-2-butanol production - RoW
2-methylpentane to generic market for solv
[sulfonyl]urea-compound production - RER
[sulfonyl]urea-compound production - RoW
[thio]carbamate-compound production - REI
[thio]carbamate-compound production - Ro
acetaldehyde oxidation - RER
acetaldehyde oxidation - RoW
acetaldehyde oxidation - RoW
acetaldehyde oxidation - RER
acetaldehyde production - RER
acetaldehyde production - RoW
acetamide-anilide-compound production, u
acetamide-anilide-compound production, u
acetic acid production, product in 98% soluti
acetic acid production, product in 98% soluti
acetic anhydride production, ketene route -
acetic anhydride production, ketene route -
acetone production, liquid - RoW
acetone production, liquid - RER
acetylene production - RoW
acetylene production - CH
acrylic acid production - RER
acrylic acid production - RoW
acrylic binder production, product in 34% so
acrylic binder production, product in 34% so
acrylic dispersion production, product in 65%
acrylic dispersion production, product in 65%
acrylic varnish production, product in 87.5%
acrylic varnish production, product in 87.5%
acrylonitrile-butadiene-styrene copolymer p
acrylonitrile-butadiene-styrene copolymer p
activated bentonite production - RoW
activated bentonite production - DE
adipic acid production - RER
adipic acid production - RoW
agricultural machinery production, tillage - I
agricultural machinery production, tillage - C
agricultural machinery production, unspecific
agricultural machinery production, unspecific
agricultural trailer production - RoW

Product system: Calculation (III)

Navigation Tree:

- ecoinvent
 - Projects
 - Product systems
 - Case 1
 - Case 2
 - Case 3
 - International production
 - market for electricity, low voltage
 - market for electricity, low voltage
 - Impact methods
 - Processes
 - A:Agriculture, forestry and fishing
 - B:Mining and quarrying
 - C:Manufacturing
 - CCL Meerane Label Production
 - D:Electricity, gas, steam and air conditioning supply
 - E:Water supply; sewerage, waste management and remediation
 - F:Construction
 - G:Wholesale and retail trade; repair of motor vehicles and motorcycles
 - H:Transportation and storage
 - J:Information and communication
 - L:Real estate activities
 - M:Professional, scientific and technical activities
 - N:Administrative and support service activities
 - Recycled Content cut-off
 - S:Other service activities
 - Case 1
 - Case 2
 - Case 3
 - International production
 - New Process
 - Flows
 - Flow properties
 - Unit groups
 - Sources
 - Actors

Results of Case 1

General information

- Product system: Case 1
- Allocation method: None
- Target amount: 1000.0 Item(s) filled water bottle, point of sale
- Impact method: CML, 2001 (baseline)

Flow contributions

Flow: Hydrogen-3, Tritium - water/ocean

- 1.519E3 kBq: treatment of spent nuclear fuel, reprocessing - RoW
- 6.244 kBq: electricity production, nuclear, pressure water reactor - CN
- 0.019 kBq: zeolite production, powder - RoW
- 9.647E-3 kBq: zeolite production, powder - RER
- 0.016 kBq: Other

Impact contributions

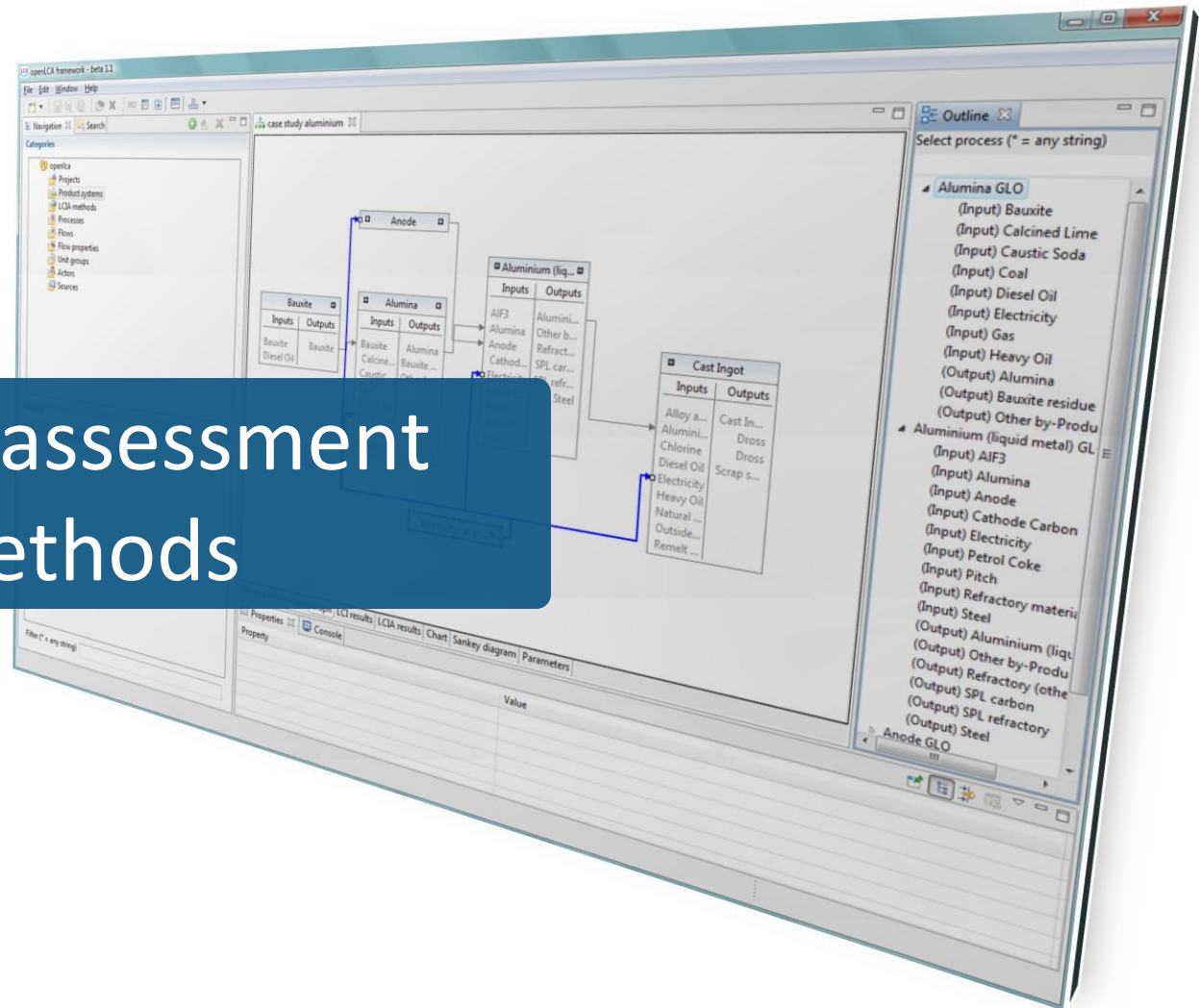
Impact category: Climate change - GWP100

- 9.273E3 kg CO2 eq.: transport, freight, lorry 16-32 metric ton, EURO5 - RER
- 4.176E2 kg CO2 eq.: refinery gas, burned in furnace - Europe without Switzerland
- 3.426E2 kg CO2 eq.: diesel, burned in building machine - GLO

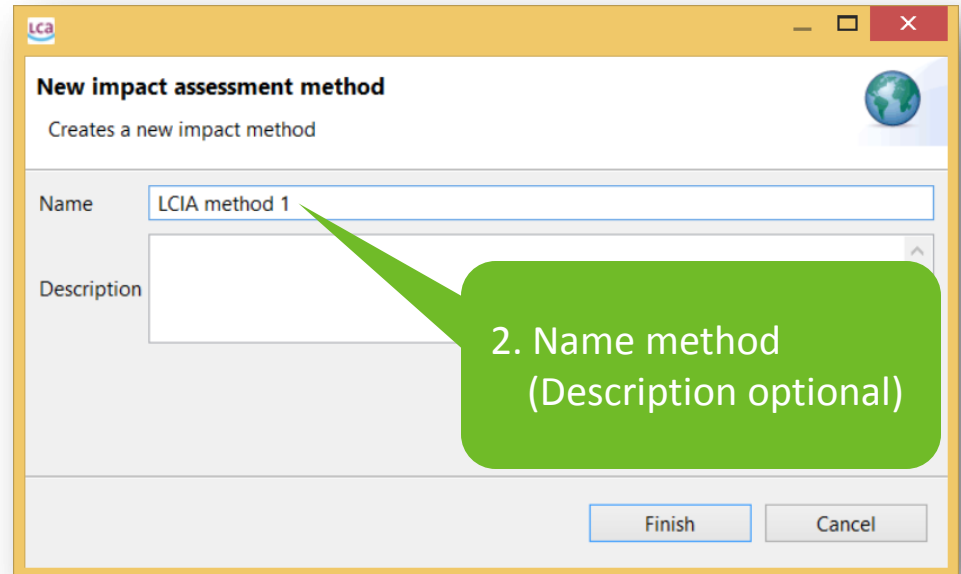
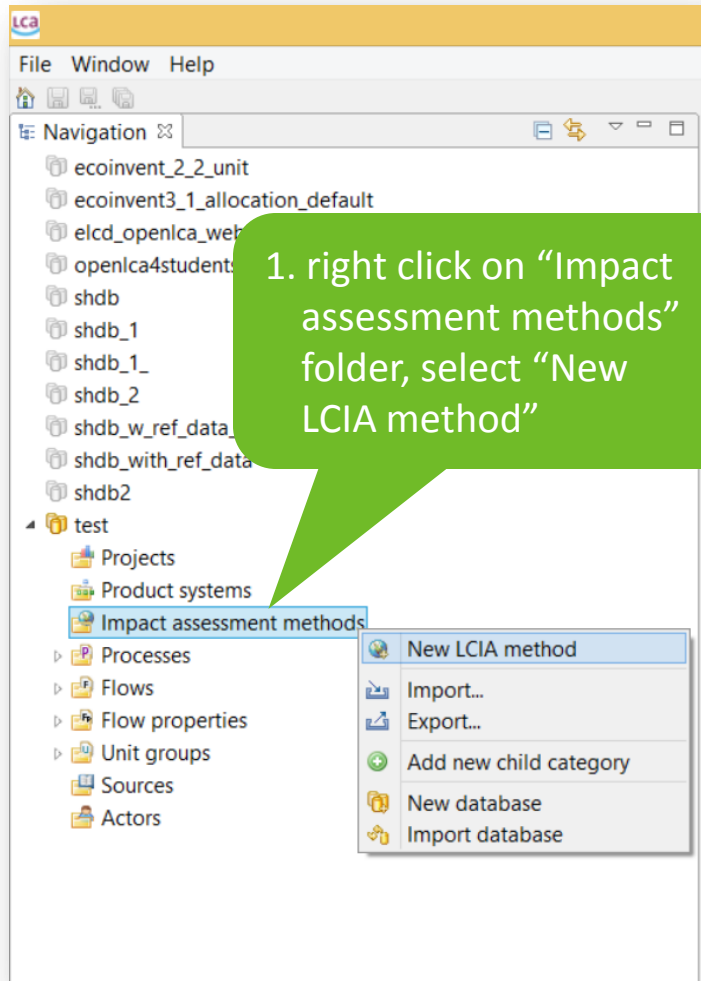
Callout Box: 3. Check the tabs for inventory results, LCIA results, Contributions, etc.

Bottom Tabs: General information | Inventory results | LCIA Result | Process contributions | Flow contributions | Locations | Grouping

Impact assessment methods



Impact assessment methods: Creation



Impact assessment methods: Creation (II)

*New LCIA method

Impact assessment method: New LCIA method

▼ General information

Name

Description

Version 00.00.000

Last change 2014-09-23T00:04:21+0200

▼ Impact categories + ×

Name	Description	Reference unit
Human toxicity		CTUh

3. Click on “+” to add new impact categories

Impact assessment methods: Creation (III)

The screenshot displays a software window titled "Impact assessment method: New LCIA method". Inside, there is a dialog box titled "Flows" with a filter input field and a "Content" section. The "Content" section shows a tree view with "Elementary flows" and "test". A green callout points to a "+" button in the background table, and another points to the "Elementary flows" folder.

4. Click on "+" to add new characterisation factors

5. Select desired elementary flows

Impact assessment methods: Creation (IV)

*New LCIA method

Impact assessment method: New LCIA method

Impact factors 1.23

Impact category: Human toxicity

Flow	Category	Flow property	Unit	Factor	Uncertainty
1,2,4-trichlorobenzene	air/high population de...	Mass	CTUh/kg	2*p1	none

6. Add value for the factor (parameters can be used as in processes!)

*New LCIA method

Parameters

Global parameters

Input parameters 1.23

Name	Value	Uncertainty	Description
p1	1.0	none	

Dependent parameters 1.23

Name	Formula	Value	Description

Impact assessment methods: Creation (V)

*New LCIA method

Impact assessment method: New LCIA method

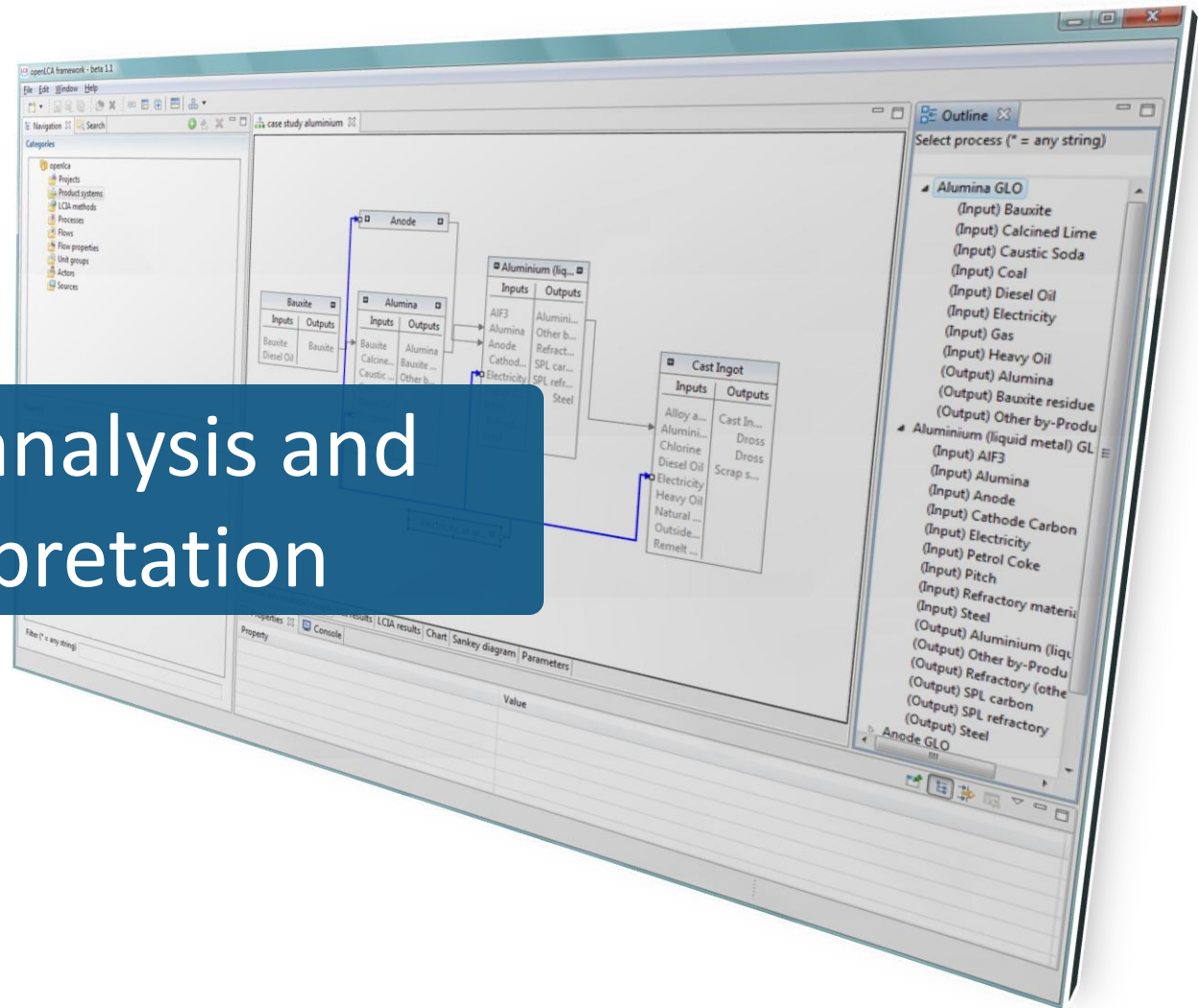
Normalization and weighting sets

Normalization and weighting set	Impact category	Normalization factor	Weighting factor
newSet	Human toxicity	-	-

8. Click on the set name to automatically add the impact categories of the method

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

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“

Calculation properties

Please select the properties for the calculation

Allocation method: As defined in processes

LCIA method: CML 2001

Normalization/weighting set:

Calculation type:

- Quick results
- Analysis
- Monte Carlo Simulation

Number of iterations: 100

Save as default Reset Calculate Cancel

Analysis: Flow & Impact contributions

openLCA framework 1.2

Navigation: MySQL at localhost:3306, bioenergie, bioenergiestat, ecoinvent_n, Projects, Product systems, conventional viticulture, cotton fibres, cotton shirt, organic viticulture, organic viticulture (unit process network), Plastikflaschenproduktion, polyester fibres, soap at user (freight), soap at user (pkm), soap transportation long distance (freight), soap transport long distance (pkm), transportation soap middle distance (freight), transportation soap middle distance (pkm), transportation soap short distance (freight), transportation soap short distance (pkm), viscose shirt, Wärme aus Pellets, wine production (conventional), wine production (organic), LCIA methods, Processes, Flows, Flow properties, Unit groups, Actors, Sources, LCIA results, elcd, elcd_nrel, lifecyclecosting, openlca4students129, openlca4studentsnew

organic viticulture (unit process network) Analysis result of organic viticulture

Product system: organic viticulture (unit process network)
Target amount: 1.0 kg grapes (organic)
LCIA method: CML 2001

Flow contributions

Flow: Particulates, < 2.5 um | Order by: Hot spots

Contribution	Value
transport, municipal waste collection, lorry 21t	7.652E-6 kg
electricity, at cogen ORC 1400KWh, wood, alloc	1.776E-6 kg
heavy fuel oil, burned in refinery furnace	1.401E-6 kg
refinery gas, burned in furnace	6.368E-7 kg
heavy fuel oil, burned in industrial furnace 1MW	5.352E-7 kg
Rest	2.763E-6 kg

Impact contributions

Impact category: atmospheric ozone depletion - ODP 25a | Order by: Hot spots

Contribution	Value
transport, natural gas, pipe	1.282E-8 kg CFC-11-Eq
crude oil, natural gas, pipe	1.151E-8 kg CFC-11-Eq
crude oil, natural gas, pipe	8.966E-9 kg CFC-11-Eq
crude oil, natural gas, pipe	7.492E-9 kg CFC-11-Eq
crude oil, natural gas, pipe	4.478E-9 kg CFC-11-Eq
Rest	8.925E-9 kg CFC-11-Eq

General information | Process contributions | Grouping | Locations | Sankey diagram

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

openLCA 1.4.1 beta 4

File Window Help

*Battery production Analysis result of Battery production Quick results transport

Process contributions

Flow: Zinc - water/unspecified Cut-off: 0 %

Contribution	Process	Amount	Unit
75.86%	Ethylene oxide, at plant - RNA	0.00022	kg
09.83%	Polyethylene terephthalate, resin, at plant - RNA	2.88611E-5	kg
06.78%	Natural gas, extracted - RNA	1.99006E-5	kg
03.05%	Natural gas, at extraction site - RNA	8.95793E-6	kg
01.84%	Crude oil, extracted - RNA	5.39161E-6	kg
01.38%	Crude oil, at production - RNA	4.04537E-6	kg
00.66%	Sulfur, at plant - RNA	1.93028E-6	kg
00.43%	Hydrochloric acid, at plant - RNA	1.27126E-6	kg
00.10%	Polyvinyl chloride, resin, at plant - RNA	2.87042E-7	kg
00.07%	Polyethylene, linear low density, resin, at plant - RNA	2.04067E-7	kg

Impact category: climate change - GWP 100a Cut-off: 2 %

Contribution	Process	Amount	Unit
33.14%	Hot rolled sheet, steel, at plant - RNA	108.58189	kg CO2-Eq
19.18%	Electricity, bituminous coal, at power plant - US	62.85205	kg CO2-Eq
10.56%	Transport, combination truck, diesel powered - US	34.61704	kg CO2-Eq
07.78%	Natural gas, combusted in industrial boiler, at hydrocracker, f...	25.50630	kg CO2-Eq
06.49%	Soda powder, at plant - RNA	21.27902	kg CO2-Eq
04.43%	Manganese oxide	14.53002	kg CO2-Eq
04.01%	Ethylene oxide, at plant - RNA	13.15162	kg CO2-Eq
03.32%	Transport, train, diesel powered - US	10.89440	kg CO2-Eq
02.41%	Electricity, natural gas, at power plant - US	7.88966	kg CO2-Eq
02.22%	Lithium manganese oxide	7.25964	kg CO2-Eq

General information | Inventory results | LCIA Results | Process contributions | Process results | Flow contributions | Contribution tree | Grouping | Locations | Sankey diagram

Formula Interpreter

Analysis: process results

openLCA 1.4.1 beta 4

File Window Help

*Battery production Analysis result of Battery production Quick results transport

Process results

Process: Battery pack (S1) Cut-off: 0.01 %

Inputs

Contribution	Flow	Upstream to...	Direct contri...	Unit
100...	Dummy, Chemicals,...	3.54816E-5	0.00000	kg
100...	Dummy, Disposal, s...	0.02947	0.00000	kg
100...	Carbon dioxide, in ...	0.28262	0.00000	kg
100...	Gasoline, combust...	4.55712E-5	0.00000	m3
100...	Diesel, combusted i...	0.02613	0.00000	m3
100...	Liquefied petroleu...	3.97621E-5	0.00000	m3
100...	Dummy, Disposal, s...	0.11025	0.00000	kg
100...	Limestone, in groun...	9.32010	0.00000	kg
100...	Dummy, Disposal, s...	0.00635	0.00000	kg

Outputs

Contribution	Flow	Upstream to...	Direct contri...	Unit
100...	NMVOC, non-meth...	0.00108	0.00000	kg
100...	Nitrate(water/unsp...	1.89655E-6	0.00000	kg
100...	Ethane, 1,2-dibrom...	2.21457E-11	0.00000	kg
100...	Sulfide(water/unsp...	0.08757	0.00000	kg
100...	Petroleum coke, at r...	0.03197	0.00000	kg
100...	Detergents, oil(wat...	1.97769E-5	0.00000	kg
100...	Phenanthrenes, alky...	1.85839E-8	0.00000	kg
100...	Chrysene(air/unspe...	1.47806E-9	0.00000	kg
100...	Ethane, 1,1,1-trichlo...	4.20792E-10	0.00000	kg

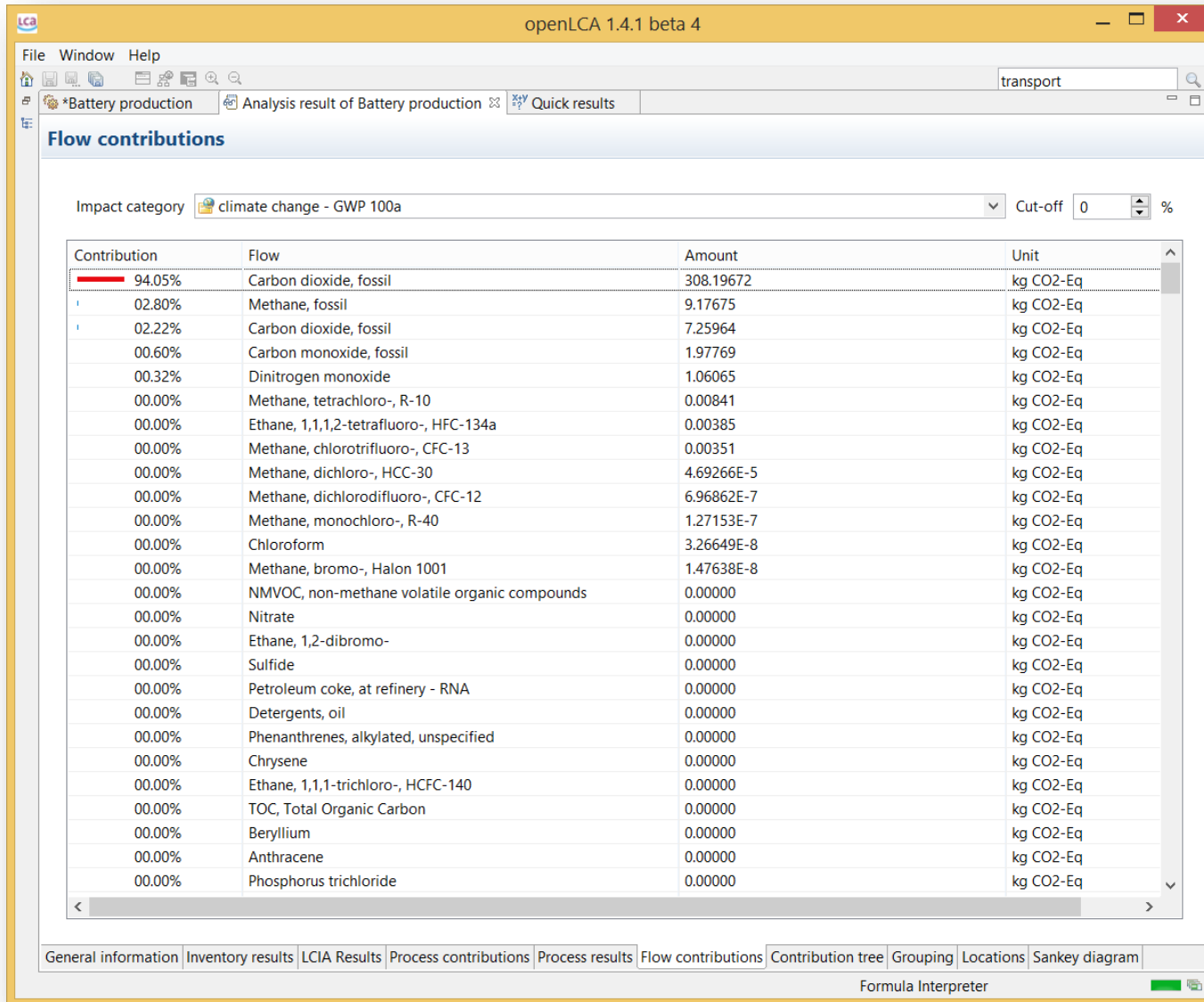
Impact assessment results

Process: Cathode, lithium-ion battery Cut-off: 0.01 %

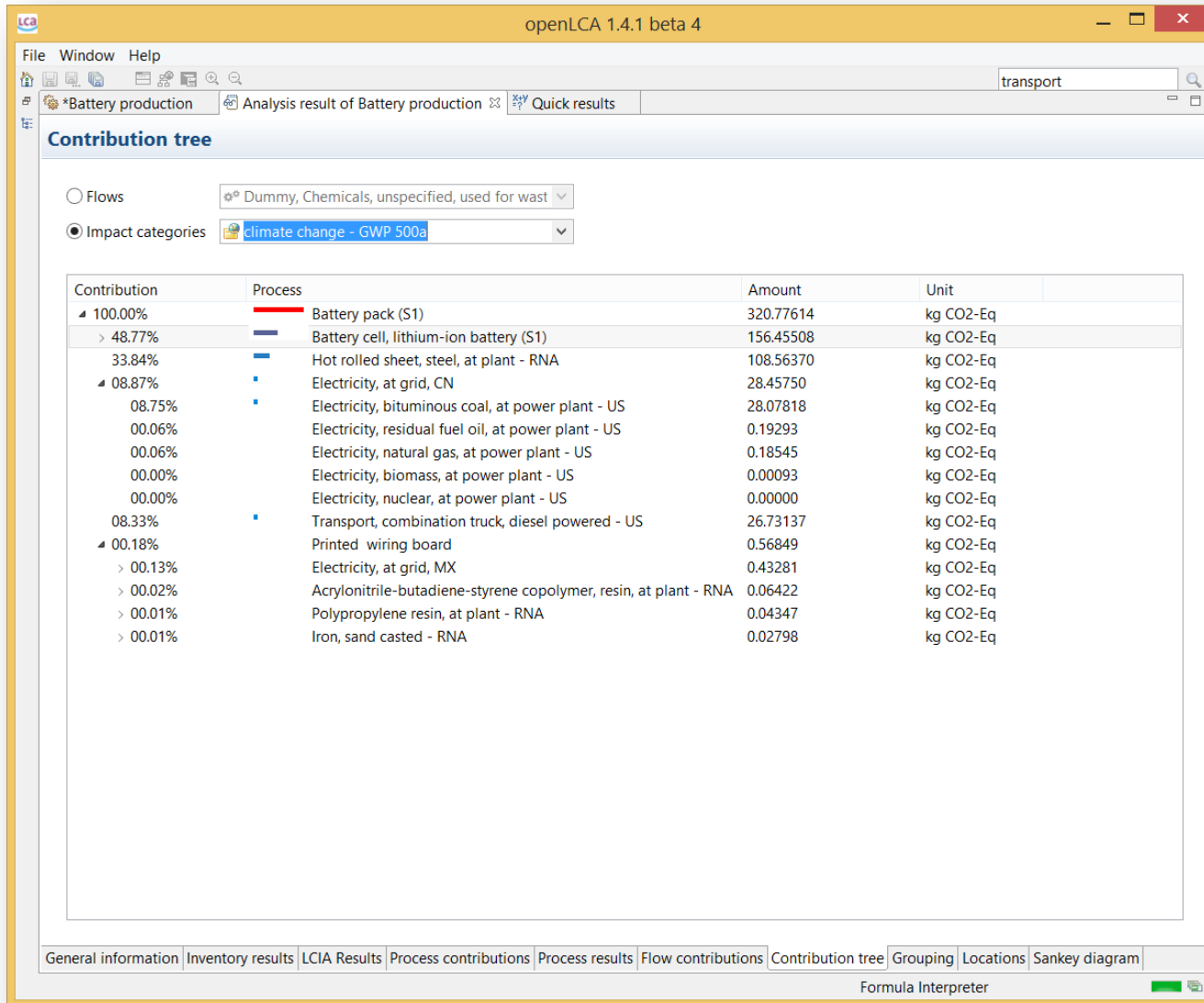
Contribution	Impact category	Upstream total	Direct impact	Unit
23.44%	climate change - GWP 500a	75.20372	0.00000	kg CO2-Eq
23.01%	climate change - GWP 100a	75.38699	0.00000	kg CO2-Eq
21.90%	climate change - GWP 20a	75.54843	0.00000	kg CO2-Eq

General information | Inventory results | LCIA Results | Process contributions | Process results | Flow contributions | Contribution tree | Grouping | Locations | Sankey diagram | Formula Interpreter

Analysis: flow contributions



Analysis: contribution tree



Analysis: grouping

The screenshot shows the openLCA 1.4.1 beta 4 software interface. The main window is titled "openLCA 1.4.1 beta 4" and has a menu bar with "File", "Window", and "Help". The search bar contains "transport". The "Grouping" tab is active, showing a list of processes under the "transport" group. A green callout bubble points to the right-click context menu options for a process name, which include "Add new groups" and "Move processes to them".

Groups

- Other
- transport

Processes in transport group:

- Acrylonitrile-butadiene-styrene copolymer, resin, at plant - RNA
- Ammonia, steam reforming, liquid, at plant - RNA
- Anode, lithium-ion battery
- Battery cell, lithium-ion battery (S1)
- Battery pack (S1)
- Benzene, at plant - RNA
- Butadiene, at plant - RNA
- Cathode, lithium-ion battery
- Chlor-alkali electrolysis, average production mix, at plant - RNA

Results

Flows: Dummy, Chemicals, unspecified, used for wastewater treatment - Product flows - RNA

Impact categories: climate change - GWP 500a

Group	Amount	Unit
Other	272.83931074518324	kg CO2-Eq
transport	47.93682716786533	kg CO2-Eq

Legend:

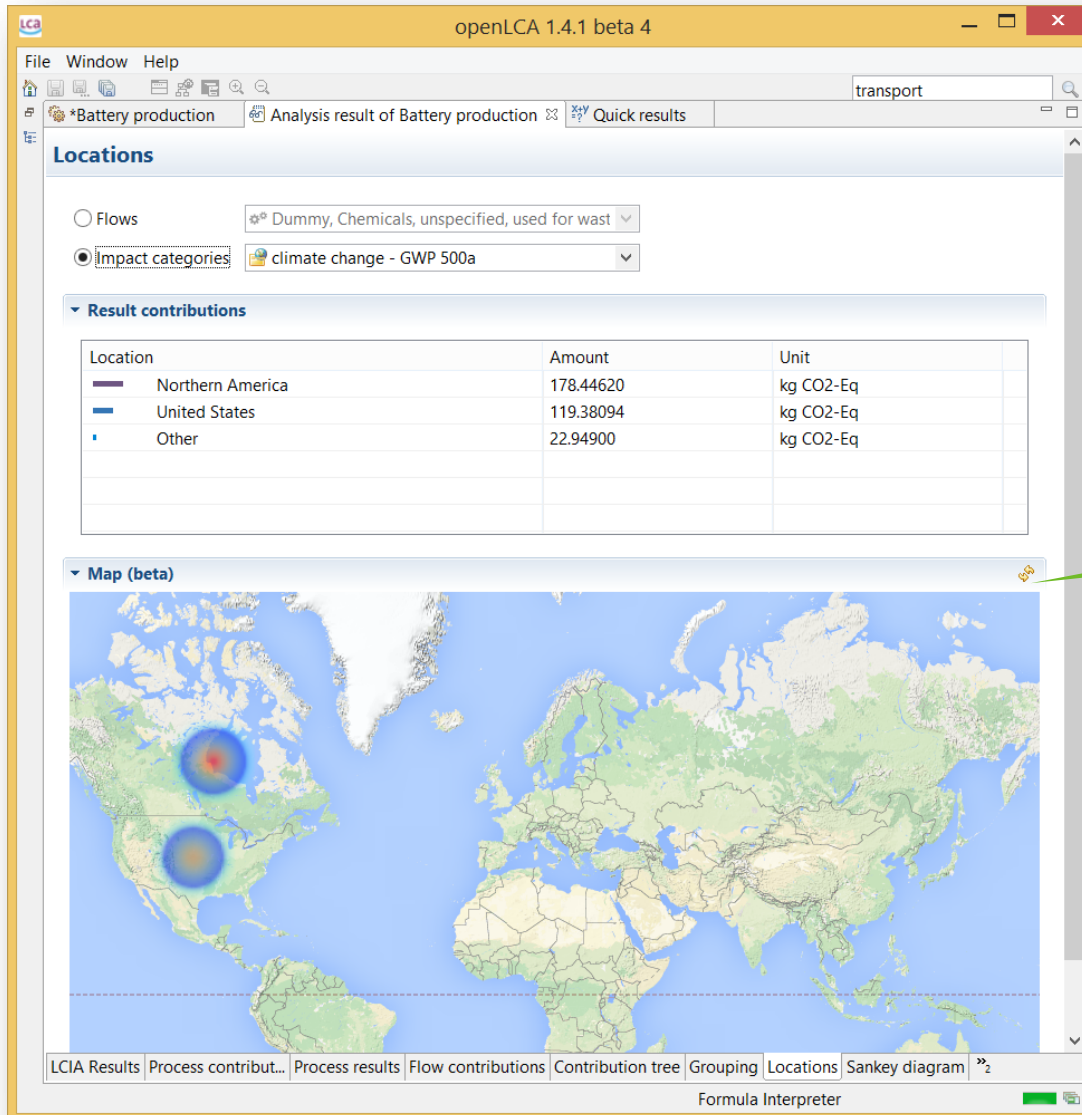
- 2.728E2 kg CO2-Eq: Other
- 47.937 kg CO2-Eq: transport

LCIA Results | Process contribut... | Process results | Flow contributions | Contribution tree | Grouping | Locations | Sankey diagram

Formula Interpreter

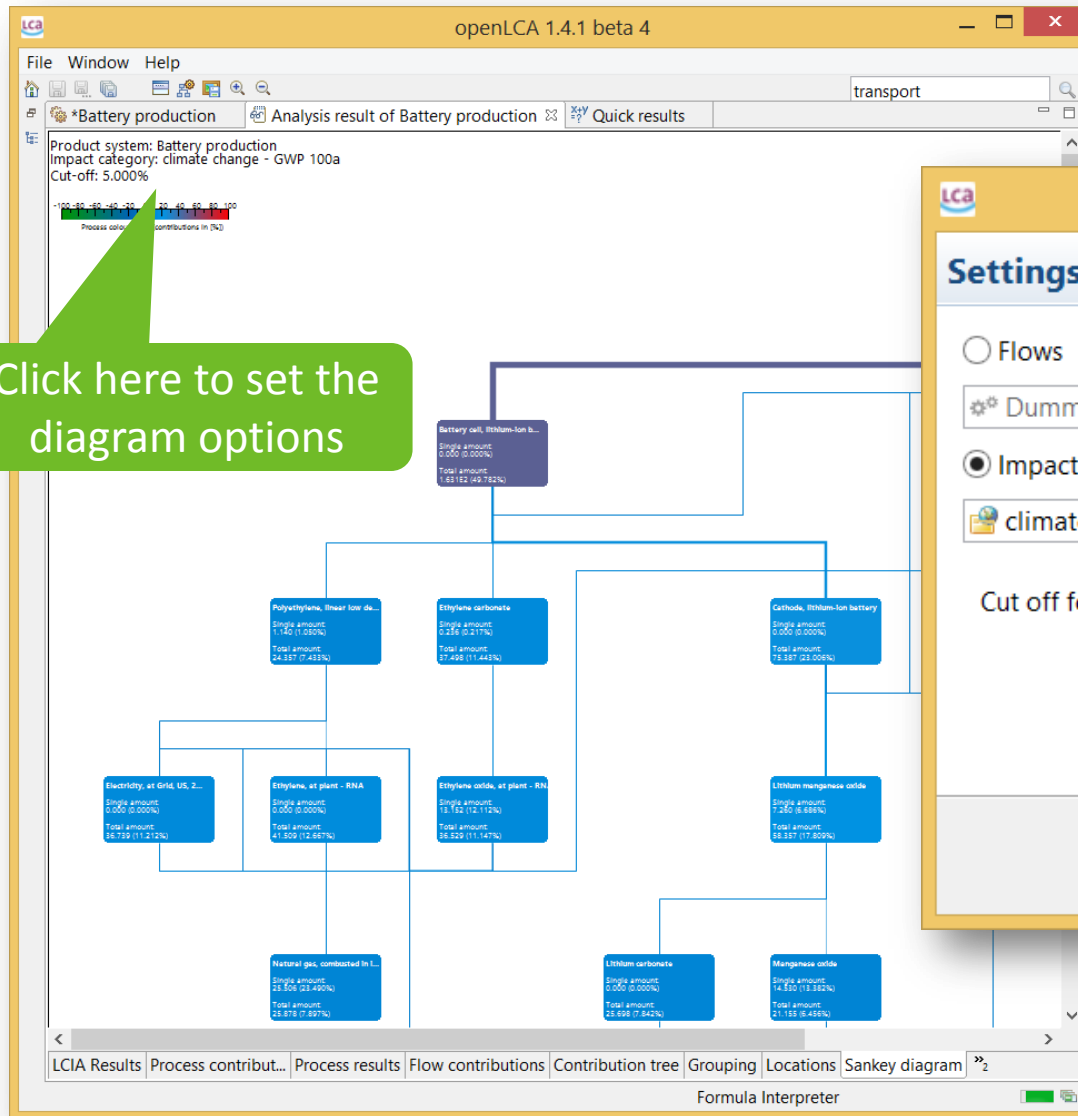
Add new groups and move (right click on process name) processes to them

Analysis: locations



If you don't see any points in the map, click "reload"

Analysis: Sankey diagram



Click here to set the diagram options

Settings for the Sankey diagram

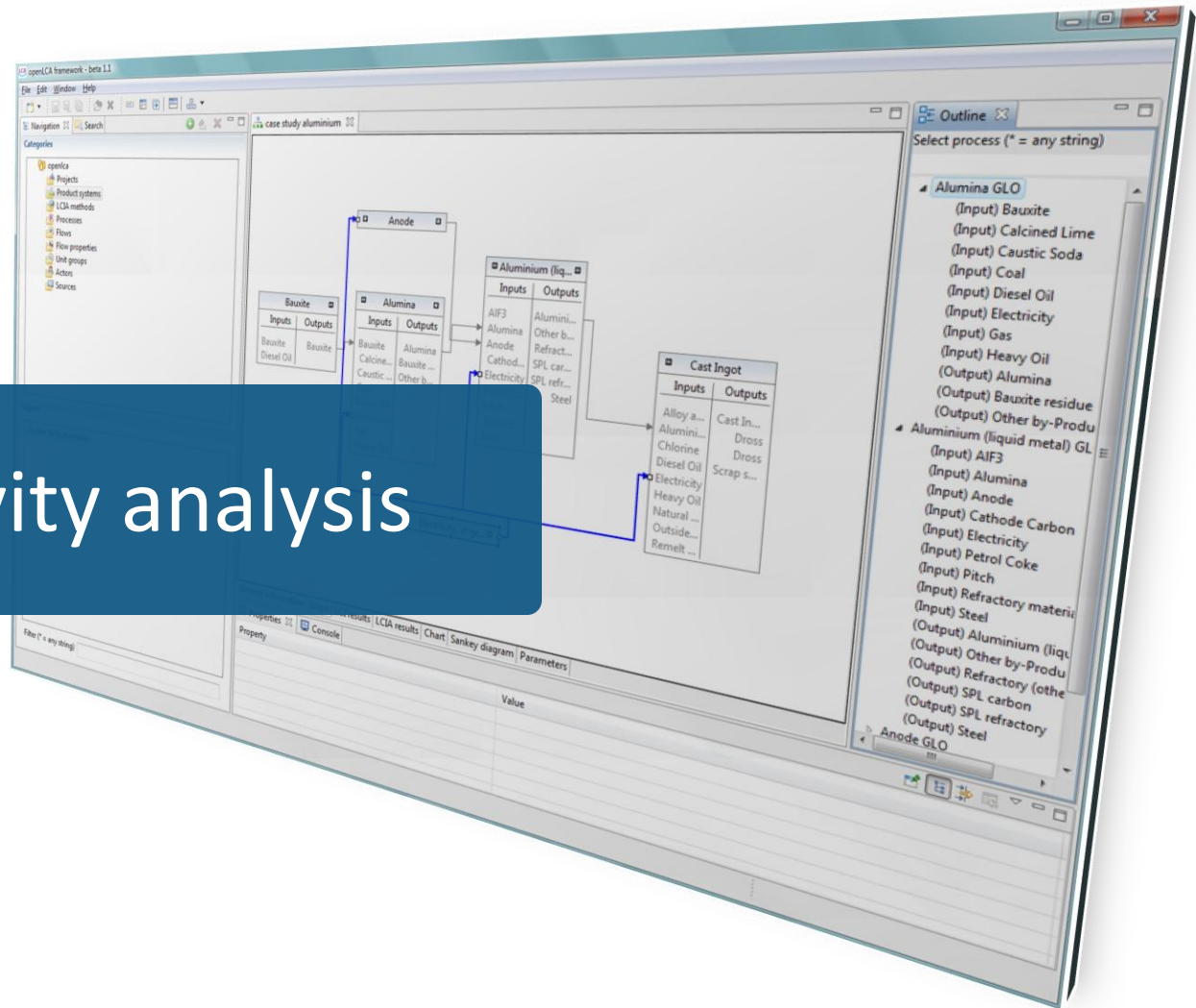
Flows

Impact categories

cut off for first layer (in %) 5.000

OK Cancel

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?
 - ...

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

The screenshot shows the openLCA 1.4 software interface. The main window is titled '*ammonium bicarbonate production - RER'. The left sidebar contains a navigation tree with the following items: bioenergiadat, ecoinvent_3_cutoff(1) (expanded), Projects, Product systems, Impact methods, Processes, Flows, Flow properties, Unit groups, Sources, Actors, elcd, gabi_2013_professional, lca_commons_1.1, openlca_lcia_methods_1.4, probas_1, and Schulung_Students. The main area is titled 'Parameters' and is divided into two sections: 'Global parameters' and 'Input parameters'. The 'Input parameters' section contains a table with the following columns: Name, Value, Uncertainty, and Description. Below this is the 'Dependent parameters' section, which contains a table with the following columns: Name, Formula, Value, and Description. At the bottom of the window, there is a tabbed interface with the following tabs: General information, Inputs/Outputs, Administrative information, Modeling and validation, Parameters (selected), Allocation, and Costs.

Process: Parameters (II)

The screenshot displays the openLCA 1.4 interface. The main window shows a navigation tree on the left and a 'Parameters' dialog in the center. The 'Parameters' dialog is divided into 'Global parameters' and 'Input parameters'. The 'Input parameters' section contains a table with the following data:

Name	Value	Uncertainty
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

Overlaid on the main window is the 'Preferences' dialog, which has a 'Global parameters' section. This section contains a table with the following headers:

Name	Amount	Uncertainty	Description

The 'Preferences' dialog also includes a search filter 'type filter text' and a list of experimental features: Field Assist, Global parameters, ILCD Network 2013 G, Locations, Logging, Number format, and Updates. The 'Global parameters' feature is currently selected. At the bottom of the 'Preferences' dialog are 'OK' and 'Cancel' buttons.

Process: Parameters (III)

Process: Plane, technology mix, cargo, 68 t payload

Inputs

Flow	Category	Flow proper...	Unit	Amount	Uncertainty	Default pro...	Pedigree un...
⚙️ kerosene	Energy carriers and...	Mass	kg	Spez_Verbr	none		
⚙️ cargo	Transport services/...	Mass	kg	1.0	none		

Click here to change the formula view

Outputs

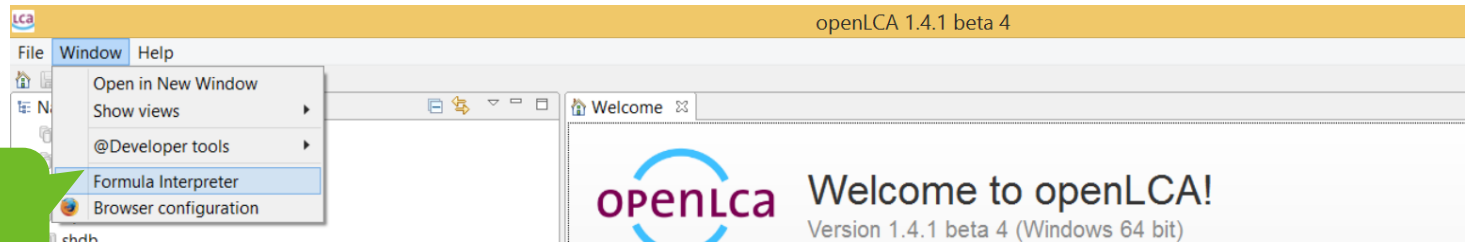
Flow	Category	Flow proper...	Unit	Amount	Uncertainty	Avoided pr...
⚙️ cargo	Transport services/...	Mass	kg	1.0	none	
🌿 Sulfur dioxide	air/unspecified	Mass	kg	$(5.0E-5 * Spez_Verbr) * 1.0$	none	
🌿 Nitrogen dioxide	air/unspecified	Mass	kg	$(0.016321 * Spez_Verbr) * 1.0$	none	

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

```
Console
Formula Interpreter
openLCA Formula Interpreter
type 'help' to display the help message

olca<< help
| evaluate an expression:           type in the expression and press enter, e.g. sin(42)
  define a variable:                type var <variable name> = <expression>, e.g. var a = sin(42)
  exit the interpreter:             type 'exit' or 'quit' and press enter
olca<<
```

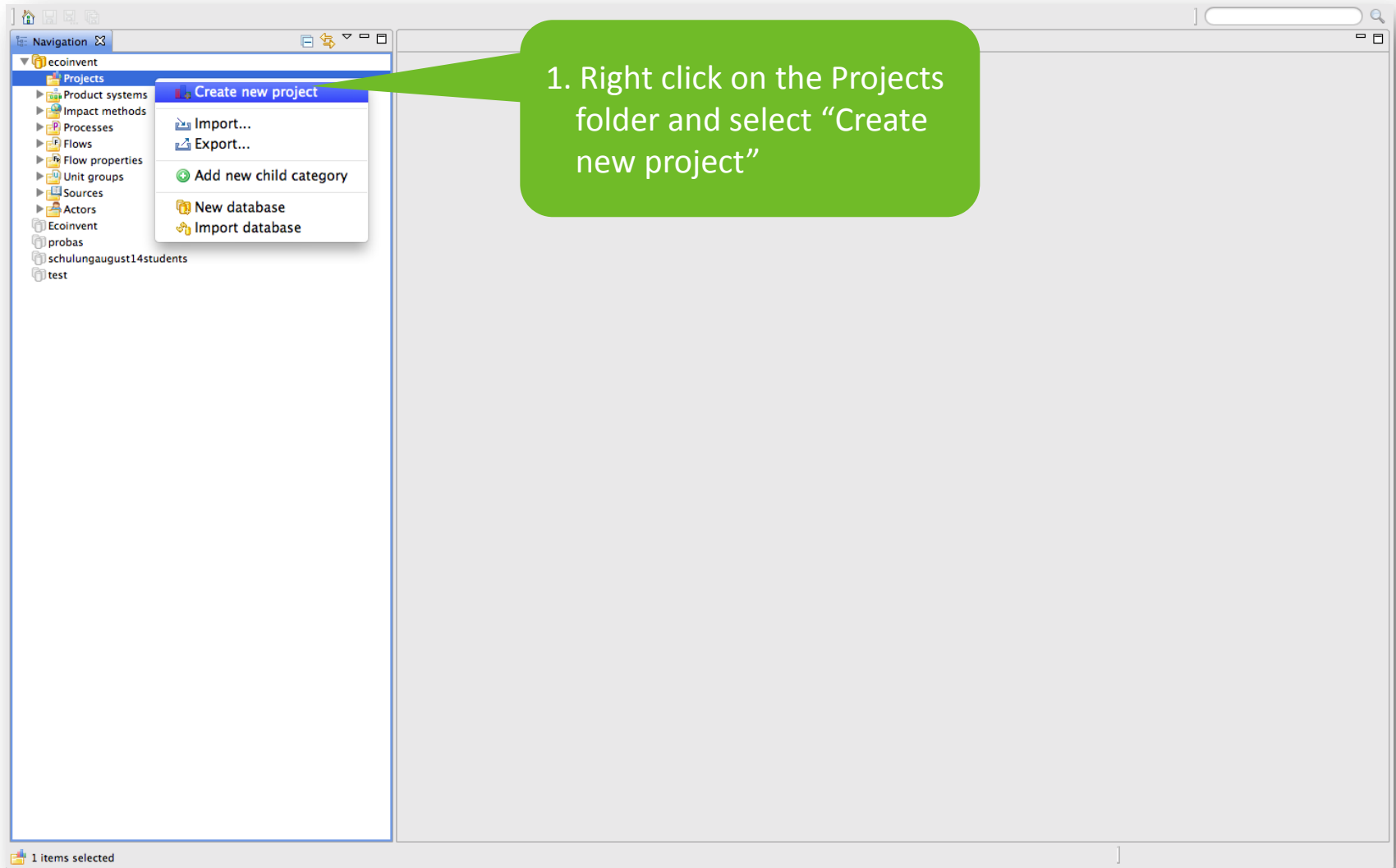

Product system: Parameters

The screenshot displays a software interface with a navigation pane on the left and a main content area on the right. The navigation pane lists various project and system components. The main content area shows a window titled '*Barge, technology mix, 1.228 t pay load capacity'. Below the title bar, there is a section for 'Parameters' containing a table with the following data:

Context	Parameter	Amount	Uncertainty
Barge, technology mix, 1...	Distanz	50.0	none

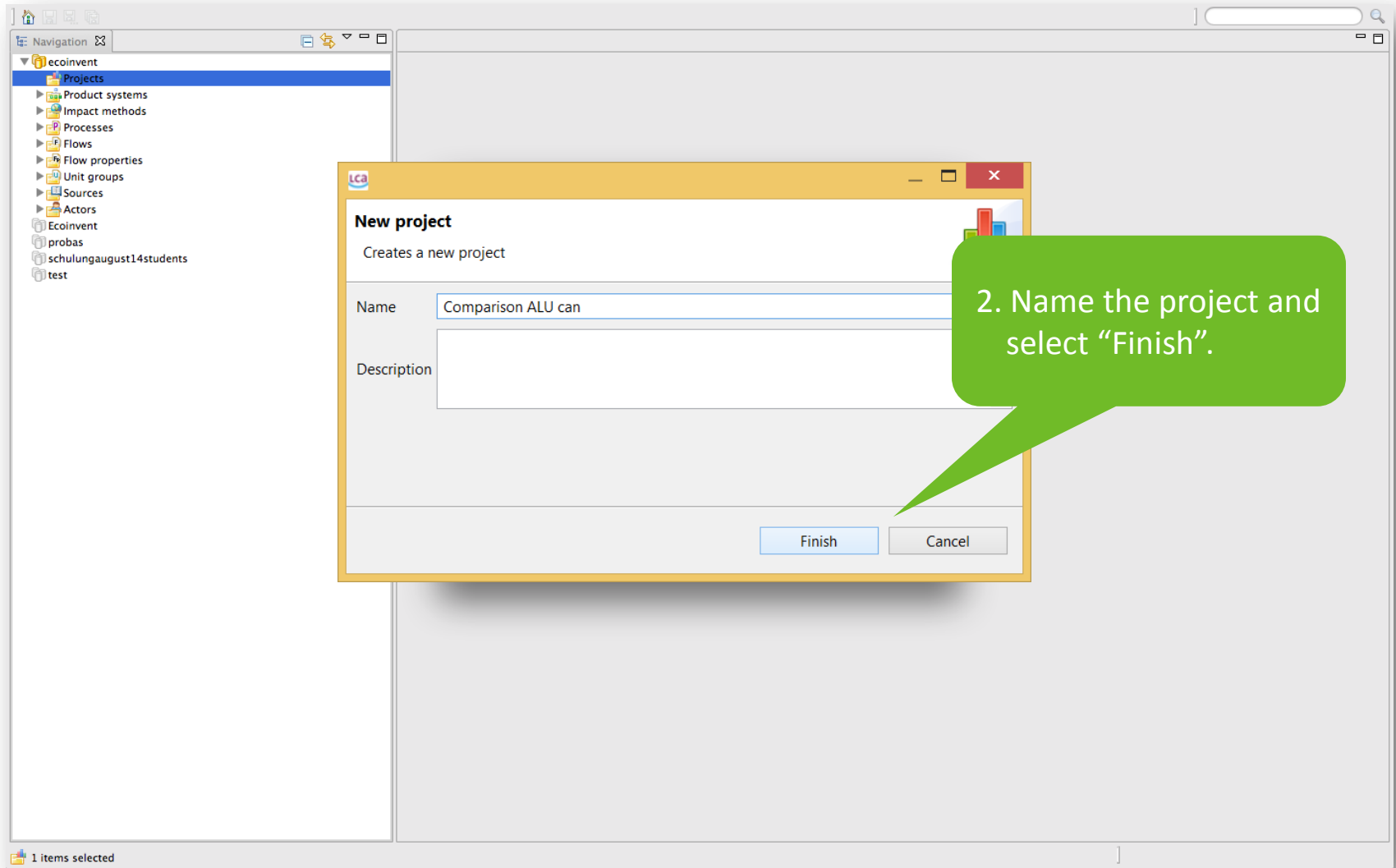
A green callout box points to the 'Amount' column of the table, containing the text: "3. Change the values as desired; the new value it will only affect to the specified process".

Project: Creation



1. Right click on the Projects folder and select “Create new project”

Project: Creation (II)



Project: Creation (III)

The screenshot displays the openLCA 1.4.1 beta 6 software interface. On the left is a navigation tree with a folder named 'casestudypetvsaluempty' containing sub-items like 'Projects', 'Product systems', 'Impact assessment methods', 'Processes', 'Flows', 'Flow properties', 'Unit groups', 'Sources', 'Actors', and several project files. The main window is titled 'Comparison ALU can' and shows the 'Project: Comparison ALU can' configuration. The 'General information' section includes fields for Name (Comparison ALU can), Description, Version (00.00.000), and Last change (2014-12-03T17:36:47+01:00). A 'Report' button is visible below. The 'LCIA Method' section is partially visible. The 'Variants' section is highlighted with a red box and contains a table with columns: Name, Product syst..., Allocation ..., Flow, Amount, Unit, and Description. A green callout bubble points to a green plus button in the top right corner of the Variants section, containing the text: '3. A new tab with the project will appear in the editor window. Click on the green button to select different variants'. The bottom of the window shows a tabbed interface with 'Project setup' and 'Report sections' tabs.

3. A new tab with the project will appear in the editor window. Click on the green button to select different variants

Name	Product syst...	Allocation ...	Flow	Amount	Unit	Description

Comparative assessments: **Projects**

- Same or different product systems can be compared using Variants

Project: PET Case Study

General information

Name: PET Case Study

Description:

Version: 00.00.008

Last change: 2014-11-13T11:08:36+0100

[Report](#)

LCIA Method

Variants

compare allocation methods

change variant target amounts

Name	Product system	Allocation method	Flow	Amount	Unit
Case 1	Bottle at POS	Economic	Bottle sale	1000.0	Item(s)
Case 2	Bottle at POS	Physical	Bottle sale	2500.0	Item(s)
Case 3	Bottle at POS	Causal	Bottle sale	7500.0	Item(s)

Comparative assessments: **Projects**

- Same or different product systems can be compared using

Variants

Project: Comparison ALU can

General information

Name: Comparison ALU can

Description:

Version: 00.00.001

Last change: 2014-12-03T17:40:51+0100

LCIA Method

Variants

Parameters

Parameter	Context	Report name	Description	Variant1	Variant2	Variant3
recycledalu	ALU can 0,5L	recycledalu	Recycling rate of ...	0.5	0.6	0.9

Process contributions

Project setup | Report sections

Change the values of the parameters per variant

Add parameters used in the product system

Comparative assessments: Projects

*Project - example

Project: Project - example

General information

Name: Project - example

Description:

Version: 00.00.001

Last change: 2014-09-23T22:28:15+0200

Report

LCIA Method

LCIA Method: CML 2001

Normalization and weighting set:

Impact category	Display	Report name	Description
acidification potential - average European	<input checked="" type="checkbox"/>	acidification potential - average Europe...	
acidification potential - generic	<input checked="" type="checkbox"/>	acidification potential - generic	
climate change - GWP 100a	<input checked="" type="checkbox"/>	climate change - GWP 100a	
climate change - GWP 20a	<input checked="" type="checkbox"/>	climate change - GWP 20a	
climate change - GWP 500a	<input checked="" type="checkbox"/>	climate change - GWP 500a	
climate change - lower limit of net GWP	<input checked="" type="checkbox"/>	climate change - lower limit of net GWP	

select the LCIA method and impact categories you are interest in

Comparative assessments: Projects

*Project - example

Project: Project - example

General information

Name: Project - example

Description:

Version: 00.00.001

Last change: 2014-09-23T22:28:15+0200

Report

LCIA Method

Variants

Parameters

Process contributions

Process	Report name	Description
Anode, lithium-ion battery	Anode, lithium-ion battery	

Once every variable is set, click "Report" to calculate results

The contribution of different processes can be compared

Project: Report

The screenshot displays the openLCA 1.4.1 beta 4 application window. The interface is divided into several sections for configuring a report. Two callout boxes highlight key features:

- 1. Text descriptions for each sections can be added**: This callout points to the 'Text' field in the 'Introduction' section, which contains a default template: `<p>changing the text of the sections,adding or removing sections,</p>`
- 2. The type of component to display in each section can be selected (e.g. tables, graphs)**: This callout points to the 'Component' dropdown menu in the 'Selected LCIA' section, which lists various visualization options such as 'Variant description table', 'LCIA category description table', 'Parameter description table', 'Parameter value table', 'LCIA result table', 'Normalisation result table', 'Single score table', 'Indicator bar chart', 'Relative LCIA results - bar chart', 'Normalisation - bar chart', 'Relative LCIA results - radar chart', 'Normalisation - radar chart', 'Single score bar chart', and 'Process contribution chart'.

Project: Report sections

Report sections

▼ **General information**

Title

▶ **Introduction** [collapse] [delete]

▶ **Project Variants** [collapse] [delete]

▶ **Selected LCIA Categories** [collapse] [delete]

▶ **LCIA Results** [collapse] [delete]

▶ **Single Indicator Results** [collapse] [delete]

▶ **Process Contributions** [collapse] [delete]

▶ **Relative Results** [collapse] [delete]

☑ **New section** [collapse] [delete]

Section

Text

New sections can be added

Or delete existing ones

Example: Project report

Variant	Description
Variant1	
Variant2	

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.

LCIA category	Unit	Description
climate change - GWP 100a	kg CO2-Eq	
climate change - GWP 20a	kg CO2-Eq	
climate change - GWP 500a	kg CO2-Eq	

LCIA Results

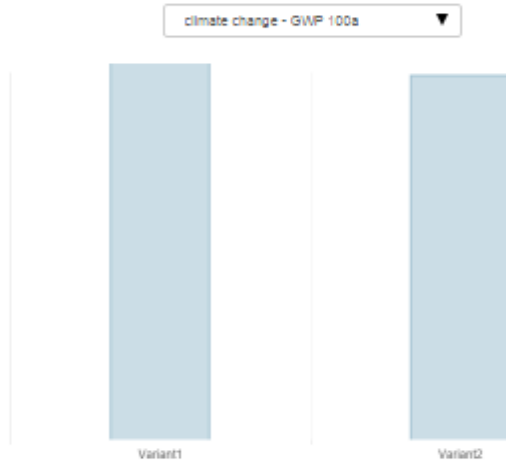
This table shows the LCIA results of the project variants. Each selected LCIA category is displayed in the rows and the project variants in the columns. The unit is the unit of the LCIA category as defined in the LCIA method.

LCIA category	Variant1	Variant2	Unit
climate change - GWP 100a	-1.35354e+2	-9.02359e+1	kg CO2-Eq
climate change - GWP 20a	-1.38358e+2	-9.22388e+1	kg CO2-Eq
climate change - GWP 500a	-1.33922e+2	-8.92811e+1	kg CO2-Eq

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.

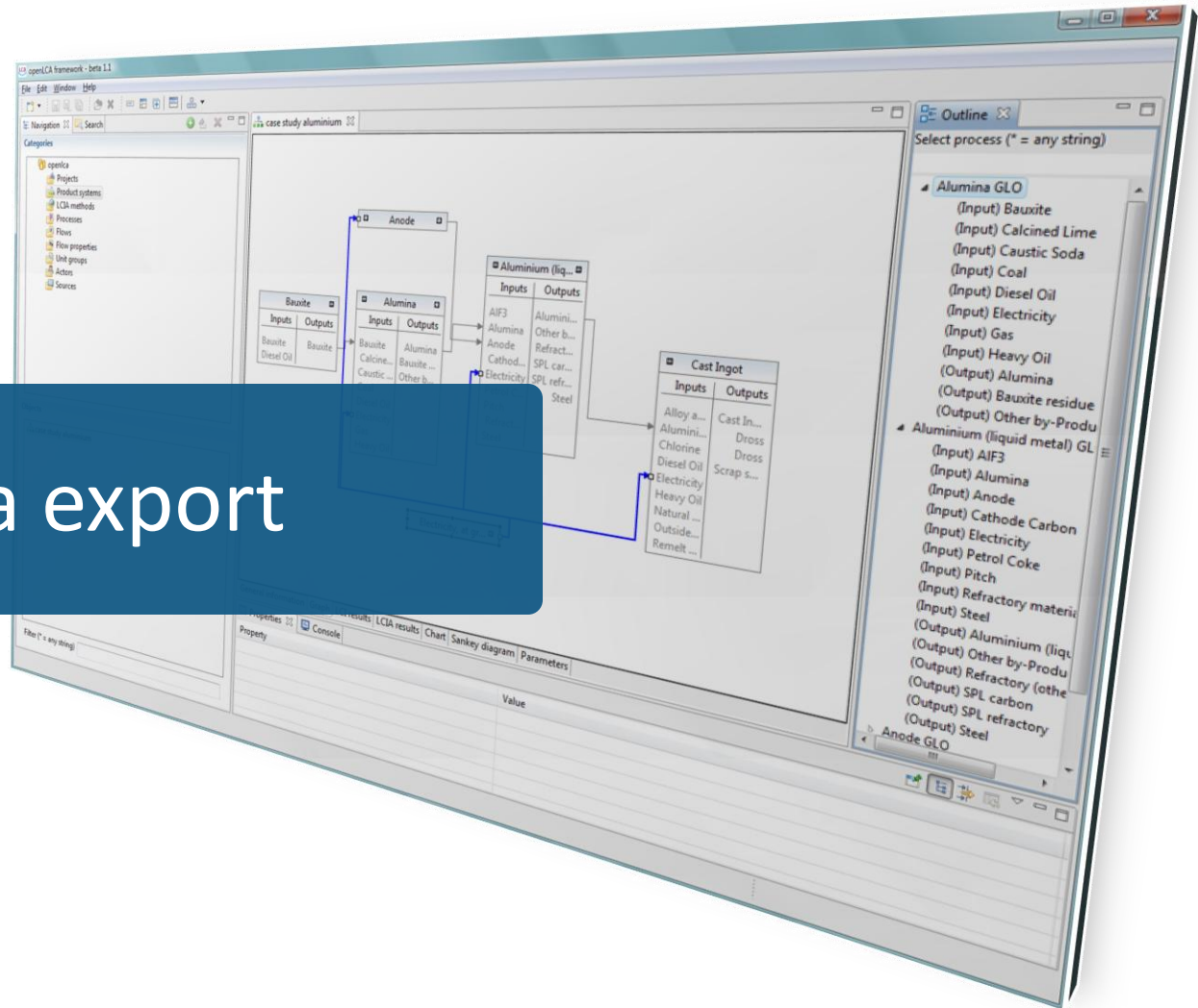


Process Contributions

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.



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)

The screenshot shows the openLCA 1.4.1 beta 4 application window. The 'File' menu is open, and the 'Export...' option is highlighted. A green callout box points to this option with the text '1. Select "Export" in File'. The 'Export' dialog box is also open, showing a tree view of export destinations. The 'EcoSpold' folder is selected, and a green callout box points to it with the text '2. Select format'. The dialog box has a search bar and buttons for '< Back', 'Next >', 'Finish', and 'Cancel'.

openLCA 1.4.1 beta 4

File Window Help

- Save Ctrl+S
- Save As... Ctrl+Shift+S
- Save All Ctrl+Shift+S
- Close Ctrl+W
- Close All Ctrl+Shift+W
- Preferences
- Import...
- Export...**
- Exit

Welcome

openLCA Welcome to openLCA!
Version 1.4.1 beta 4 (Windows 64 bit)

High performance Life Cycle Assessment (LCA) and sustainability assessment software. Truly open source. Available for free. Created and maintained since 2006 by GreenDelta. Berlin. www.greendelta.com. Licensed under...

Export

Select

Choose export destination.

Select an export destination:

type filter text

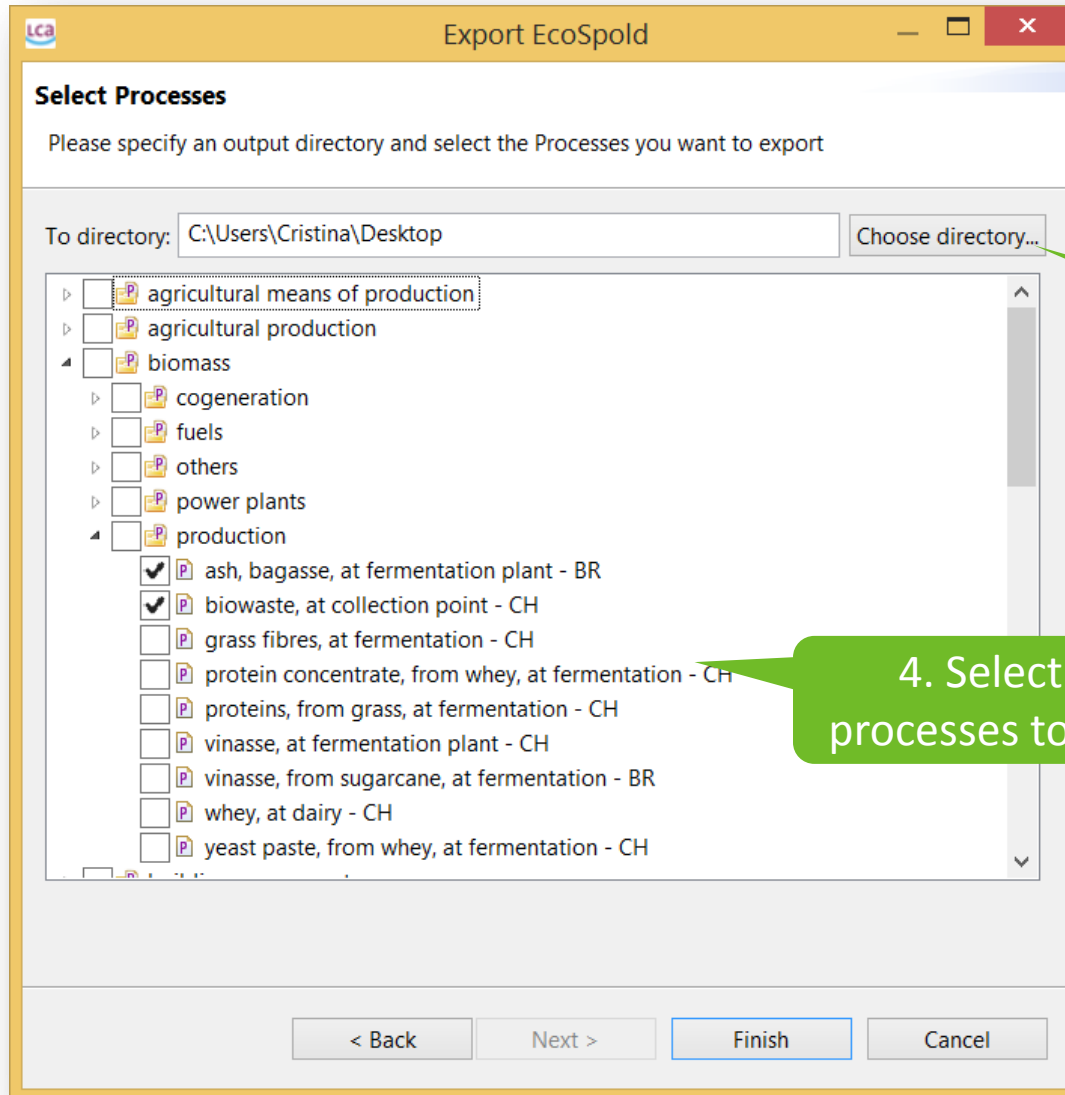
- ▲ EcoSpold
 - ☒ EcoSpold 2
 - ☒ Impact methods
 - ☒ Processes
- ▲ Excel
 - ☒ Processes
- ▶ ILCD
- ▶ ILCD Network Export

< Back Next > Finish Cancel

1. Select "Export" in File

2. Select format

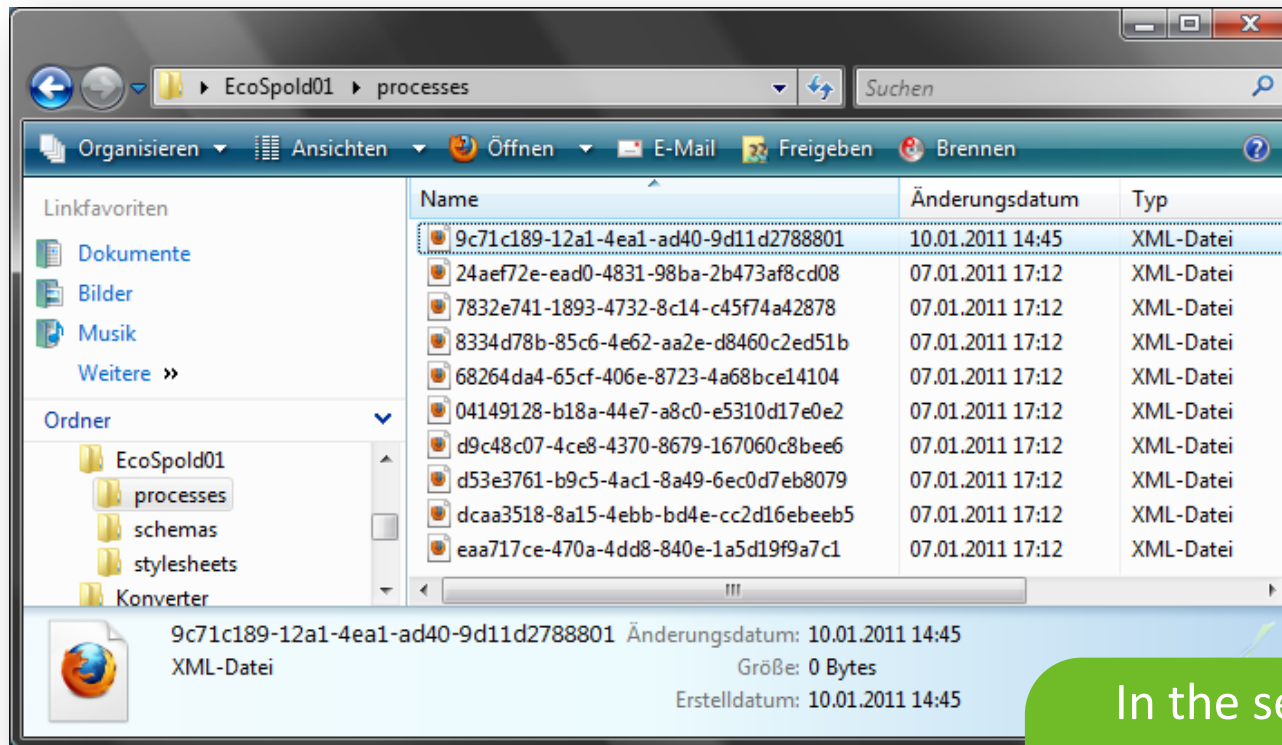
Example: process export (II)



3. Select the directory where data will be stored

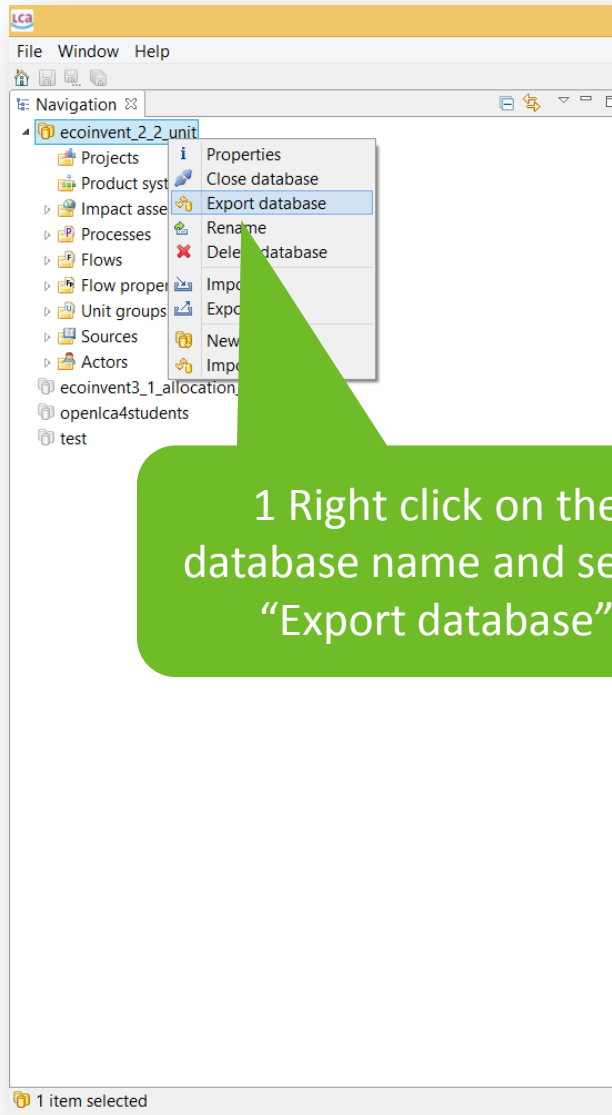
4. Select the processes to export

Example: process export (III)

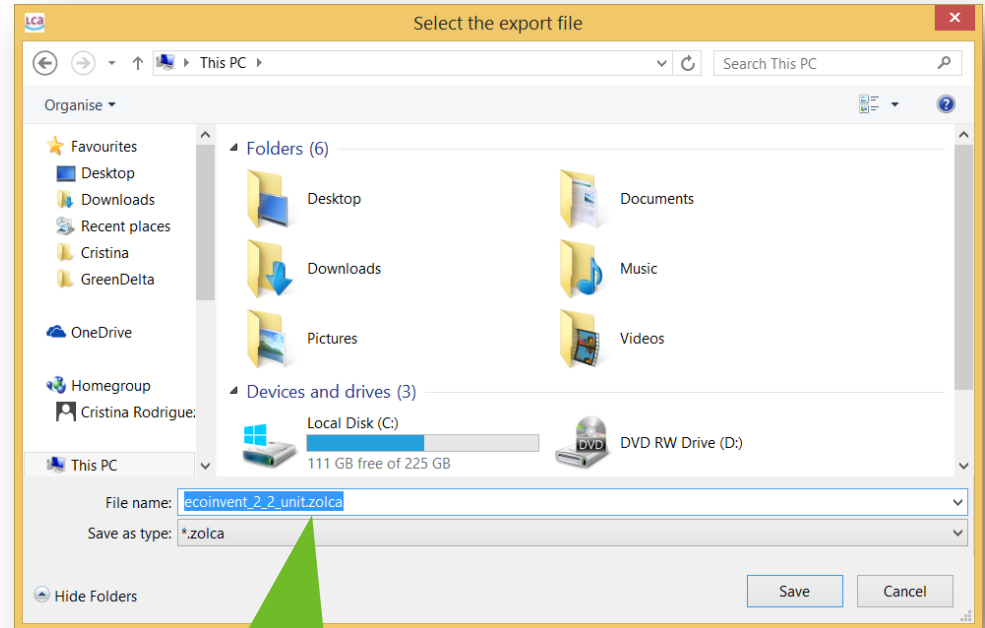


In the selected directory a folder with the name of the export format is created. For instance, Desktop\EcoSpold01\processes

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.

ILCD network database: **import**

1. Go to File → Import

2. Choose "ILCD Network import"

3. Select the server connection and the processes to import

File Window Help

- Save Ctrl+S
- Save As...
- Save All Ctrl+Shift+S
- Close Ctrl+W
- Close All Ctrl+Shift+W
- Preferences
- Import...**
- Export...
- Exit

Welcome to openLCA!
on 1.4.1 beta 4 (Windows 64 bit)

What's new

For the 1.4 version, we completely redesigned and "renovated" openLCA. Results are

Import

Select

Select an import source:

type filter text

- File Import
 - EcoSpold 1
 - EcoSpold 2
 - Excel
 - ILCD
 - SimaPro CSV
 - ILCD Network Import
 - Other
- Database Import

< Back Next > Finish Cancel

Network Import

Search

Search and select processes for the import

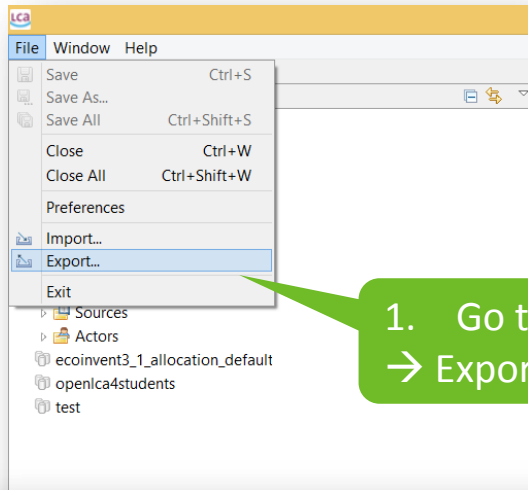
Connection: bioenergiestat @ http://iai-uivser1.iai.fzk.de/bed-ws/resource Change

Process Search

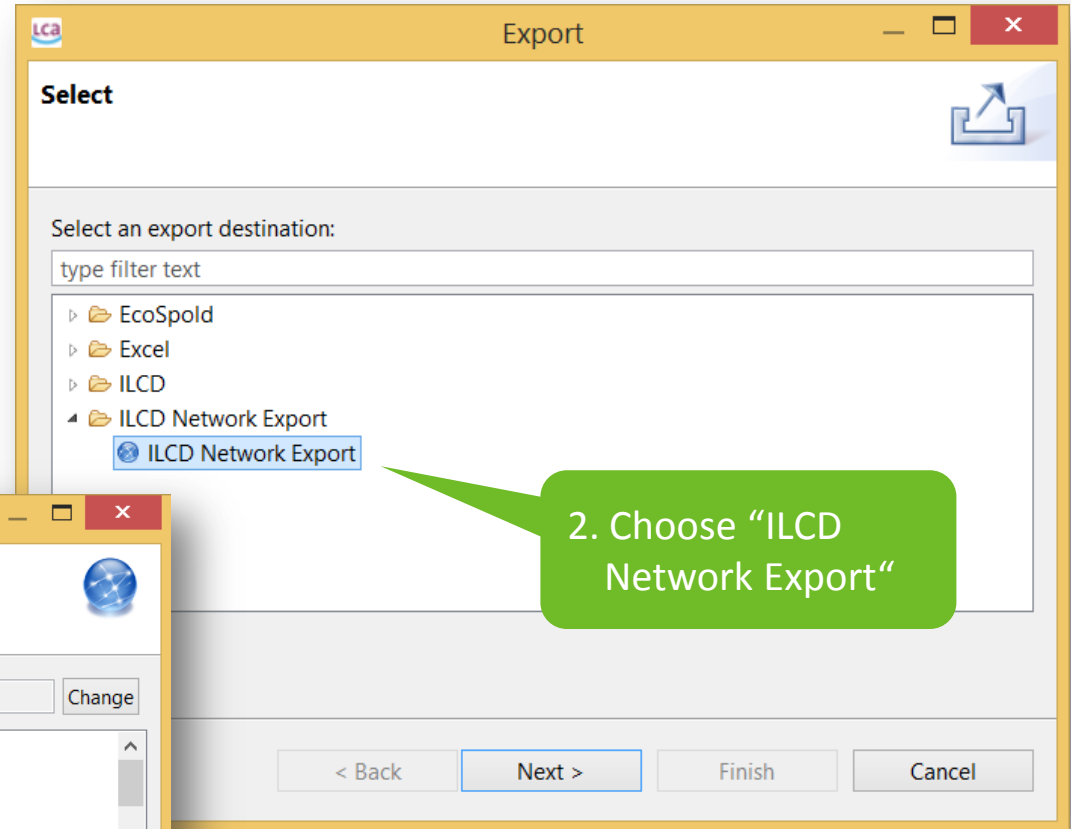
Name	Location	Time	Type
------	----------	------	------

< Back Next > Finish Cancel

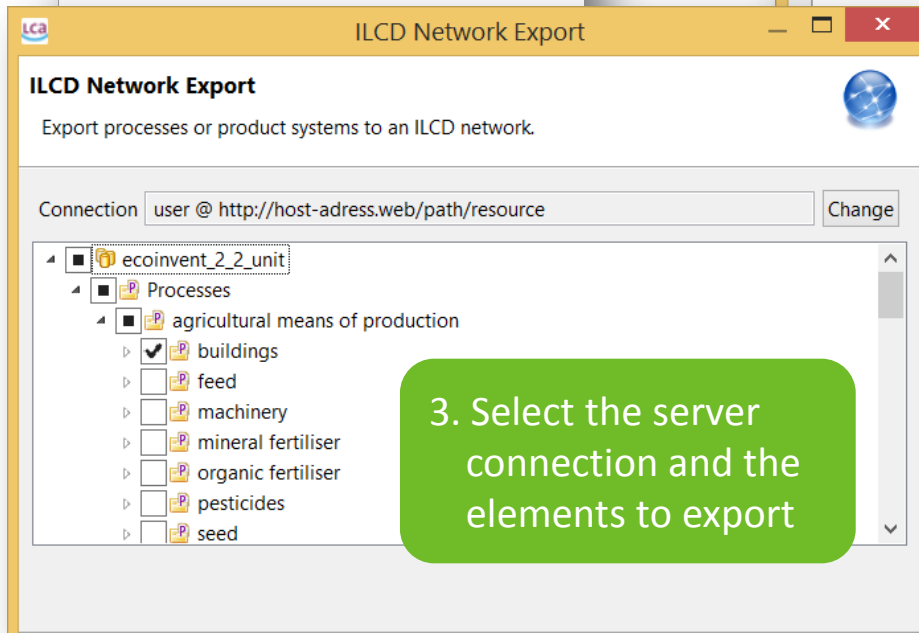
ILCD network database: export



1. Go to File
→ Export

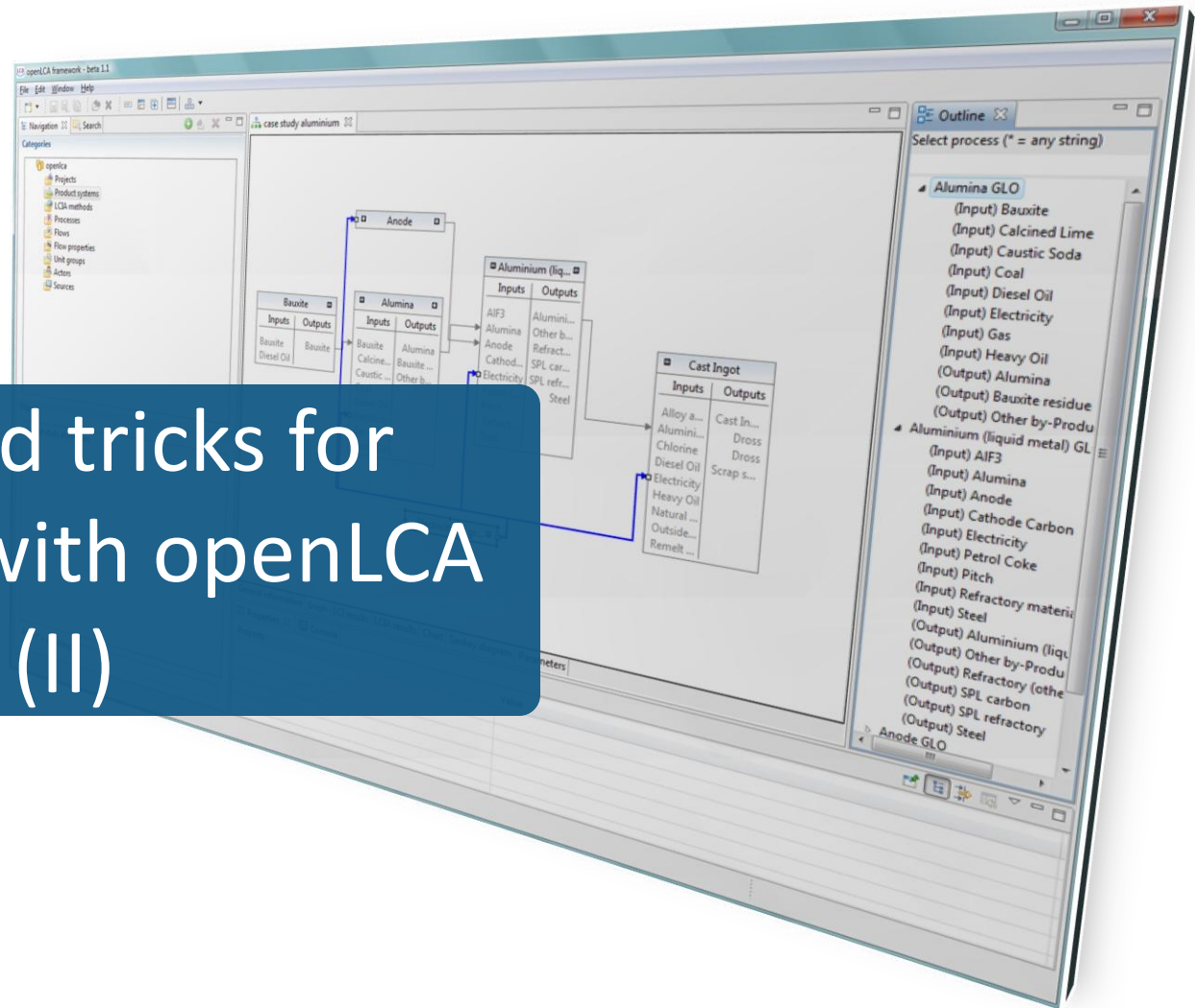


2. Choose "ILCD
Network Export"



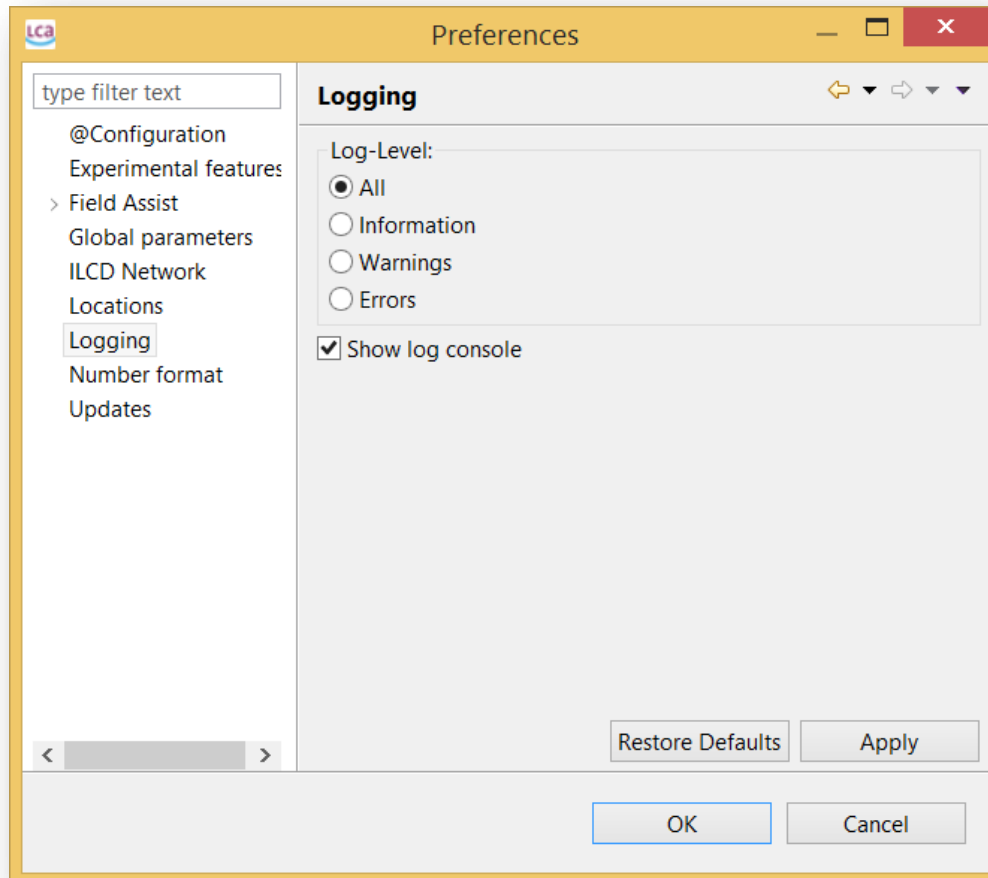
3. Select the server
connection and the
elements to export

Tips and tricks for working with openLCA (II)



Errors

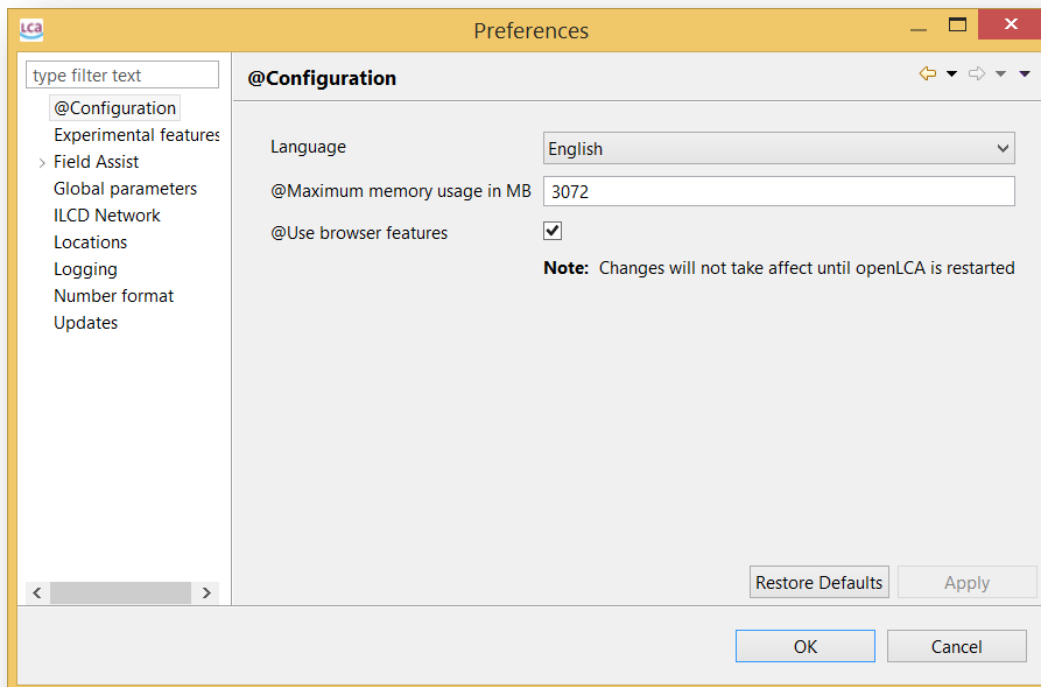
- It is possible to report all errors in a log file automatically
- To do so go to file/preferences/logging and check „All“



The log file is rewritten every time openLCA is restarted!

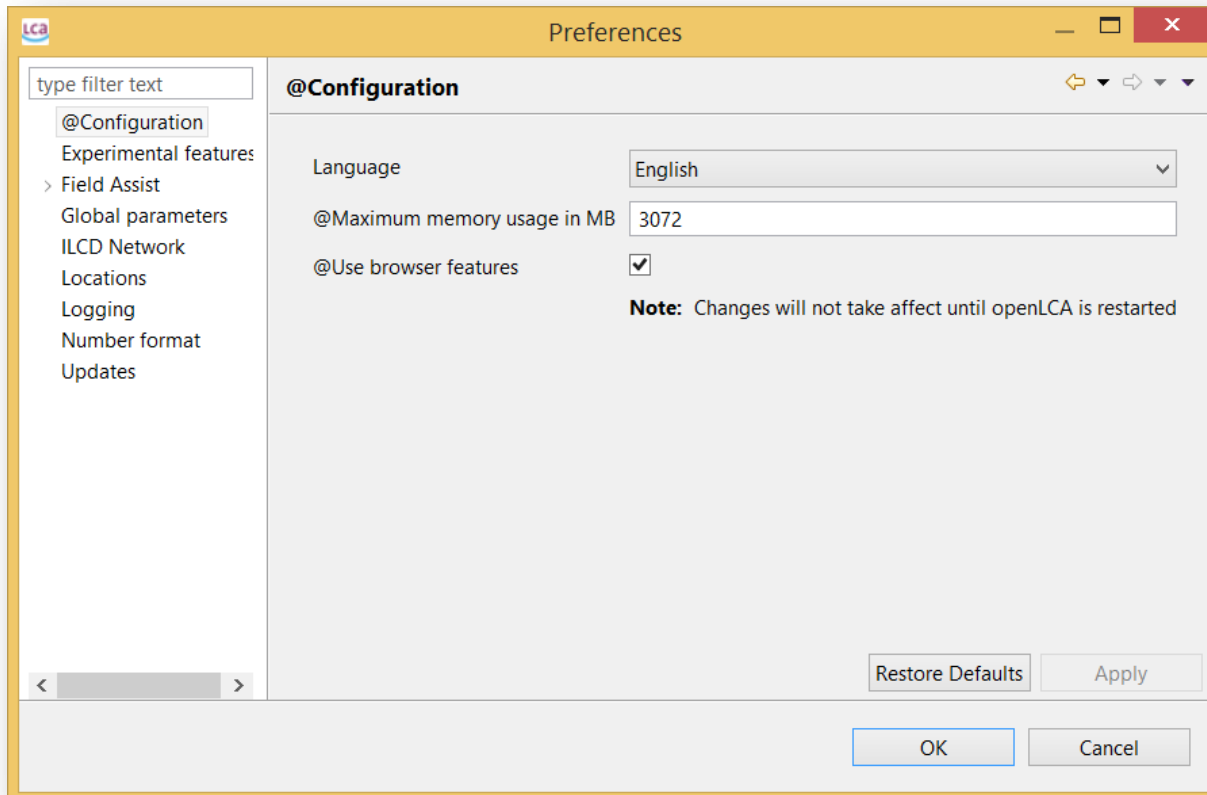
Language

- 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.

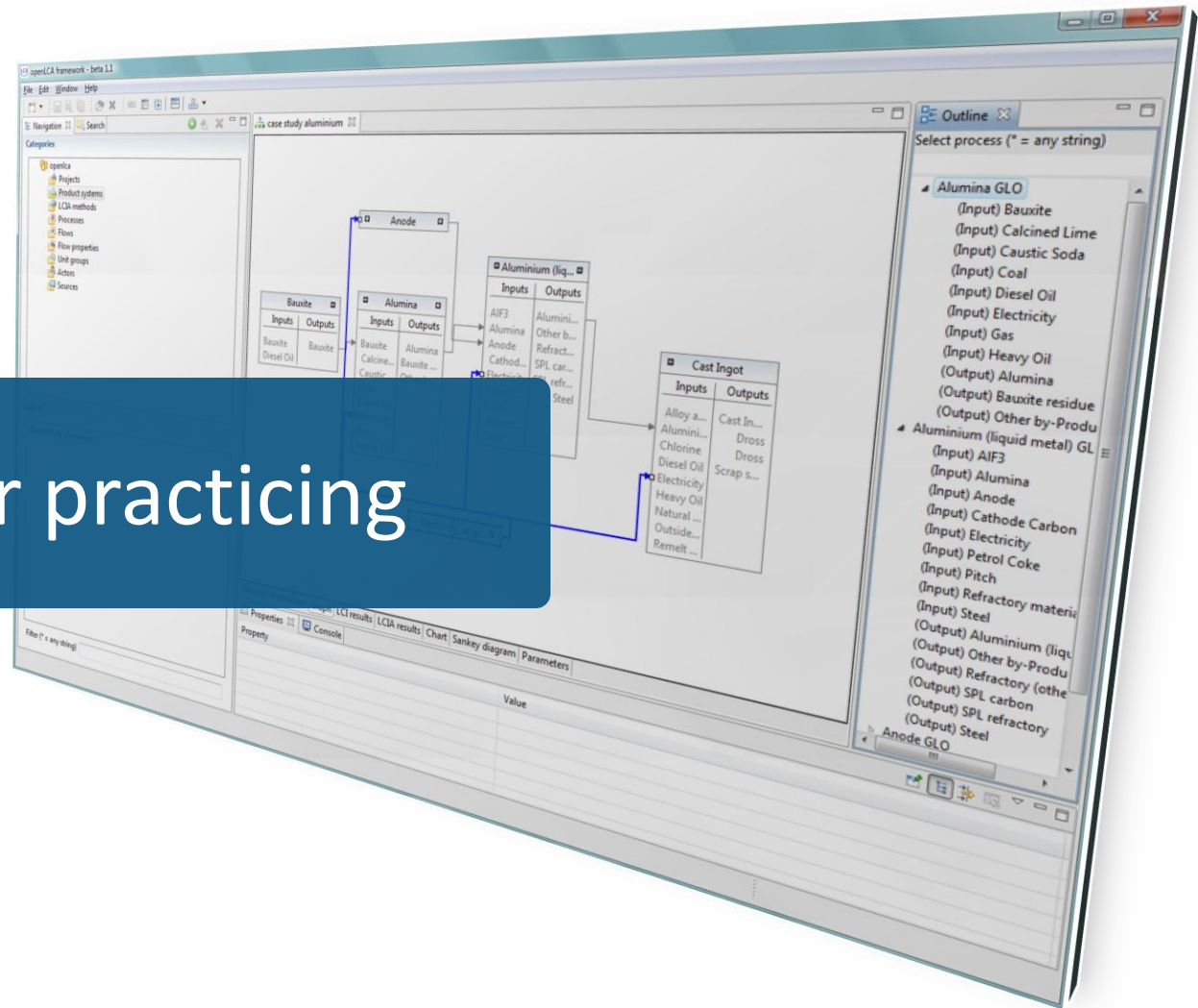


openLCA-data **directory**

- 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:

```
-clean
-nl
en
-data
@noDefault
-olcaDataDir
HERE THE FULL PATH OF THE NEW DIRECTORY
-olcaVersion
1.4.0
-vmargs
-Xmx4096M
-Dorg.openlca.core.updateSite=http://nexus.openlca.org/updateSite
```

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

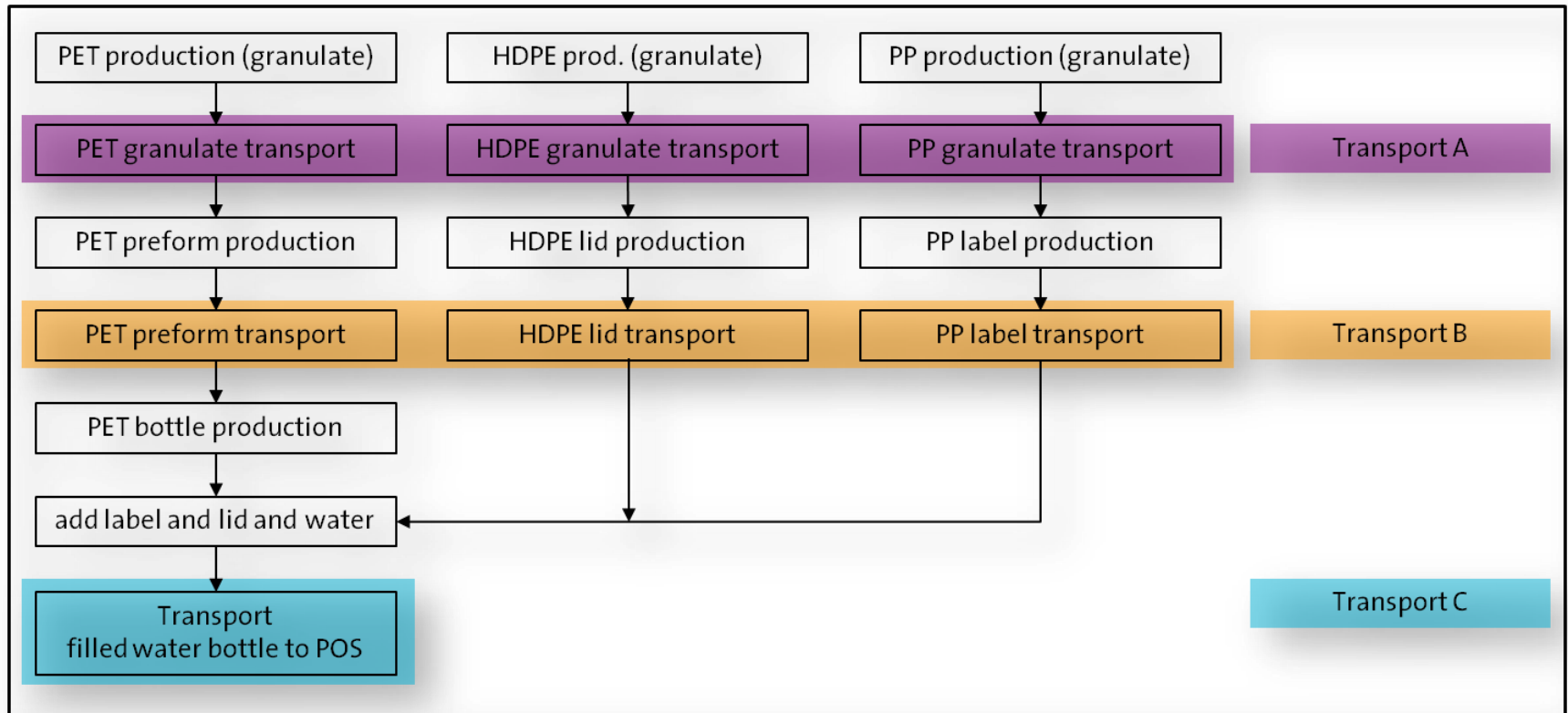
FU: 1,000 1-litre still water bottles

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.

	PET	HDPE	PP	Empty bottle	Water	Full bottle
Weight	60 g	4g	1g	65g	1kg	1.065kg

- 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”

	Amount	Weight transported
Transport A	200km	0.065kg
Transport B	200km	0.065kg
Transport C	50km	1.065kg

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

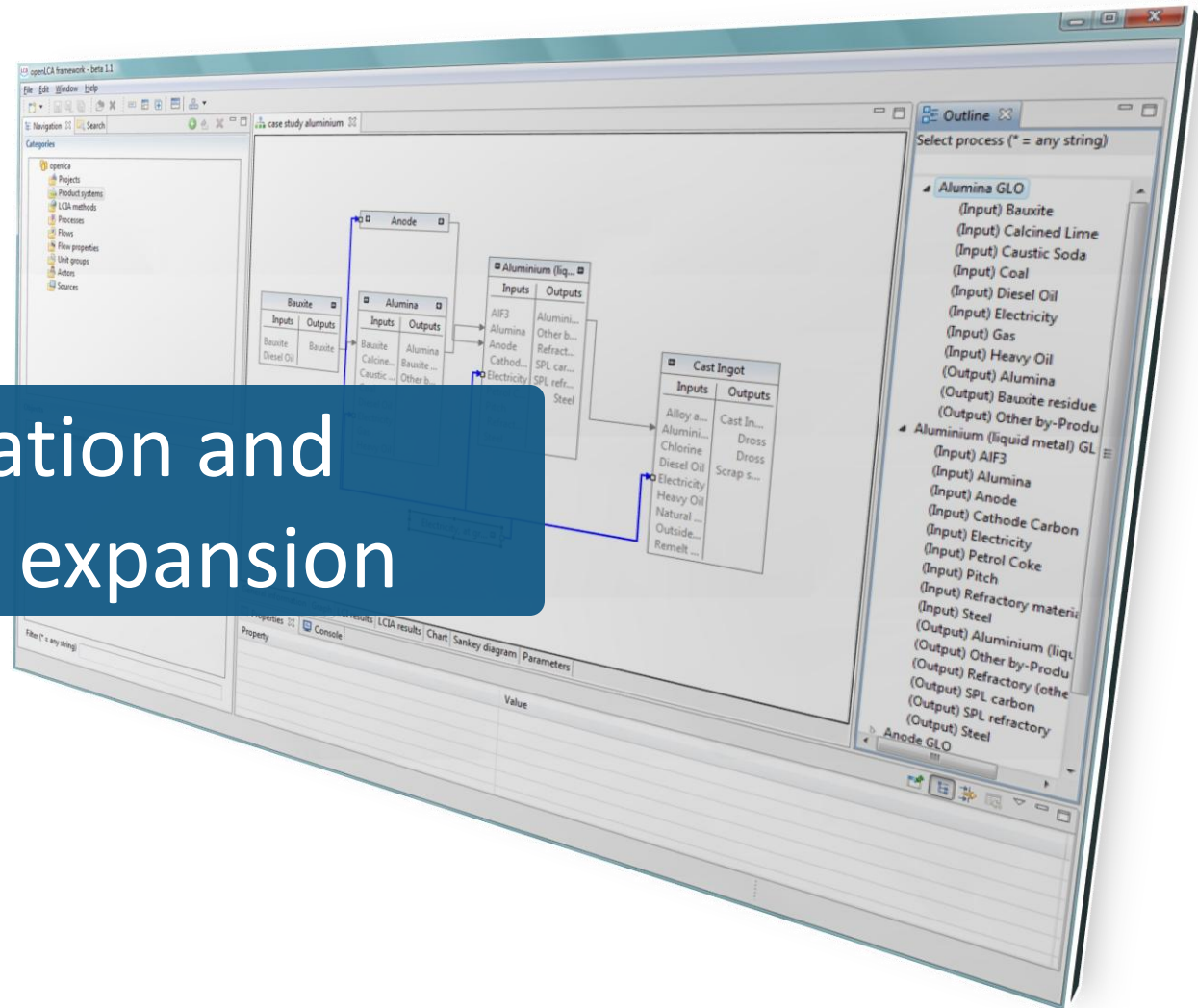
- d) Calculate the product system using the LCIA method ReciPe Midpoint (H) and the normalization/weighting set “Europe ReciPe Midpoint (H)”
- What’s the climate change impact of the product system relative to the total annual impact of CC per person in Europe? Check values also for terrestrial acidification & 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

co-generation

Allocation

Default method: None

Calculate default values

Physical & economic allocation

Product	Physical	Economic
Electricity, at grid, US - RNA (2.00 MJ)	1.0	1.0
Heat, onsite boiler, hardwood mill, average, SE - RNA (1.00 MJ)	1.0	1.0

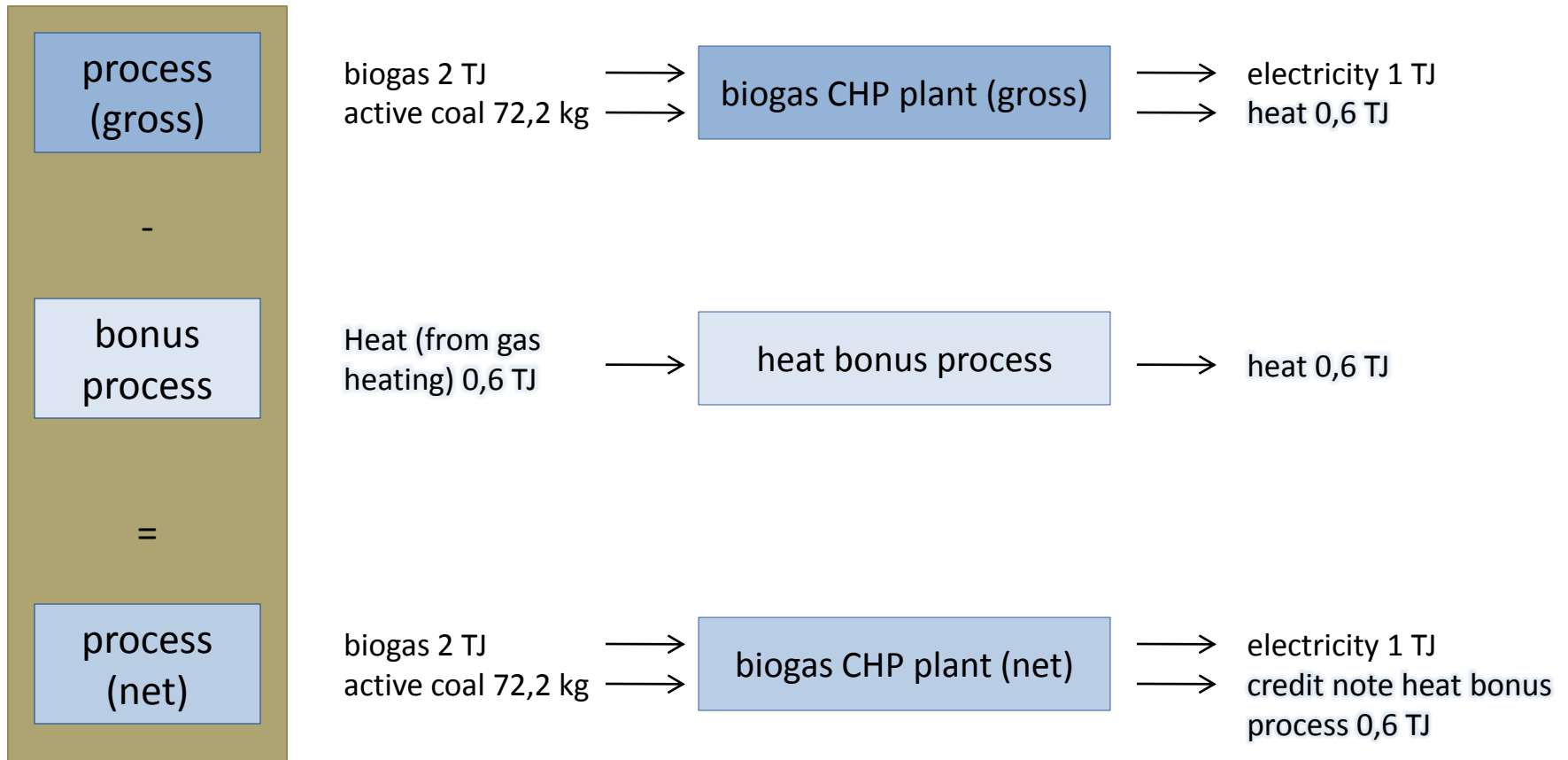
Causal allocation

Flow	Direction	Category	Amount	Electricity, at grid, US - RNA	Heat, onsite boiler, hardwood ...
Sulfur dioxide	Output	air/high po...	0.50000 kg	1.0	1.0
Carbon dioxide, fossil	Output	air/high po...	2.00000 kg	1.0	1.0
Crude oil, at production...	Input	Product flo...	3.00000 kg	1.0	1.0

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)



System expansion in openLCA

*Heat, onsite boiler, hardwood mill, average, SE - RNA

Process: Heat, onsite boiler, hardwood mill, average, SE

▼ Inputs

Flow	Category	Flow prope...	Unit	Amount	Uncertainty	Default pro...	Pedig
⚙️ Wood fuel, SE hardwoo...	Product flows	Mass	kg	0.0426236...	none		
⚙️ Residual fuel oil, combu...	Product flows	Volume	l	1.0138630...	none		
⚙️ Wood fuel, SE hardwoo...	Product flows	Mass	kg	0.0065590...	none		
⚙️ Natural gas, combusted...	Product flows	Volume	m3	7.2418787...	none		
⚙️ Liquefied petroleum ga...	Product flows	Volume	L	3.0208979...	none		

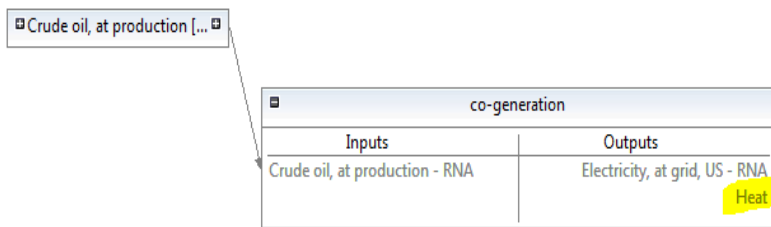
▼ Outputs

Flow	Category	Flow prope...	Unit	Amount	Uncertainty	Avoided product
⚙️ Heat, onsite boiler, hard...	Product flows	Energy	MJ	1.0	none	
⚙️ Electricity, onsite boiler,...	Product flows	Energy	kWh	0.0019196...	none	<input checked="" type="checkbox"/>

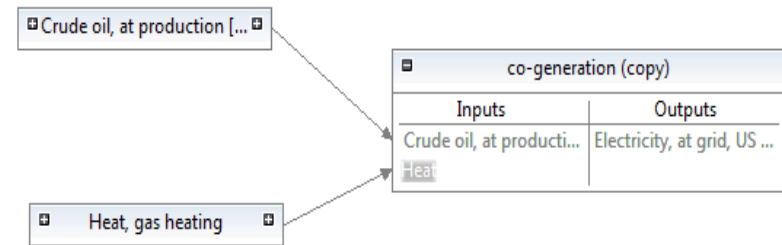
A process providing the avoided product flow should exist!

Check the box of "Avoided product" for the by-product

System expansion vs. allocation – model graphs

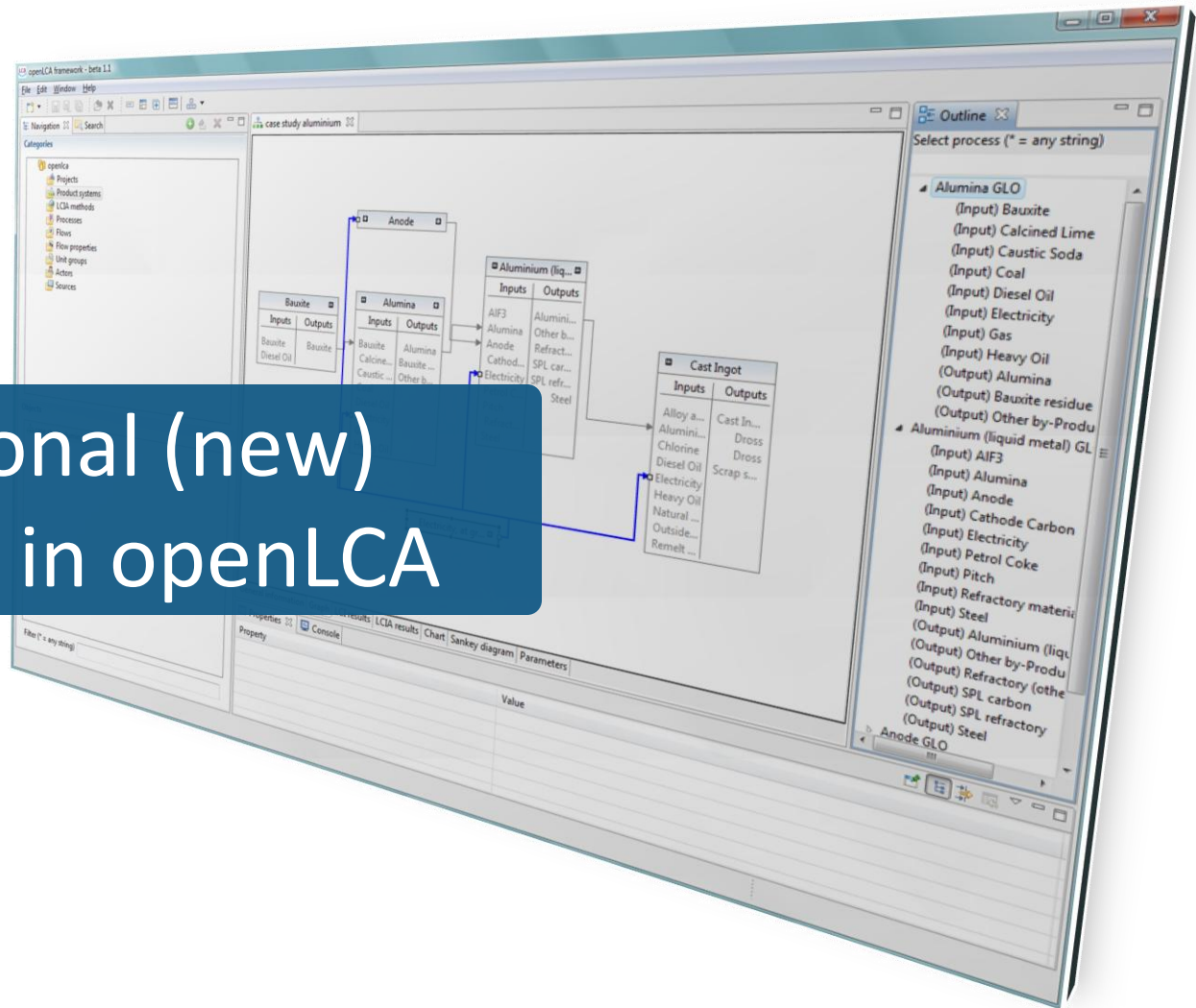


Model Graph 1: Product system “Co-generation” without system expansion



VS. Model Graph 2: Product system “Co-generation” with system expansion

Additional (new) features in openLCA



Element usage

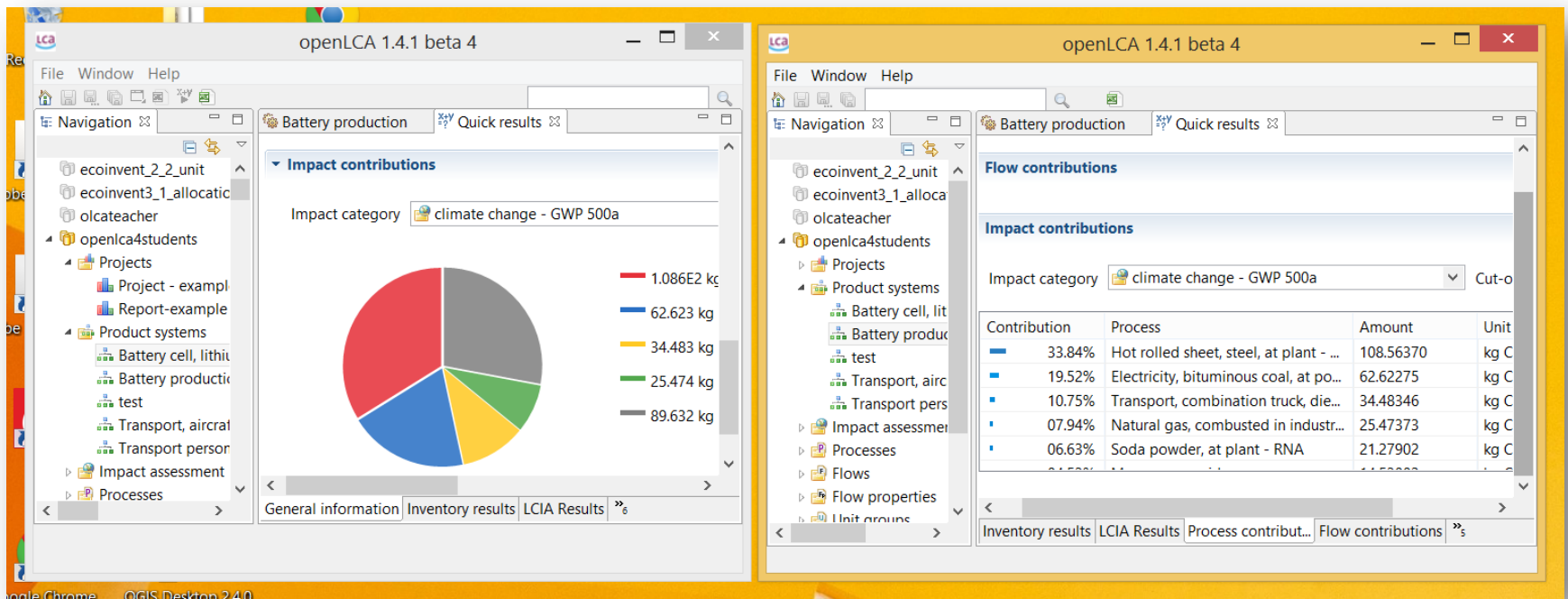
- Available for any element of the database.
- Results can be filtered.

The screenshot shows a software interface with a list of elements on the left and a usage report on the right. The element 'Carbon monoxide' is selected in the list, and a context menu is open over it, with 'Usage' highlighted. The usage report on the right is titled 'Usage of: Carbon monoxide, fossil' and includes a filter box containing 'ad'. Below the filter is a table with two columns: 'Type' and 'Name'.

Type	Name
	Acrylonitrile-butadiene-styrene copolymer, resin, at plant, CTR
	Fuel grade uranium, at regional storage
	Natural gas, combusted in industrial boiler, at hydrocracker, for butadiene
	Forest residue, processed and loaded, at landing system
	selected LCI results, additional

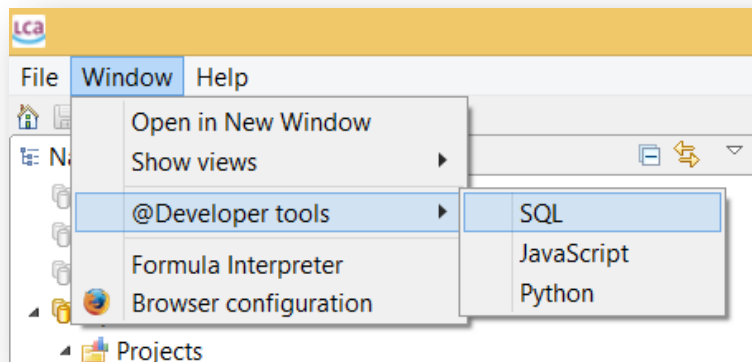
Multiple windows view

- 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.



SQL Query Browser

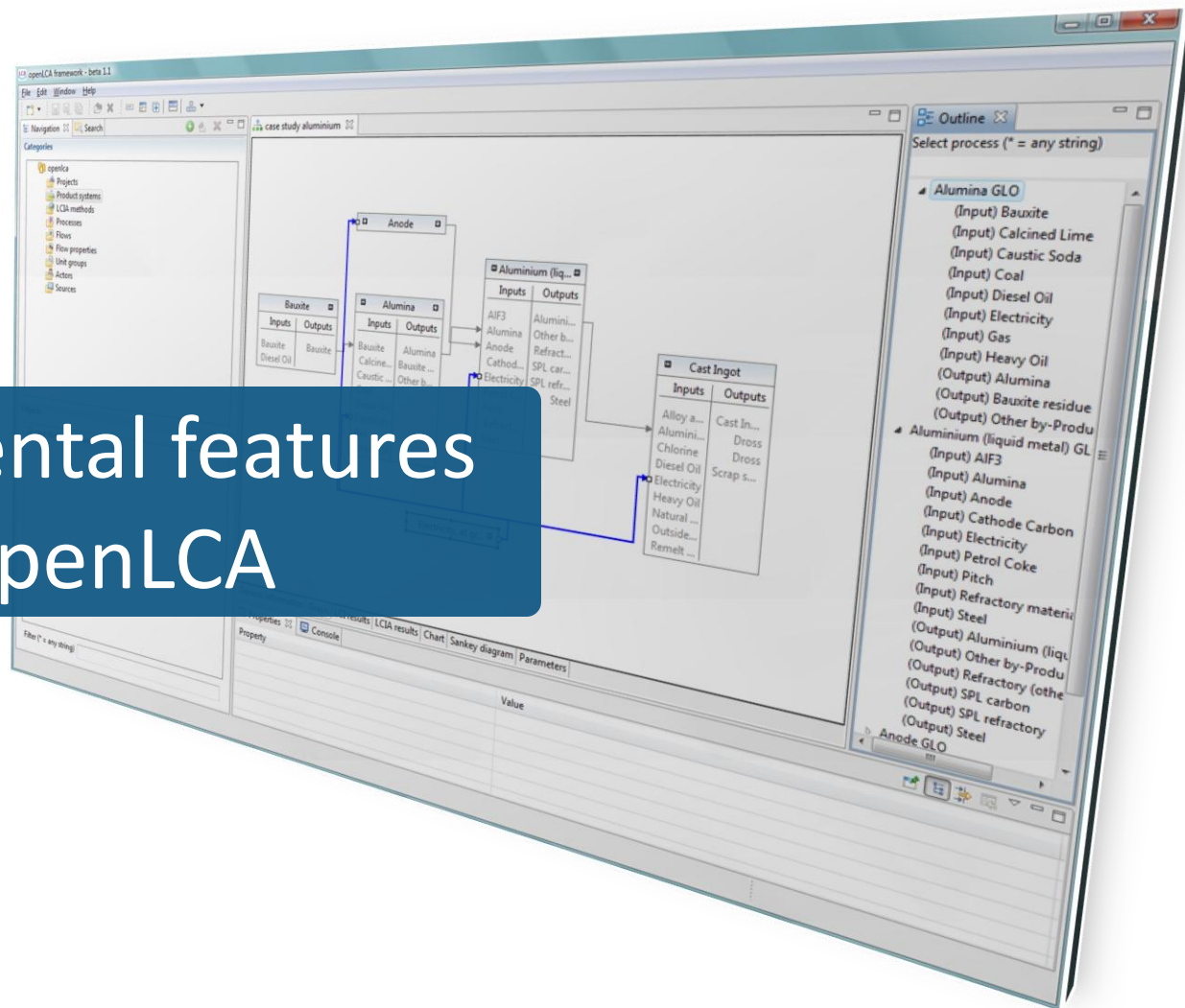
▼ SQL Statement

```
select name, cas_number, formula from tbl_flows|
```

▼ Results

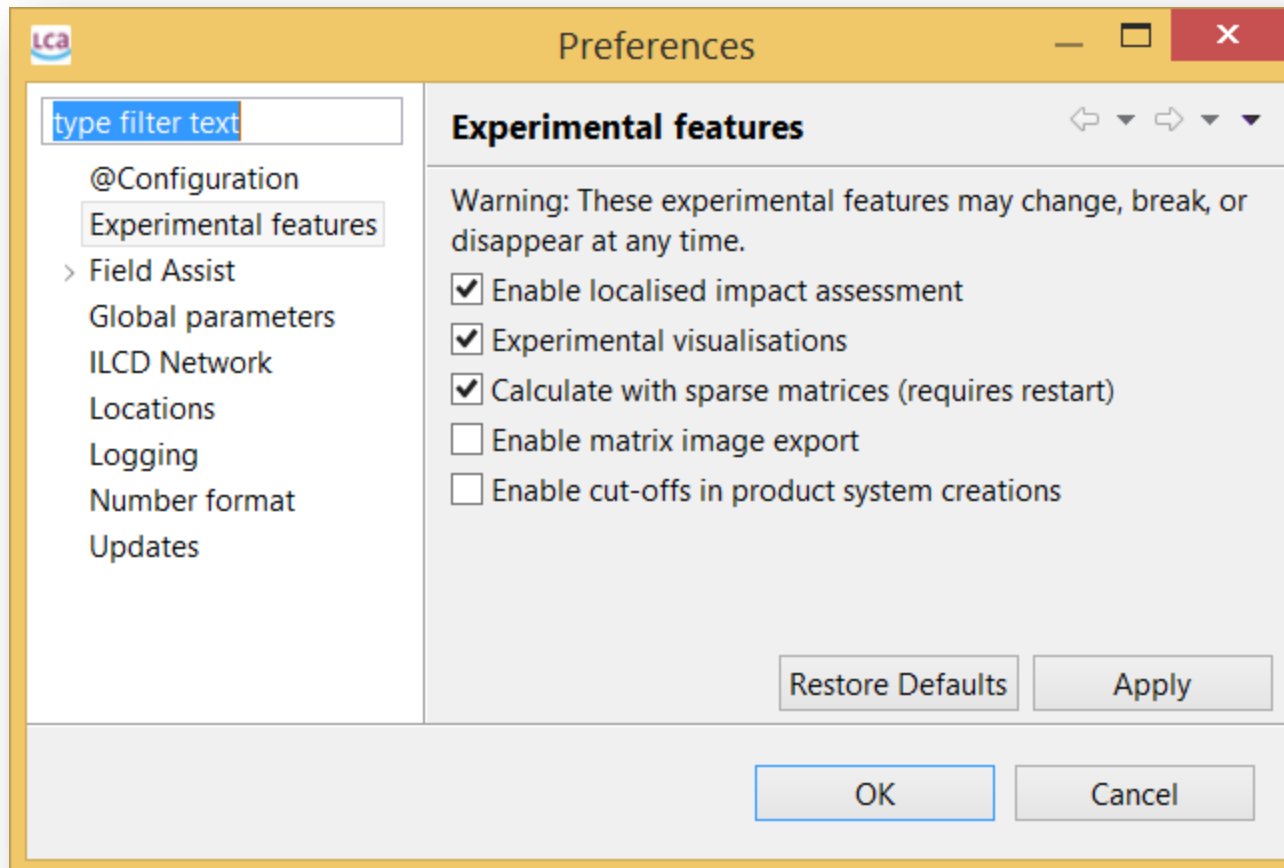
NAME	CAS_NUMBER	FORMULA
Ethene, tetrachloro-	000127-18-4	C2Cl4
Florasulam	145701-23-1	C12H8F3N5O3S
Nitrite	014797-65-0	NO2 -
Xenon-137	014835-21-3	Xe-137
Ethyl cellulose	009004-57-3	NULL
Sulfate	014808-79-8	SO4--
Aniline	000062-53-3	C6H7N
Transformation, from traffic area, road network	NULL	CORINE 122a
Cesium-137	010045-97-3	Cs-137
Chlorosulfonic acid	007790-94-5	HSO3Cl
Manganese	007439-96-5	Mn

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.

Product system statistics	
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)
Recalculate	



Product system Statistics (II)

Product system statistics

Processes with highest in-degree (linked inputs):

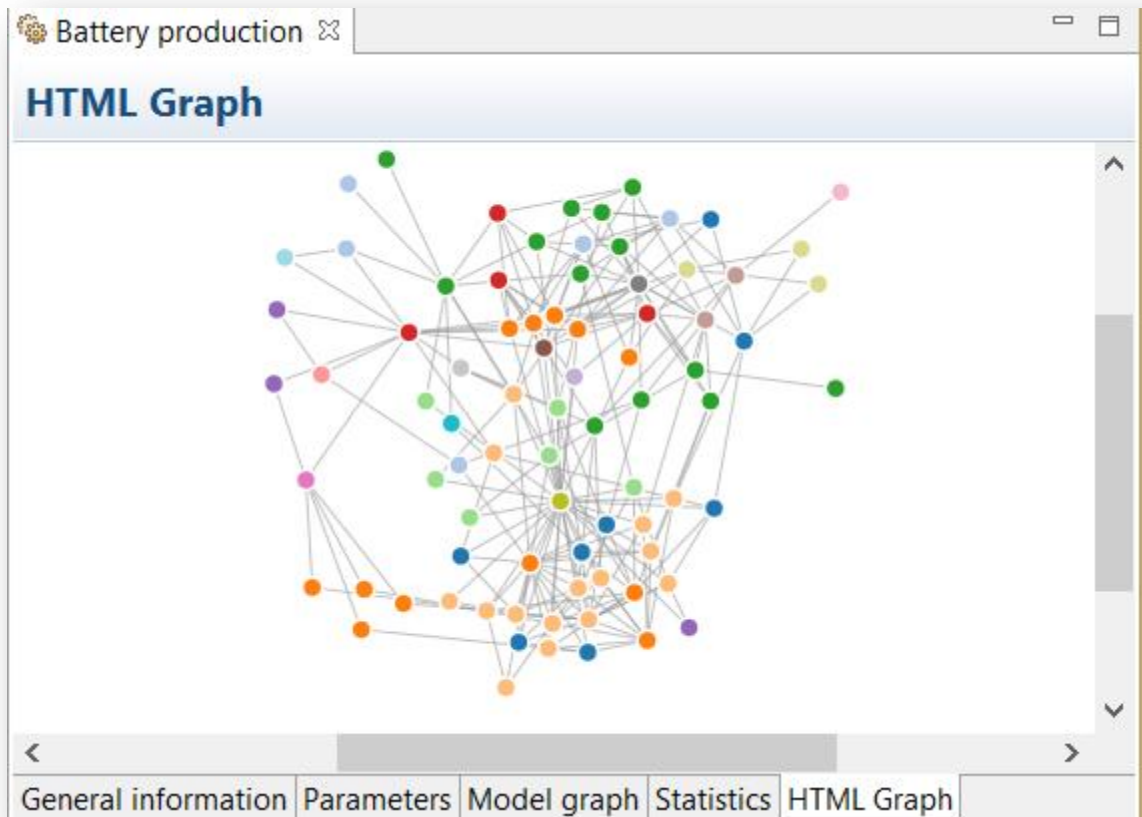
	Number of input links	Process
	8	Lithium carbonate
	8	Battery cell, lithium-ion battery (S1)
	7	Ethylene dichloride-vinyl chloride monomer, at plant
	7	Electricity, at Grid, US, 2008
	7	Ethylene, at plant

Processes with highest out-degree (linked outputs)

	Number of output links	Process
	27	Electricity, at Grid, US, 2008
	18	Transport, train, diesel powered

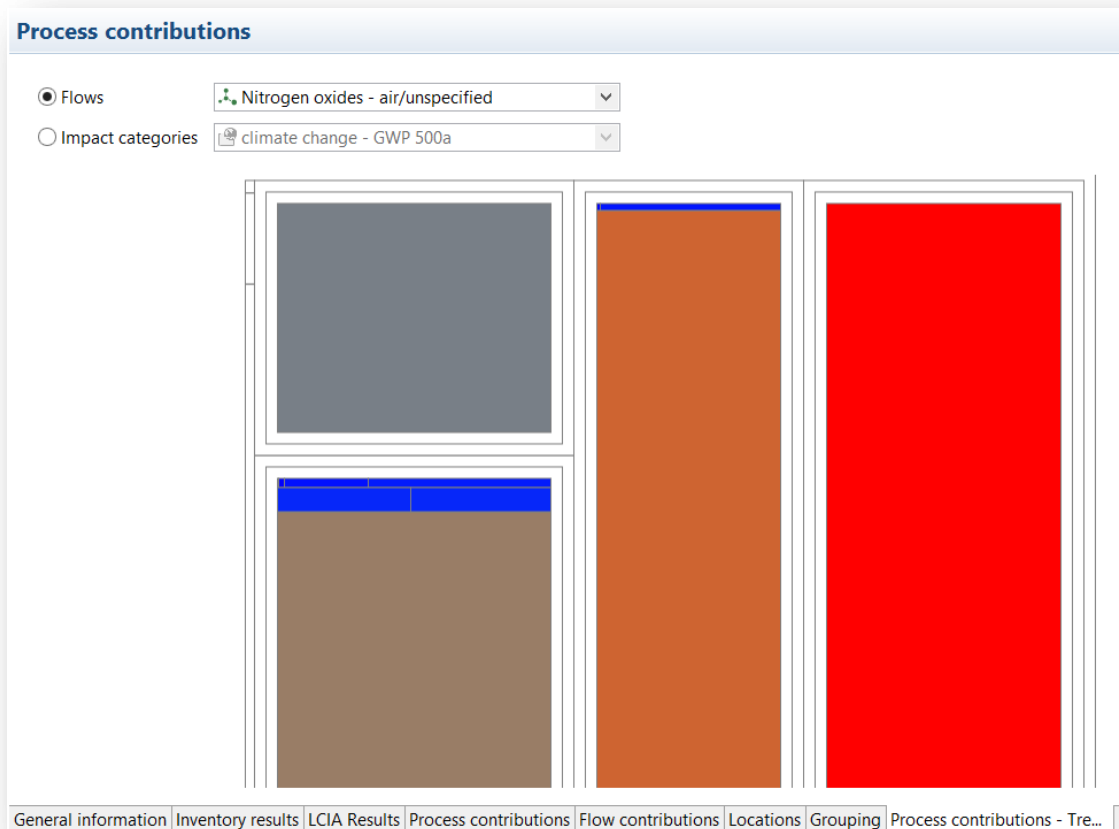
Experimental visualisations: **HTML Graph**

- Available in the product system editor.
- It provides visual representation of the process links in the product system.



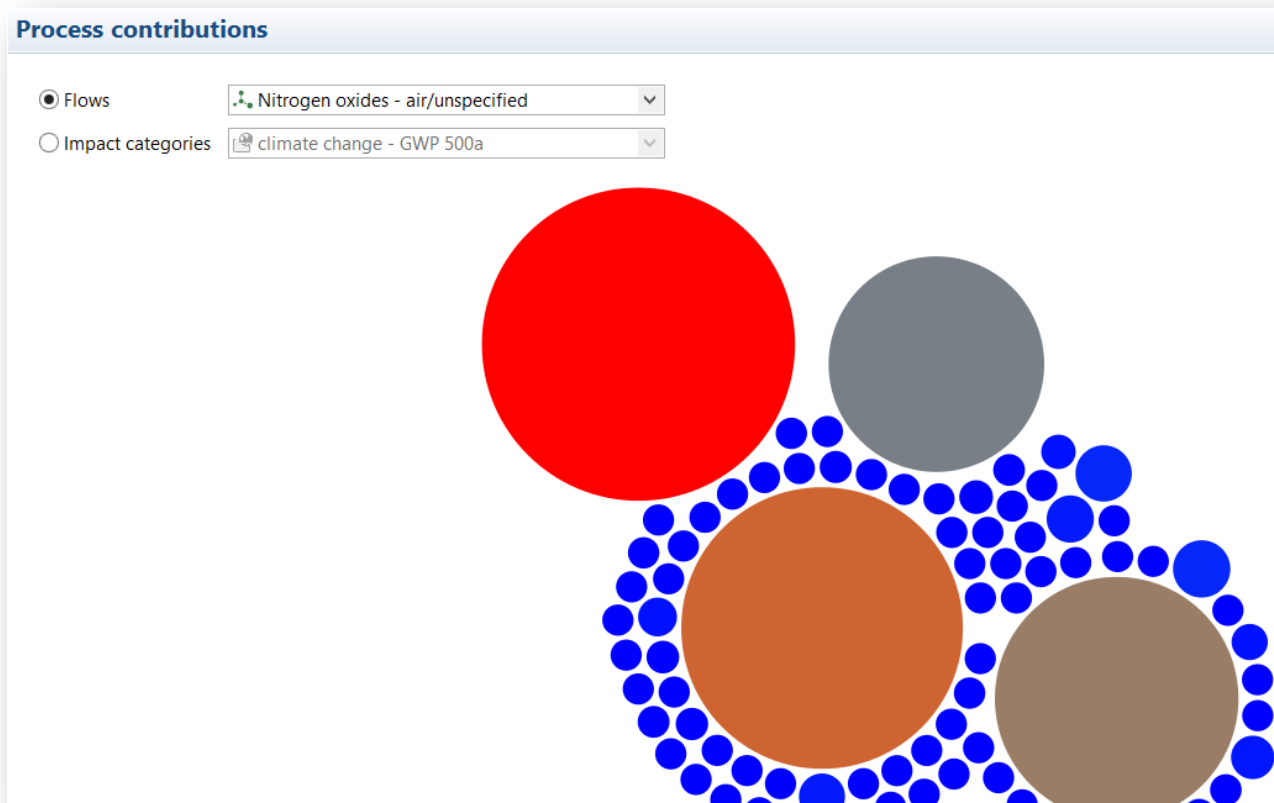
Experimental visualisations: Treemap

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



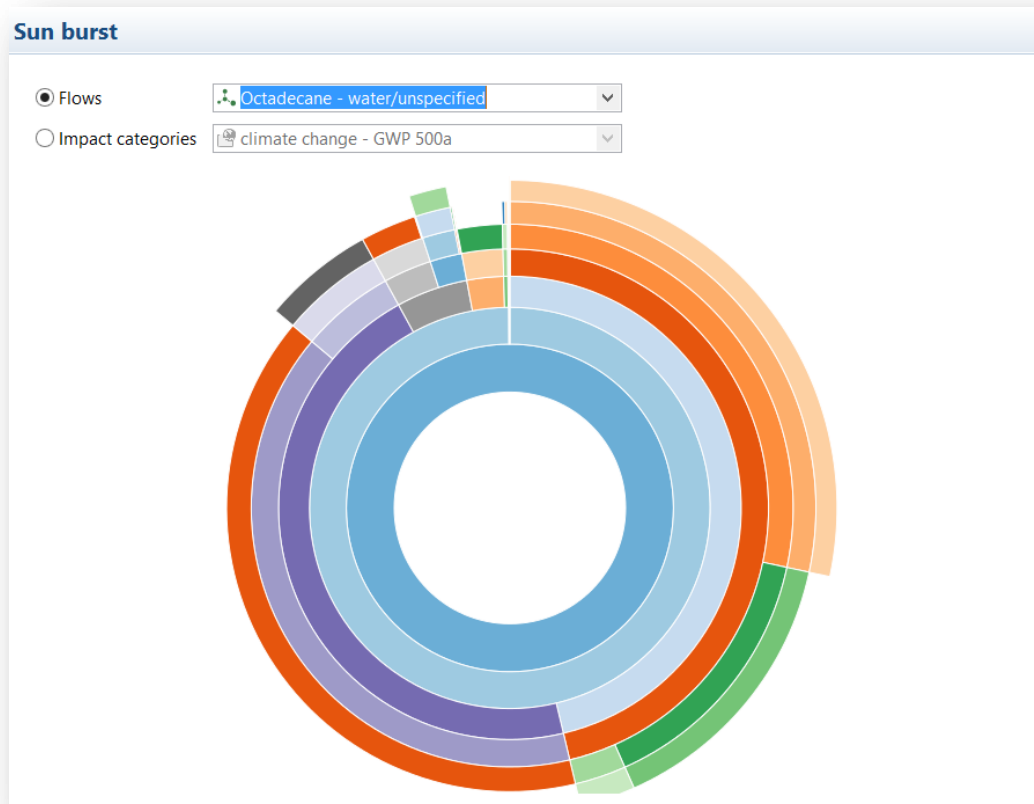
Experimental visualisations: Bubble chart

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



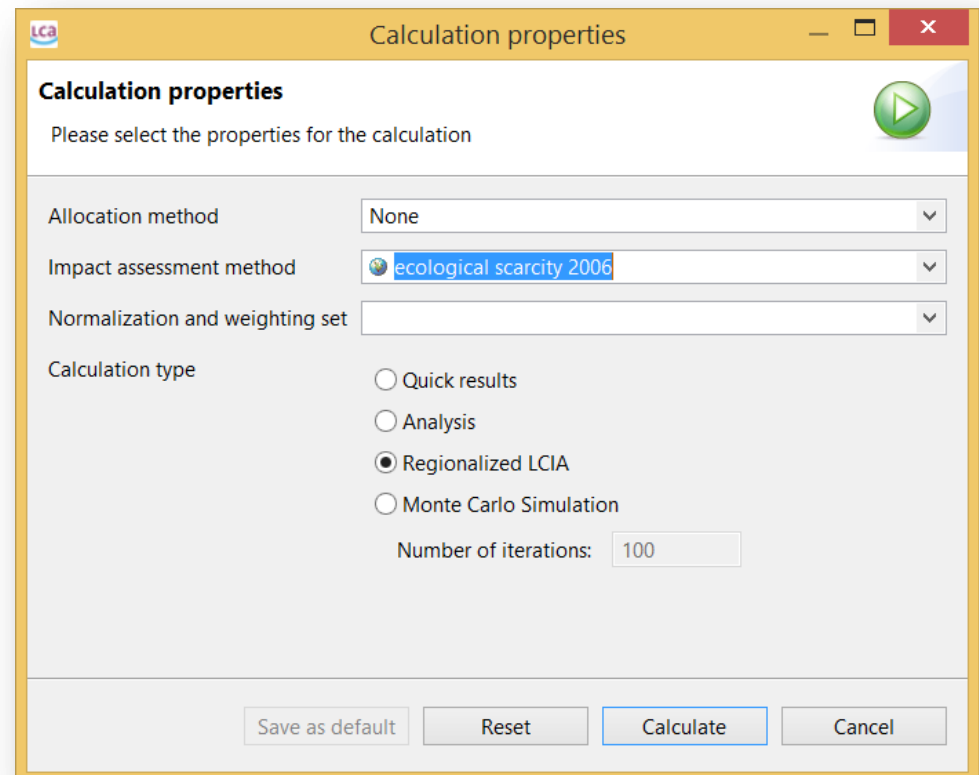
Experimental visualisations: Sun burst

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

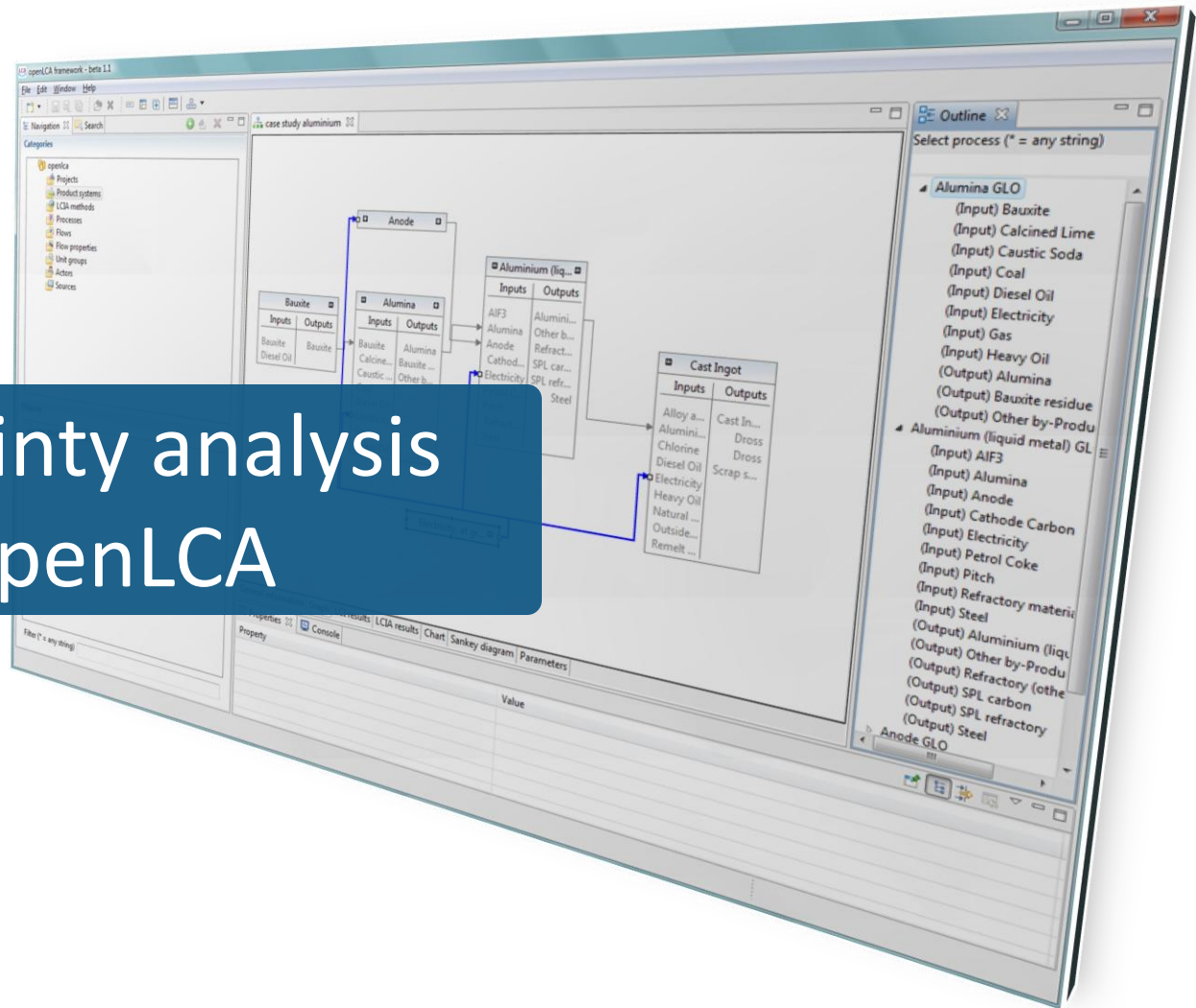


Other experimental features

- 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.

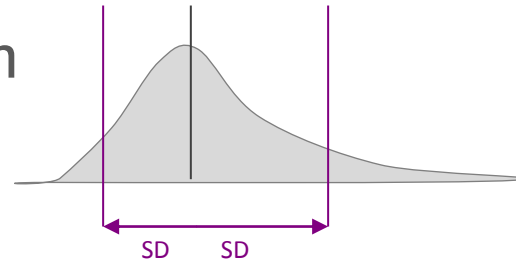
Data uncertainty: basics II

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

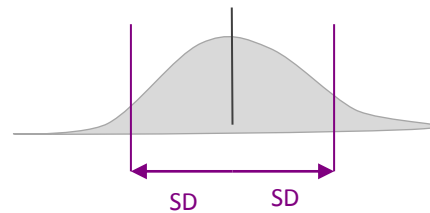
- The median is the mean value (for 100 samples the 50th sample is the median).
- The mean is the arithmetic average of all samples.

Uncertainty distribution

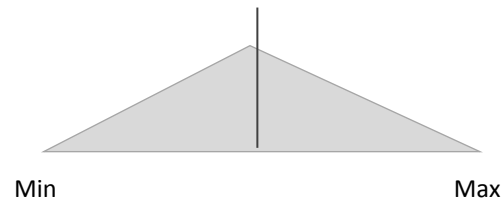
- Log-normal distribution



- 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

openLCA 1.4.1 beta 4

Transport, aircraft, freight - RNA

Process: Transport, aircraft, freight

Inputs

Flow	Category	Flow proper...	Unit	Amount	Uncertainty	Default pro...	Pedigree un...
Kerosene, at refinery - RN...	Product flows	Volume	L	0.41991972...	none	Edit	

1. Select "Edit" in the uncertainty field

LCA

Uncertainty

Uncertainty distribution: Logarithmic normal distribution

Geometric mean: 2.5

Geometric standard deviation: 0.9

OK Test Cancel

2. Define the values of the distribution

Starting the Monte Carlo simulation

The image shows a software interface for starting a Monte Carlo simulation. The main window, titled "Product system: Case 1", has a "Calculate" button. A "Calculation properties" dialog box is open, showing the following settings:

- Allocation method: None
- Impact assessment method: IPCC 2007
- Normalization and weighting set: (empty)
- Calculation type: Monte Carlo Simulation
- Number of iterations: 100

Two green callout bubbles provide instructions:

1. Open a product system and click the calculation button
2. Select "Monte Carlo Simulation", the impact method and the number of iterations

Starting the Monte Carlo simulation

openLCA 1.4.1 beta 4

*Transport, aircraft, freight - RNA Transport, aircraft, freight Transport, aircraft, freight

Monte Carlo Simulation

Settings

Product system: Transport, aircraft, freight

Process: Transport, aircraft, freight

Quantitative reference: 1.00 t*km Transport, aircraft, freight - RNA

Number of simulations: 100

Progress

Start

Results

Flows: Benzene - water/unspecified

Impact categories: climate change - GWP 500a

results: 1 mean: 0.000 standard deviation: 0.000 5% percentile: 0.000 95% percentile: 0.000 median: 0.000

1

0

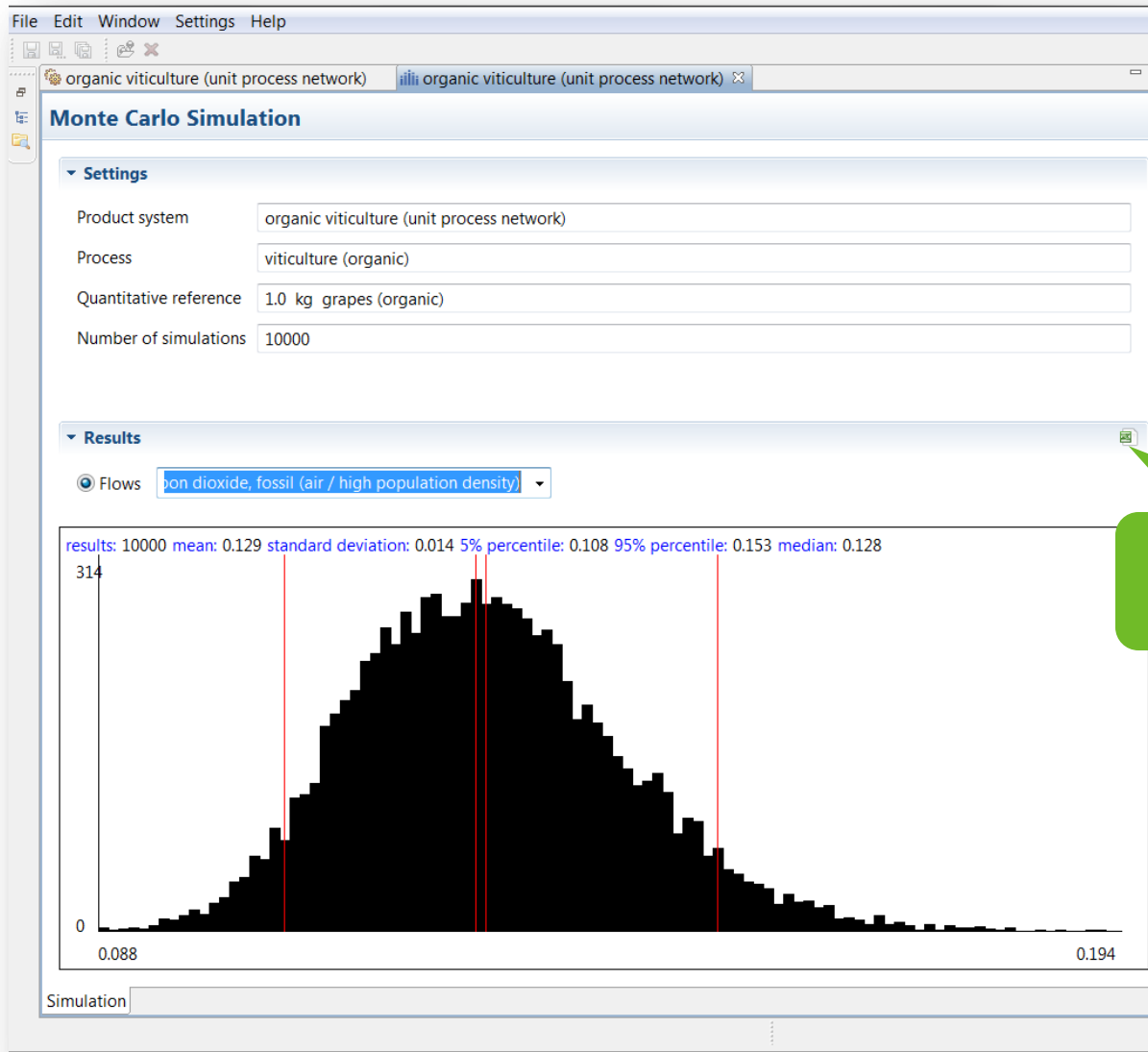
0.000 0.000

Monte Carlo Simulation

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

Relevant
criteria

	1	2	3	4	5
Reliability					
Completeness					
Time					
Geography					
Technology					

Score

Qualitative
descriptors

The Pedigree approach in ecoinvent

	1	2	3	4	5
Reliability	1.00	1.05	1.10	1.20	1.50
Completeness	1.00	1.02	1.05	1.10	1.20
Time	1.00	1.03	1.2	1.20	1.50
Geography	1.00	1.01			1.10
Technology	1.00		1.50	1.50	2.00

Default uncertainty factors

The Pedigree matrix in openLCA

The screenshot shows the openLCA software interface for a process named "Transport, aircraft, freight". The interface is divided into two main sections: "Inputs" and "Outputs".

Inputs Table:

Flow	Category	Flow proper...	Unit	Amount	Unce...	Def...	Pedigree uncertainty	
* Kerosene, at refinery - RN...	Product flows	Volume	L	0.41991972...	none			Edit

Outputs Table:

Flow	Category	Flow proper...	Unit	Amount	Uncertainty	Avoided pr...	Pedigree un...
* Transport, aircraft, freight...	Product flows	Goods trans...	t*km	1.0	none		
* Hydrocarbons, unspecified	air/unspecified	Mass	kg	0.00104611...	none		
* Carbon monoxide, fossil	air/unspecified	Mass	kg	0.00441023...	none		
* Carbon dioxide, fossil	air/unspecified	Mass	kg	1.05284715...	none		
* Nitrogen oxides	air/unspecified	Mass	kg	0.00536646...	none		

A green callout box with a white border and a tail pointing to the "Edit" button in the first row of the Inputs table contains the following text:

1. Click "Edit" to add or modify the Pedigree uncertainty

The Pedigree matrix in openLCA

Pedigree matrix ✕

Click on the matrix cells to select entries

Indicator score	1	2	3	4	5
Reliability	Verified data based on measurements	Verified data partly based on assumptions or non-verified data based on measurements	Non-verified data partly based on qualified estimates	Qualified estimate (e.g. by industrial expert)	Non-qualified estimates
Completeness	Representative data from all sites relevant for the market considered, over and adequate period to even out normal fluctuations	Representative data from > 50% of the sites relevant for the market considered, over an adequate period to even out normal fluctuations	Representative data from only some sites (<< 50%) relevant for the market considered or > 50% of sites but from shorter periods	Representative data from only one site relevant for the market considered or some sites but from shorter periods	Representativeness unknown or data from a small number of sites and from shorter periods
Temporal correlation	Less than 3 years of difference to the time period of the data set	Less than 6 years of difference to the time period of the data set	Less than 10 years of difference to the time period of the data set	Less than 15 years of difference to the time period of the data set	Age of data unknown or more than 15 years of difference to the time period of the data set
Geographical correlation	Data from area under study	Average data from larger area in which the area under study is included	Data from area with similar production conditions	Data from area with slightly similar production conditions	Data from unknown or distinctly different area (North America instead of Middle East, OECD-Europe instead of Russia)
Further technological correlation	Data from enterprises, processes and materials under study	Data from processes and materials under study (i.e. identical technology) but from different enterprises	Data from processes and materials under study but from different technology	Data on related processes or materials	Data on related processes on laboratory scale or from different technology

Base uncertainty: σg: 1.2555818742947564

OK Cancel

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

Basic uncertainty

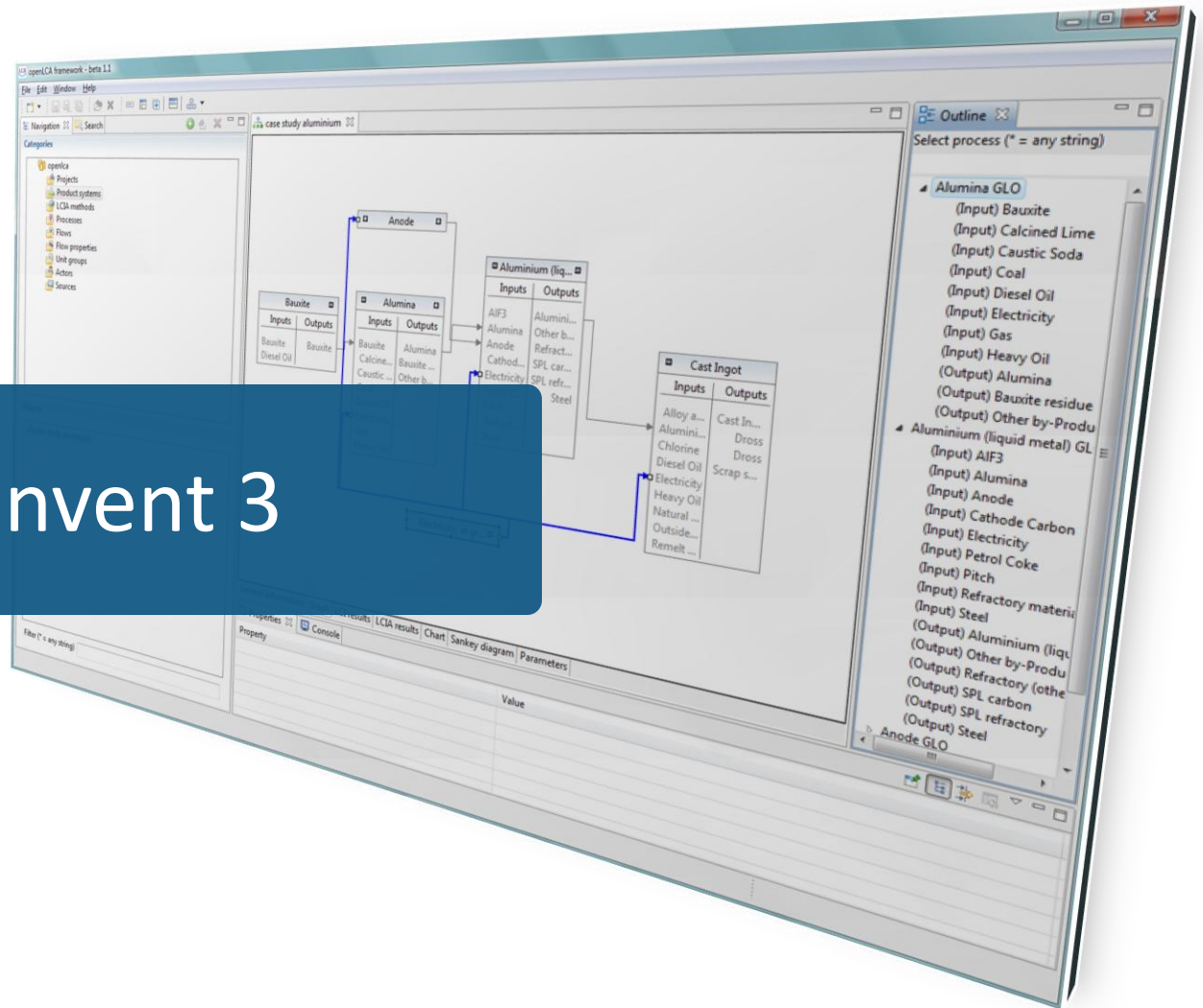
- Developed by the ecoinvent centre:

Basic uncertainty	Value
Energy requirement	1.05
Transportation services	2.00
Infrastruktur	3.00
CO2 in air	1.05
PM2.5 of combustion	3.00
Heavy metal in water	5.00
Radionuclides in water	3.00

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

```
<?xml version="1.0" encoding="utf-8"?>  
<ecoSpold xmlns="http://www.EcoInvent.org/EcoSpold02">  
  <childActivityDataset>  
    <activityDescription>  
      <activity id="0a5c6801-e080-4b4e-b029-b80b73a54fd7" activityNameId="11916431-4240-4fb7-b7a2-90f90e35c400" parentActivityId="d63fcb68-86ed-4554-ab3c-b4ba5c7b0">  
        <activityName xml:lang="en">titanium zinc plate production, without pre-weathering</activityName>  
        <includedActivitiesStart xml:lang="en" />  
        <includedActivitiesEnd xml:lang="en">The dataset describes the production of titanium zinc alloy from primary zinc and the fabrication of titanium zinc pla</includedActivitiesEnd>  
        <generalComment>  
          <text xml:lang="en" index="2">[This is a dataset transferred from ecoSpold v1 / ecoinvent database version 2. It may not in all aspects fulfill the requi</text>  
          <text xml:lang="en" index="1">The production steps pre-alloying, melting, casting, rolling, coiling, stretch forming and cutting are approximated using "</text>  
        </generalComment>  
        <tag>ConvertedDataset</tag>  
        </activity>  
        <classification classificationId="aeaec32d-b5a4-44e0-bb50-25c0f4fe3d37">  
          <classificationSystem xml:lang="en">EcoSpold01Categories</classificationSystem>  
          <classificationValue xml:lang="en">metals/extraction</classificationValue>  
        </classification>  
        <classification classificationId="6fe7bc2b-4be4-48f7-92b0-f27dea9053ce">  
          <classificationSystem xml:lang="en">ISIC rev.4 ecoinvent</classificationSystem>  
          <classificationValue xml:lang="en">2420:Manufacture of basic precious and other non-ferrous metals</classificationValue>  
        </classification>  
        <geography geographyId="0e0e1020-7d7e-11de-9ae2-0019e336be3a">  
          <shortname xml:lang="en">DE</shortname>  
          <comment>  
            <text xml:lang="en" index="1">Data from a leading titan zinc plate producer in Germany. Applicable for Europe.</text>  
          </comment>  
        </geography>  
        <technology technologyLevel="3">  
          <comment>  
            <text xml:lang="en" index="1">Induction furnace for all the pre-alloying and melting steps, roll stands with 5 rolling pairs for the rolling step. Coilir</text>  
          </comment>  
        </technology>  
        <timePeriod startDate="1997-01-01" endDate="2013-12-31" isDataValidForEntirePeriod="false" />  
        <macroEconomicScenario macroEconomicScenarioId="d9f57f0a-a01f-42eb-a57b-8f18d6635801">  
          <name xml:lang="en">Business-as-Usual</name>  
        </macroEconomicScenario>  
      </activityDescription>  
    <flowData>  
      <intermediateExchange id="8fcd8ca4-28b0-46dd-bf9e-54c44bc0c82e" unitId="487df68b-4994-4027-8fdc-a4dc298257b7" casNumber="007440-66-6" amount="1.06" intermedi</intermediateExchange>  
      <name xml:lang="en">zinc</name>  
      <unitName xml:lang="en">kg</unitName>  
      <comment xml:lang="en">(1,4,1,3,1,5,3)</comment>  
      <comment>EcoSpold01Location=RER</comment>  
      <uncertainty>  
        <lognormal meanValue="1.06" mu="0.06" variance="0.01" varianceWithPedigreeUncertainty="0.0121" />  
      </uncertainty>  
    </flowData>  
  </childActivityDataset>  
</ecoSpold>
```

EcoSpold 2

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

```
<elementaryExchange id="d567a064-d1e0-4905-96e5-23f4684d10f4" unitId="487df68b-4994-4027-8fdc-a4dc298257b7" casNumber="022537-50-4" amount="1.5714E-07" elementaryExchangeType="ion" />
<name xml:lang="en">Tin, ion</name>
<unitName xml:lang="en">kg</unitName>
<comment xml:lang="en">This flow is issued during the process "contouring, brass". Contouring, brass is used as a proxy for rolling and colling of titanium
</comment>
<uncertainty>
<lognormal meanValue="1.5714E-07" mu="-15.67" variance="0.81" varianceWithPedigreeUncertainty="1.02" />
<pedigreeMatrix reliability="5" completeness="5" temporalCorrelation="5" geographicalCorrelation="5" furtherTechnologyCorrelation="5" />
</uncertainty>
<property propertyId="c74c3729-e577-4081-b572-a283d2561a75" amount="0" unitId="577e242a-461f-44a7-922c-d8e1c3d2bf45">
<name xml:lang="en">carbon content, fossil</name>
<unitName xml:lang="en">dimensionless</unitName>
</property>
<property propertyId="6d9e1462-80e3-4f10-b3f4-71feb6d6f1168" amount="0" unitId="487df68b-4994-4027-8fdc-a4dc298257b7">
<name xml:lang="en">water in wet mass</name>
<unitName xml:lang="en">kg</unitName>
</property>
<property propertyId="67f102e2-9cb6-4d20-aa16-bf74d8a03326" amount="1" unitId="487df68b-4994-4027-8fdc-a4dc298257b7">
<name xml:lang="en">wet mass</name>
<unitName xml:lang="en">kg</unitName>
</property>
<property propertyId="6393c14b-db78-445d-a47b-c0cb866a1b25" amount="0" unitId="577e242a-461f-44a7-922c-d8e1c3d2bf45">
<name xml:lang="en">carbon content, non-fossil</name>
<unitName xml:lang="en">dimensionless</unitName>
</property>
<property propertyId="a9358458-9724-4f03-b622-106eda248916" amount="0" unitId="577e242a-461f-44a7-922c-d8e1c3d2bf45">
<name xml:lang="en">water content</name>
<unitName xml:lang="en">dimensionless</unitName>
</property>
<property propertyId="3a0afd6-04c3-41c6-a3da-92c4f61e0eaa" amount="1" unitId="487df68b-4994-4027-8fdc-a4dc298257b7">
<name xml:lang="en">dry mass</name>
<unitName xml:lang="en">kg</unitName>
</property>
<property propertyId="a301a838-7975-4d89-9e74-8eb77ad03cd1" amount="0" isDefiningValue="false" unitId="577e242a-461f-44a7-922c-d8e1c3d2bf45">
<name xml:lang="en">carbon content</name>
<unitName xml:lang="en">dimensionless</unitName>
<comment xml:lang="en">carbon content on a dry matter basis (reserved; not for manual entry)</comment>
</property>
<property propertyId="f2283db2-62e4-467f-b9ac-c4f45be563b4" amount="0" isDefiningValue="false" unitId="487df68b-4994-4027-8fdc-a4dc298257b7">
<name xml:lang="en">carbon allocation</name>
<unitName xml:lang="en">kg</unitName>
<comment xml:lang="en">carbon content per unit of product (reserved; not for manual entry)</comment>
</property>
<compartment subcompartmentId="e47f0a6c-3be8-4027-9eee-de251784f708">
<compartment xml:lang="en">water</compartment>
<subcompartment xml:lang="en">unspecified</subcompartment>
```

EcoSpold 2

- Flow properties: details for each process data set
 - e.g.: Flow: “Tin, ion”; Summary: water content (o), C content (o), etc. (!)

```
<elementaryExchange id="d567a064-d1e0-4905-96e5-23f4684d10f4" unitId="487df68b-4994-4027-8fdc-a4dc298257b7" casNumber="022537-50-4" amount="1.5714E-07" eleme
<name xml:lang="en">Tin, ion</name>
<unitName xml:lang="en">kg</unitName>
<comment xml:lang="en">This flow is issued during the process "contouring, brass". Contouring, brass is used as a proxy for rolling and colling of titanium
<uncertainty>
  <lognormal meanValue="1.5714E-07" mu="-15.67" variance="0.81" varianceWithPedigreeUncertainty="1.02" />
  <pedigreeMatrix reliability="5" completeness="5" temporalCorrelation="5" geographicalCorrelation="5" furtherTechnologyCorrelation="5" />
</uncertainty>
<property propertyId="c74c3729-e577-4081-b572-a283d2561a75" amount="0" unitId="577e242a-461f-44a7-922c-d8e1c3d2bf45">
  <name xml:lang="en">carbon content, fossil</name>
  <unitName xml:lang="en">dimensionless</unitName>
</property>
<property propertyId="6d9e1462-80e3-4f10-b3f4-71febd6f1168" amount="0" unitId="487df68b-4994-4027-8fdc-a4dc298257b7">
  <name xml:lang="en">water in wet mass</name>
  <unitName xml:lang="en">kg</unitName>
</property>
<property propertyId="67f102e2-9cb6-4d20-aa16-bf74d8a03326" amount="1" unitId="487df68b-4994-4027-8fdc-a4dc298257b7">
  <name xml:lang="en">wet mass</name>
  <unitName xml:lang="en">kg</unitName>
</property>
<property propertyId="6393c14b-db78-445d-a47b-c0cb866a1b25" amount="0" unitId="577e242a-461f-44a7-922c-d8e1c3d2bf45">
  <name xml:lang="en">carbon content, non-fossil</name>
  <unitName xml:lang="en">dimensionless</unitName>
</property>
<property propertyId="a9358458-9724-4f03-b622-106eda248916" amount="0" unitId="577e242a-461f-44a7-922c-d8e1c3d2bf45">
  <name xml:lang="en">water content</name>
  <unitName xml:lang="en">dimensionless</unitName>
</property>
<property propertyId="3a0af1d6-04c3-41c6-a3da-92c4f61e0eaa" amount="1" unitId="487df68b-4994-4027-8fdc-a4dc298257b7">
  <name xml:lang="en">dry mass</name>
  <unitName xml:lang="en">kg</unitName>
</property>
<property propertyId="a301a838-7975-4d89-9e74-8eb77ad03cd1" amount="0" isDefiningValue="false" unitId="577e242a-461f-44a7-922c-d8e1c3d2bf45">
  <name xml:lang="en">carbon content</name>
  <unitName xml:lang="en">dimensionless</unitName>
  <comment xml:lang="en">carbon content on a dry matter basis (reserved; not for manual entry)</comment>
</property>
<property propertyId="f2283db2-62e4-467f-b9ac-c4f45be563b4" amount="0" isDefiningValue="false" unitId="487df68b-4994-4027-8fdc-a4dc298257b7">
  <name xml:lang="en">carbon allocation</name>
  <unitName xml:lang="en">kg</unitName>
  <comment xml:lang="en">carbon content per unit of product (reserved; not for manual entry)</comment>
</property>
<compartment subcompartmentId="e47f0a6c-3be8-4027-9eee-de251784f708">
  <compartment xml:lang="en">water</compartment>
  <subcompartment xml:lang="en">unspecified</subcompartment>
```

EcoSpold 2

- Flow properties: details for each process data set
 - Auto generated flow properties
“EcoSpold01Allocation_undefined_xy“

```
.....</outputGroup>2</outputGroup><CR LF>
.....</intermediateExchange><CR LF>
.....<intermediateExchange id="eb369ed2-ccf9-449f-b7ff-3a1eda104871" unitId="487df68b-4994-4027-8fdc-a4dc298257b7" amount="0" intermediateExc
.....<name xml:lang="en">palladium</name><CR LF>
.....<unitName xml:lang="en">kg</unitName><CR LF>
.....<property propertyId="40ca2c51-2da6-4351-bd4c-d6f181fc7d55" amount="37.91"><CR LF>
.....<name xml:lang="en">EcoSpold01Allocation_undefined_2</name><CR LF>
.....</property><CR LF>
.....<property propertyId="13706ab5-1a8c-42fd-8329-c93266943c87" amount="37.91"><CR LF>
.....<name xml:lang="en">EcoSpold01Allocation_undefined_16</name><CR LF>
.....</property><CR LF>
.....<property propertyId="db2e27d1-47cd-4180-8416-4f79369de00c" amount="37.91"><CR LF>
.....<name xml:lang="en">EcoSpold01Allocation_undefined_6</name><CR LF>
.....</property><CR LF>
.....<property propertyId="3db02346-808f-4eb6-9232-317a23c63484" amount="37.91"><CR LF>
.....<name xml:lang="en">EcoSpold01Allocation_undefined_7</name><CR LF>
.....</property><CR LF>
.....<property propertyId="9909d836-d0a3-45ed-a8d6-62f5febc763a" amount="100"><CR LF>
.....<name xml:lang="en">EcoSpold01Allocation_undefined_21</name><CR LF>
.....</property><CR LF>
.....<property propertyId="9c38ea07-adcd-4018-8636-eb32382f39a7" amount="37.91"><CR LF>
.....<name xml:lang="en">EcoSpold01Allocation_undefined_5</name><CR LF>
.....</property><CR LF>
.....<property propertyId="e2bdc7a2-bfb2-4db4-9fa2-12e46f767097" amount="37.91"><CR LF>
.....<name xml:lang="en">EcoSpold01Allocation_undefined_19</name><CR LF>
.....</property><CR LF>
.....<property propertyId="9676ed7d-a99c-40ed-9ff5-55081521ad8b" amount="37.91"><CR LF>
.....<name xml:lang="en">EcoSpold01Allocation_undefined_8</name><CR LF>
.....</property><CR LF>
.....<property propertyId="a9358458-9724-4f03-b622-106eda248916" amount="0" unitId="577e242a-461f-44a7-922c-d8e1c3d2bf45"><CR LF>
.....<name xml:lang="en">water content</name><CR LF>
.....<unitName xml:lang="en">dimensionless</unitName><CR LF>
```

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 currentecoinvent 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

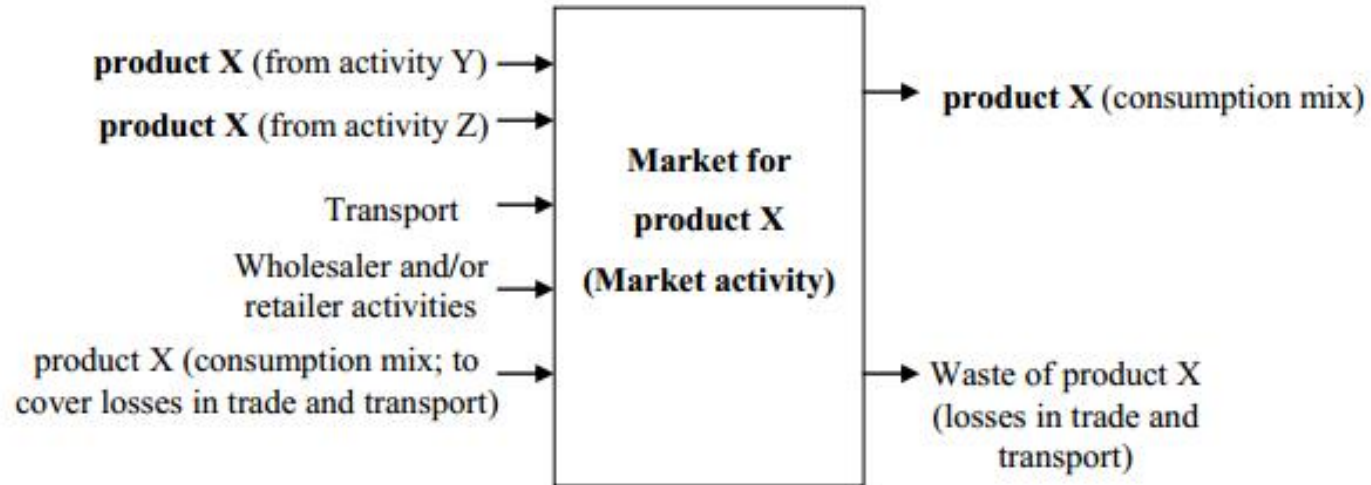
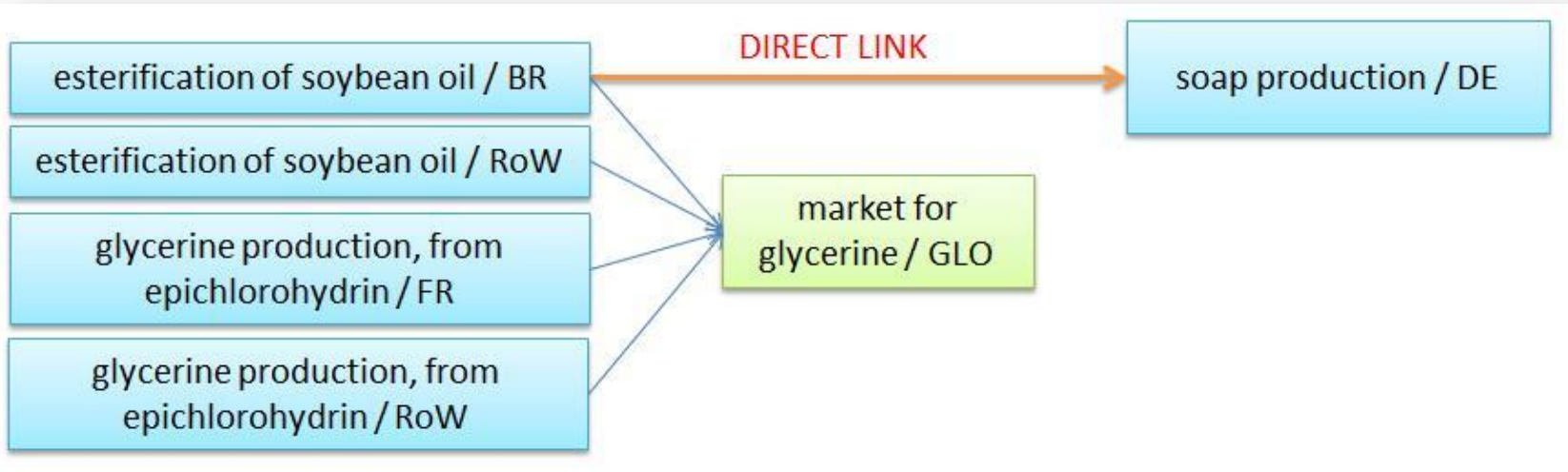


Figure 4.2. A market activity with its intermediate exchanges. Texts in brackets are not part of the name of the exchange.

(ecoinvent 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

Welcome Search result view market for banana - GLO

Process: market for banana

Inputs

Flow	Category	Flow property	Unit	Allocation
transport, freight, inland waterw...	502:Inland water transp...	Goods transpo...	t*km	0
transport, freight train - RoW	491:Transport via railwa...	Goods transpo...	t*km	0
transport, freight train - CH	491:Transport via railwa...	Goods transpo...	t*km	1
transport, freight train - CN	491:Transport via railwa...	Goods transpo...	t*km	0
transport, freight, lorry, unspecif...	492:Other land transport...	Goods transpo...	t*km	0
transport, freight, sea, transocea...	501:Sea and coastal wat...	Goods transpo...	t*km	0
transport, freight train - Europe ...	491:Transport via railwa...	Goods transpo...	t*km	0
transport, freight train - US	491:Transport via railwa...	Goods transpo...	t*km	0
banana - GLO	012:Growing of perenni...	Mass	kg	1

Outputs

Flow	Category	Flow property	Unit	Allocation
banana - GLO	012:Growing of perenni...	Mass	kg	1

(ecoinvent 3.1 allocation default)

Ecoinvent 3: e.g. banana production

Welcome Search result view market for banana - GLO banana production - GLO

Process: banana production

Inputs

Flow	Category	Flow property	Unit	A
ammonium nitrate, as N - GLO	201:Manufacture of basi...	Mass	kg	0
electricity, low voltage - ASCC	351:Electric power gene...	Energy	kWh	5
electricity, low voltage - AT	351:Electric power gene...	Energy	kWh	4
electricity, low voltage - AU	351:Electric power gene...	Energy	kWh	1
electricity, low voltage - BA	351:Electric power gene...	Energy	kWh	6
electricity, low voltage - BE	351:Electric power gene...	Energy	kWh	6
electricity, low voltage - BG	351:Electric power gene...	Energy	kWh	2
electricity, low voltage - BR	351:Electric power gene...	Energy	kWh	3
electricity, low voltage - CA-AB	351:Electric power gene...	Energy	kWh	2
electricity, low voltage - CA-BC	351:Electric power gene...	Energy	kWh	5
electricity, low voltage - CA-MB	351:Electric power gene...	Energy	kWh	3
electricity, low voltage - CA-NB	351:Electric power gene...	Energy	kWh	1
electricity, low voltage - CA-NE	351:Electric power gene...	Energy	kWh	2

Outputs

Flow	Category	Flow property	Unit	A
banana - GLO	012:Growing of perenni...	Mass	kg	1
Ammonia	air/low population dens...	Mass	kg	1
Nitrogen oxides	air/low population dens...	Mass	kg	2
Dinitrogen monoxide	air/low population dens...	Mass	kg	1
Zinc	soil/agricultural	Mass	kg	-2

(ecoinvent 3.1 allocation default)

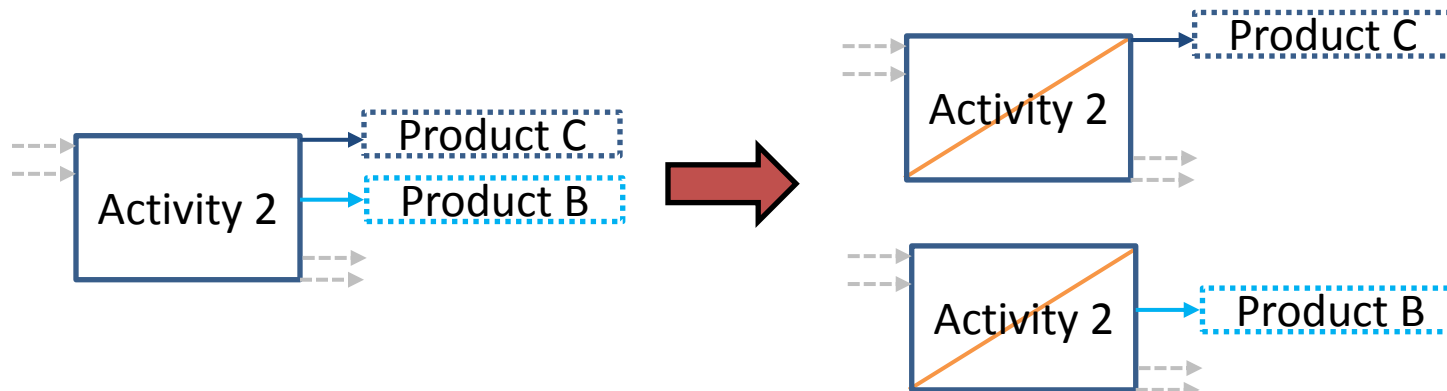
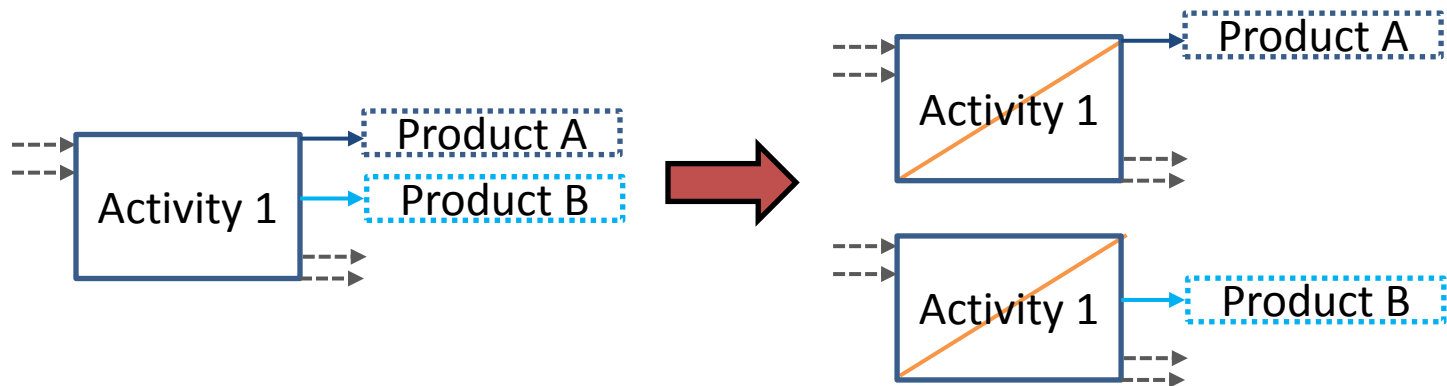
Ecoinvent 3 **System models**

– 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)

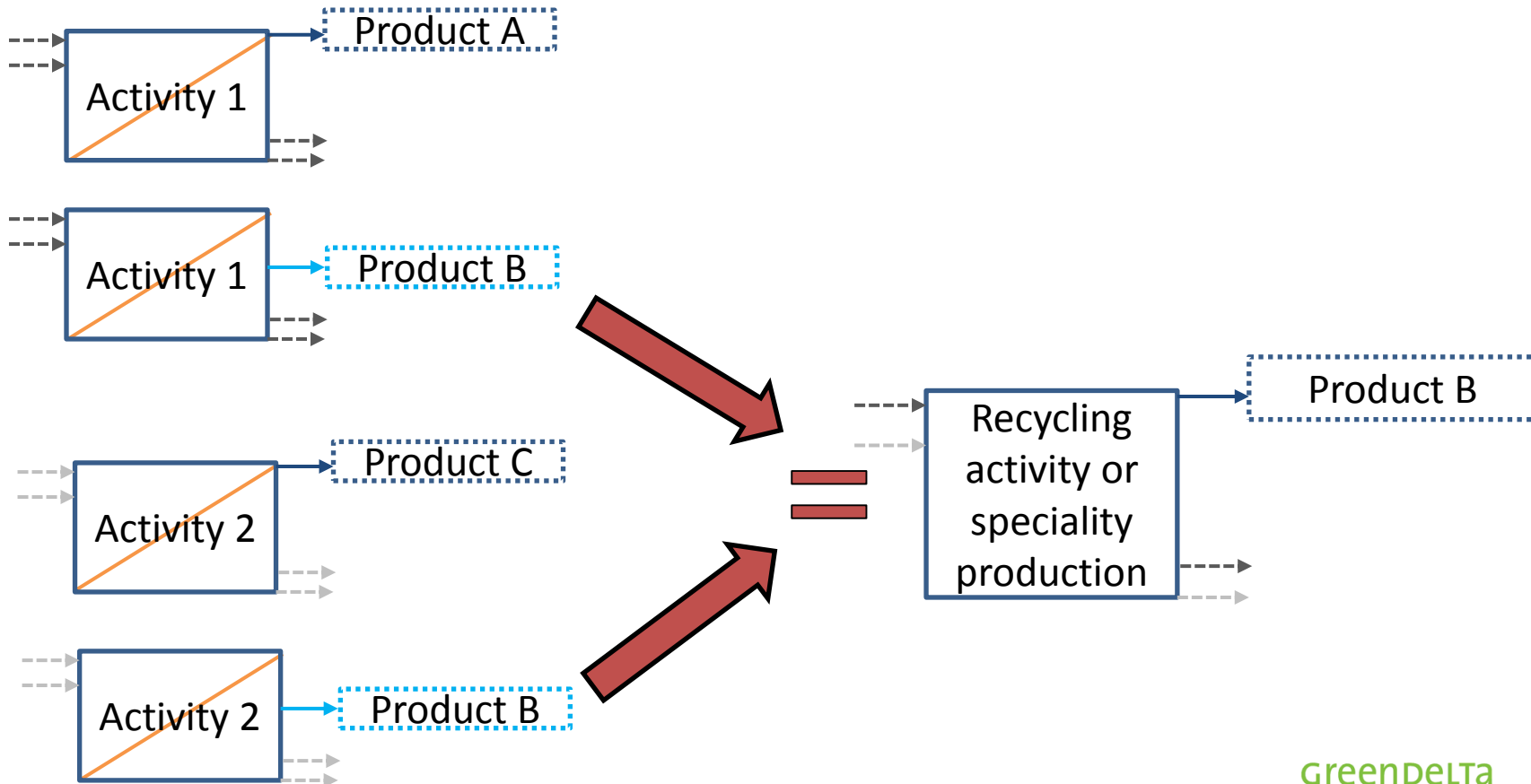
Ecoinvent 3 Allocation model

- Divide the data sets into new activities according the allocation factor



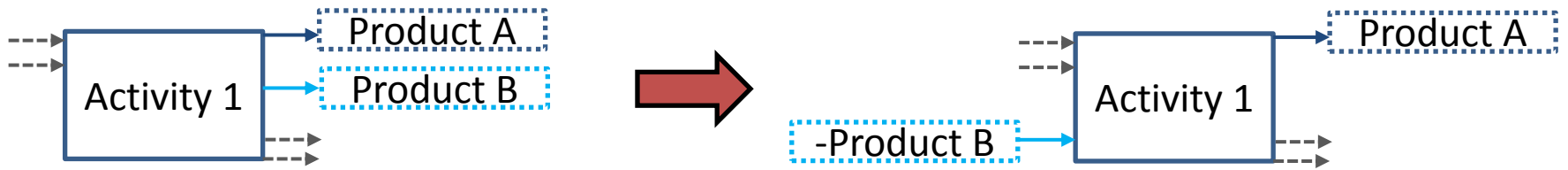
Ecoinvent 3 Allocation model

- After allocation, all activities producing the same marketable by-product yielded from a treatment activity get aggregated and are grouped into a single dataset

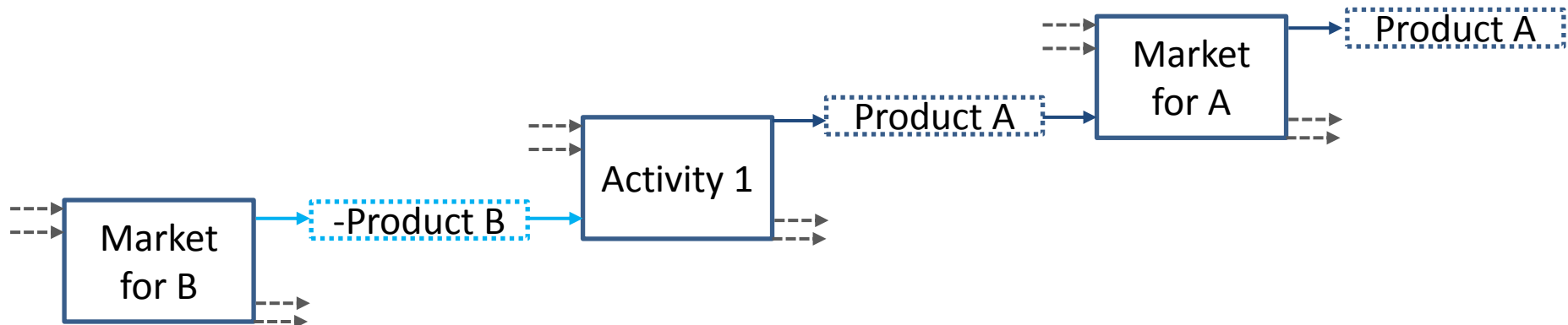


Ecoinvent 3 Substitution model

- 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?

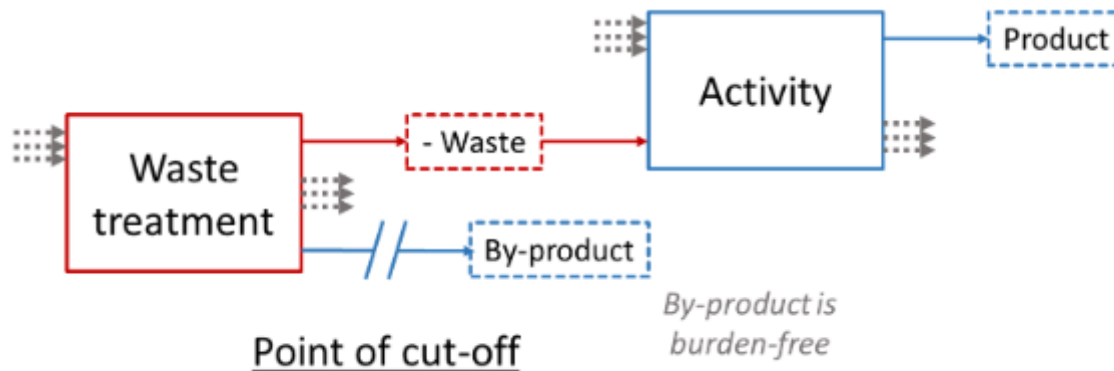
Ecoinvent 3 **Cut-off model (II)**

- 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“)

(http://www.ecoinvent.org/fileadmin/documents/en/System_Models/System_model_description_and_specification-Cutoff.pdf)

Ecoinvent 3 Cut-off model (III)

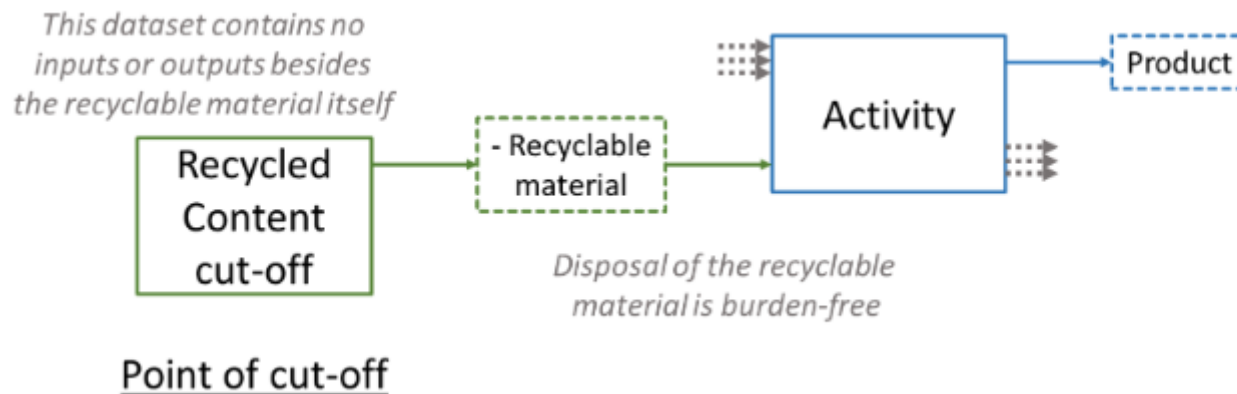
- Waste products handling: by-product is burden-free



(http://www.ecoinvent.org/fileadmin/documents/en/System_Models/System_model_description_and_specification-Cutoff.pdf)

Ecoinvent 3 Cut-off model (IV)

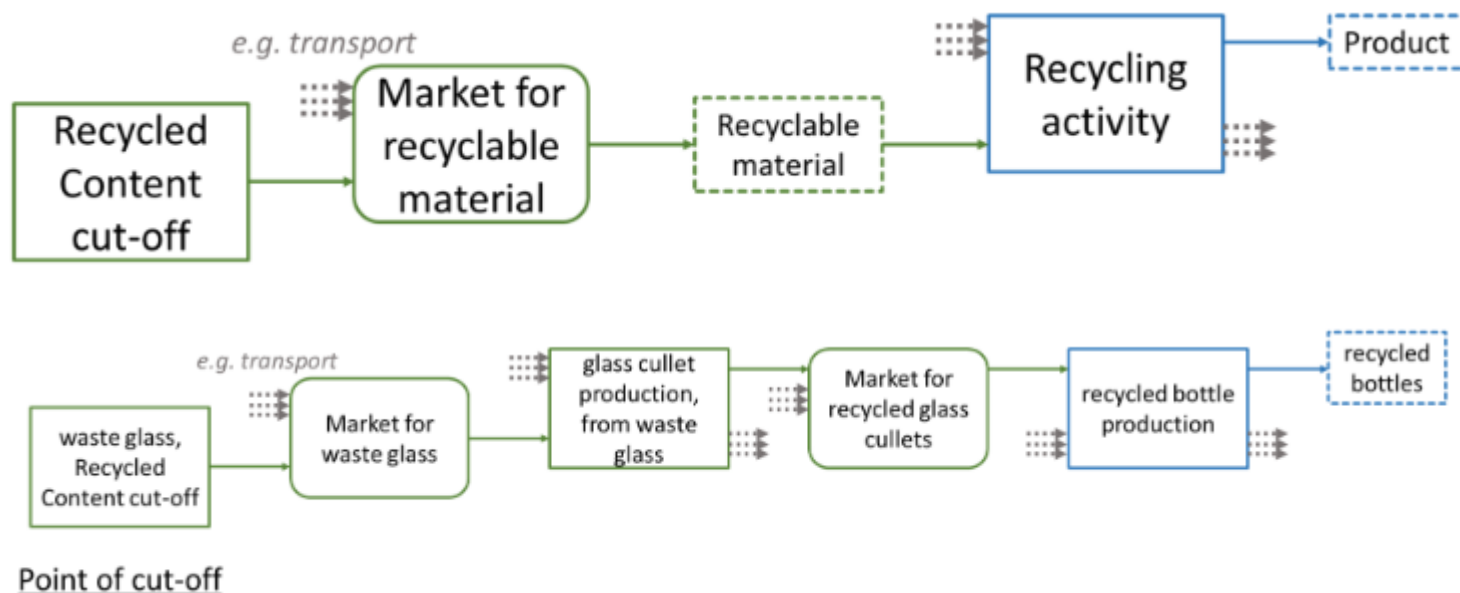
- Handling of recyclable materials: negative input (=output) of a dummy process recycled content cut-off



(http://www.ecoinvent.org/fileadmin/documents/en/System_Models/System_model_description_and_specification-Cutoff.pdf)

Ecoinvent 3 Cut-off model (V)

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



(http://www.ecoinvent.org/fileadmin/documents/en/System_Models/System_model_description_and_specification-Cutoff.pdf)

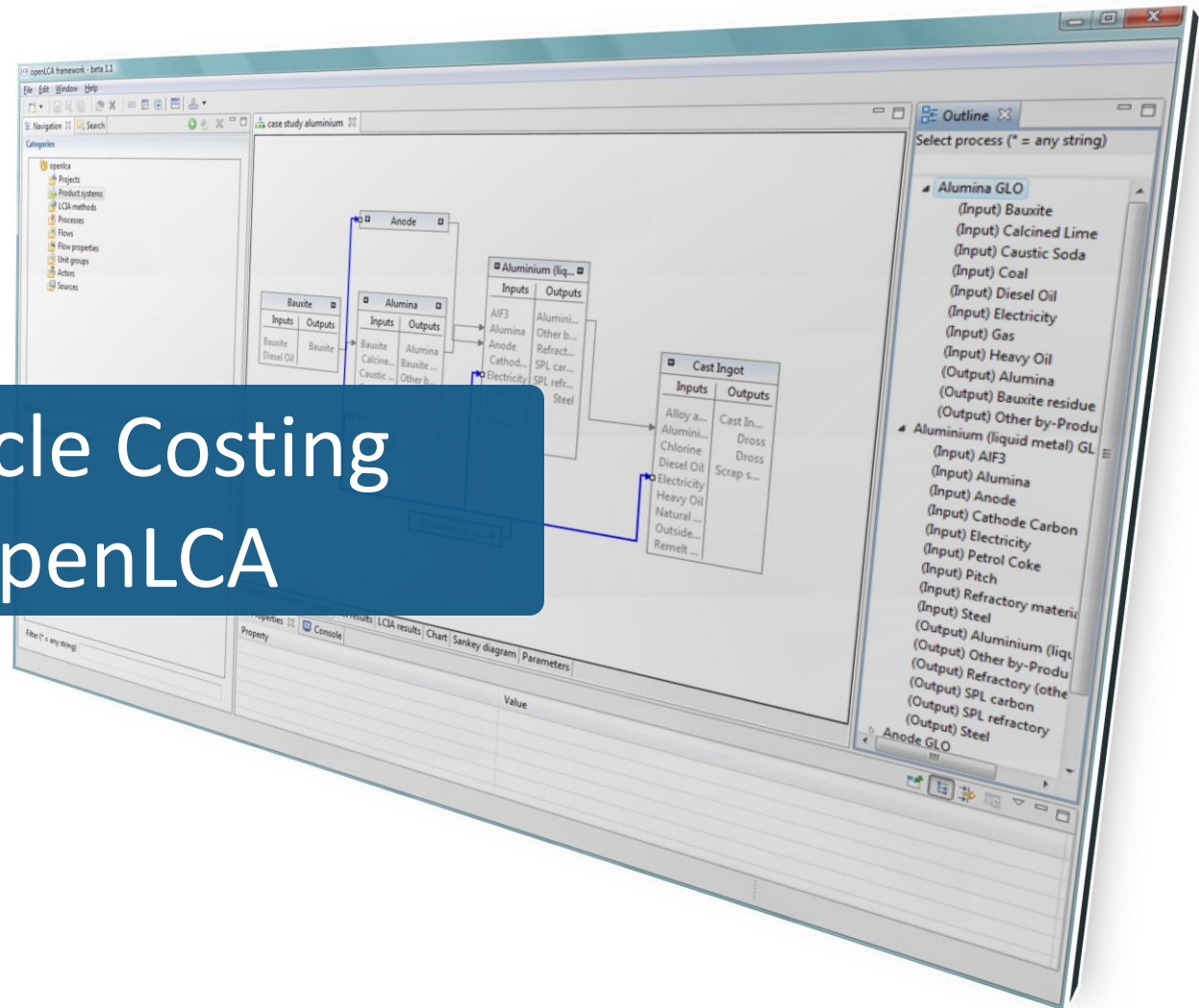
Ecoinvent 3 **New data**

- (very few: some international data; water data)
- Data updates
 - e.g. electricity mixes, transport

Ecoinvent 3 Consequences for openLCA

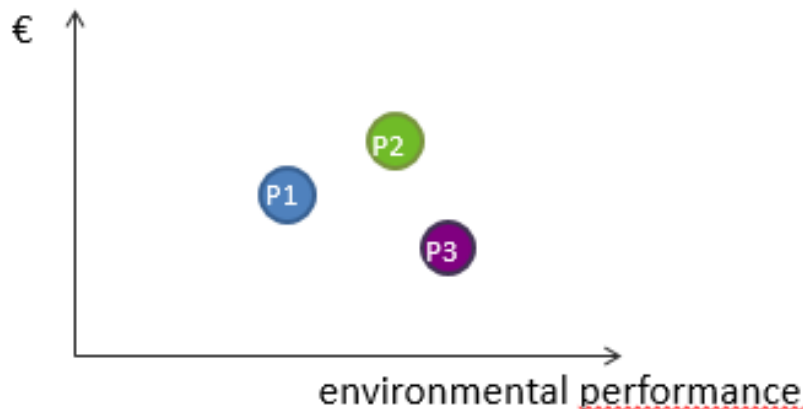
- Much larger systems
 - Optimization of performance in product systems (open, create new): before 2 min, now 10s
 - Optimization of the calculation (Background: matrix inversion, memory use, speed)
- modeling corrections (correct some links; uncertainty information)
- (openLCA structure adapts well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

Life Cycle Costing in openLCA



Motivation of LCC

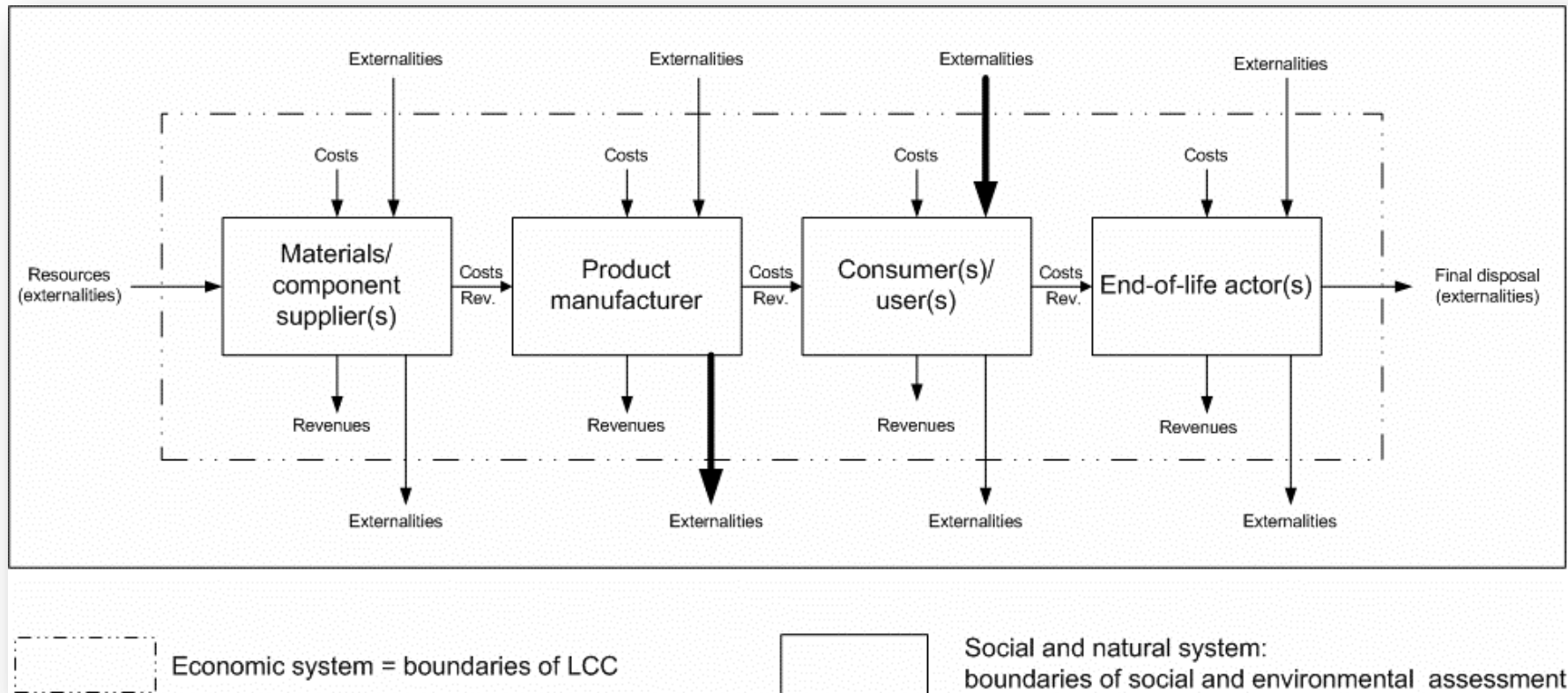
- LCC gives an overview over all costs that arise through the entire life cycle of a product.
- 2 perspectives: manufacturer and consumer
- Important for goods that entail high costs through maintenance (e.g. car or train) or for the comparison of different products
- LCC can be used for the calculation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



Example: The consumer perspective

	Opel Corsa	Fiat Punto	Citroen Advance
Purchase price	10,945 €	10,890 €	10,9990 €
Costs per year			
Buy price	1,977 €	2,164 €	1,936 €
Taxes, insurance, etc.	1,753 €	1,911 €	1,527 €
Operating costs	909 €	964 €	998 €
Repair costs	352 €	490 €	318 €
Total yearly costs	4,991 €	5,529 €	4,779 €

Scope of LCC



Source: Rebitzer G., Hunkeler D. (2003): Life Cycle Costing in LCM: Ambitions, opportunities, and limitations, Discussing a framework, In: Int J LCA 8 (5), pp. 253-256

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

The screenshot displays the openLCA 1.4.1 beta 4 software interface. The main window is titled 'energy costs' and shows the configuration for a flow named 'Flow: energy costs'. The 'Flow properties' section is expanded, revealing a table with the following data:

Name	Conversion f...	Reference unit	Formula	Is reference
Market va...	1.0	EUR	1.0 EUR = 1...	<input checked="" type="checkbox"/>

The interface also shows a navigation pane on the left with a tree view containing folders like 'Projects', 'Product systems', 'Impact assessment methods', 'Processes', and 'Flows'. Under 'Flows', there is a sub-folder 'LCC' which contains the 'energy costs' flow being edited. The bottom of the window has tabs for 'General information' and 'Flow properties'.

Option 1: Procedure in openLCA (II)

– Adding costs flows to processes (outputs)

Process: Blade, steel LCC

Inputs

Flow	Category	Flow proper...	Unit	Amount	Uncertainty	Default
⚙️ Steel, billets, at plant - US	Product flows	Mass	g	2	none	
⚙️ Electricity, at grid, CN	Product flows	Energy	kWh	0.05	none	

Outputs

Flow	Category	Flow proper...	Unit	Amount	Uncertainty	Avoided
⚙️ Blade, steel_LCC	Product flows	Number of ...	Item(s)	1	none	
📊 energy costs	LCC	Market valu...	EUR	0.2*0.05	none	
📊 personell costs	LCC	Market valu...	EUR	0.004	none	
📊 material costs	LCC	Market valu...	EUR	0.02*0.90	none	

Option 1: Procedure in openLCA (III)


- Creation of an impact assessment method

▼ Impact categories

Name	Description	Reference unit
Energy costs		EUR
Material costs		EUR
Personnel costs		EUR
Transport costs		EUR

Impact assessment method: LCC

▼ Impact factors

Impact category  Energy costs

Flow	Category	Flow property	Unit	Factor	Uncertainty
energy costs	LCC	Market value US 2000, bulk prices	EUR/EUR	1.0	none

Option 1: Procedure in openLCA (IV)

- Calculate the product system costs results with the new LCIA method



LCIA Results

LCIA Results

Impact category	Result	Reference unit
Material costs	0.21268	EUR
Transport costs	0.05000	EUR
Personnel costs	0.10050	EUR
Energy costs	0.06646	EUR

Impact contributions

Impact category  Material costs

Contribution	Process	Amount	Unit
 74.99%	Use phase shaver, ABS, 2 blades LCC - US	0.15950	EUR
 16.93%	Blade, steel LCC - GLO	0.03600	EUR
 07.50%	Shaver handle, ABS LCC - GLO	0.01595	EUR

Option 2: Costs tab in the process editor

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

Process costs

Shaver, ABS, 2 blades, packaged with PET_LCC

Cost category	Amount	Fixed ...
Local taxes	500.0	No

New cost entry

Cost category: Construction Expenses

Amount: 1000.0

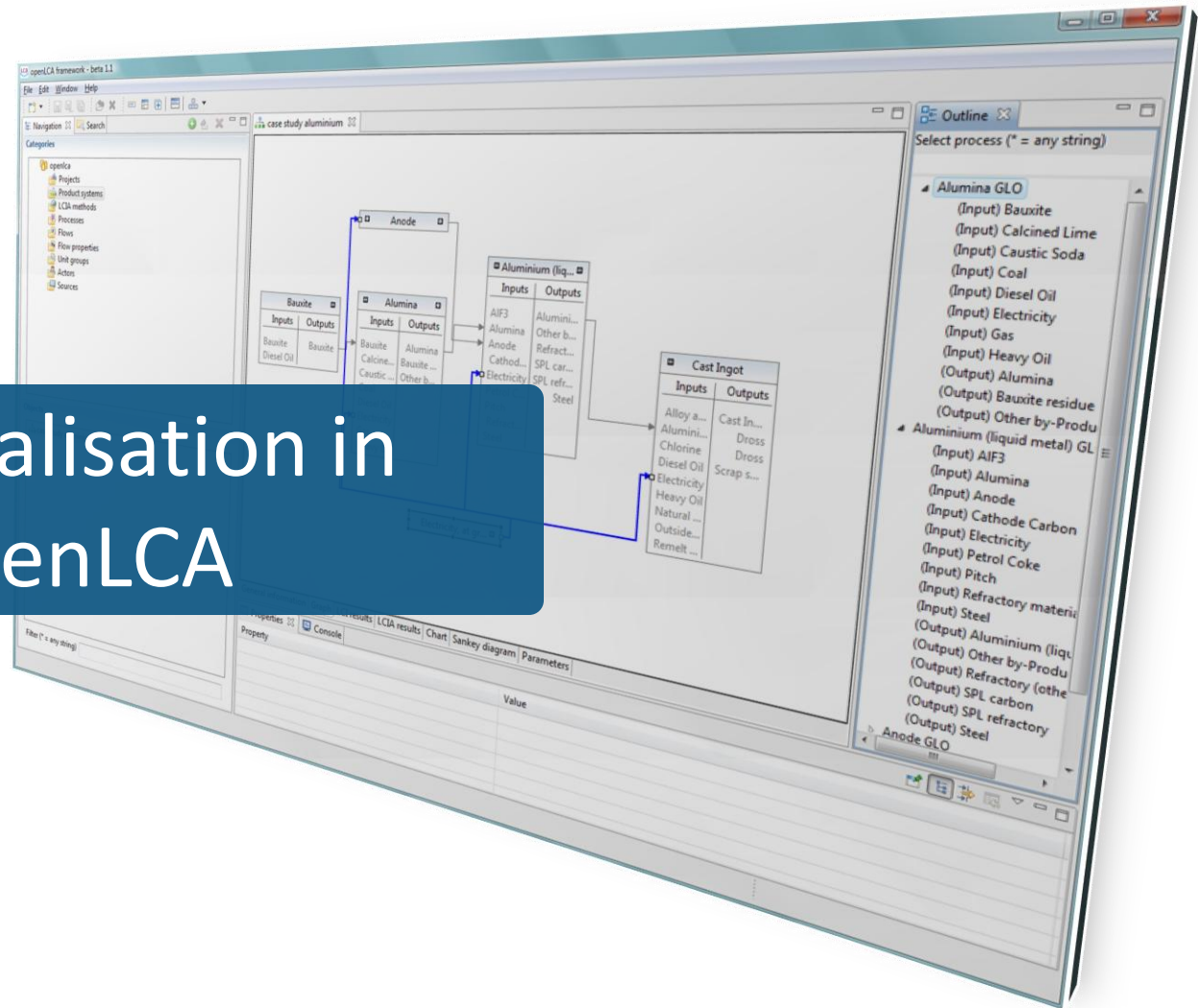
Fixed costs:

OK Cancel

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

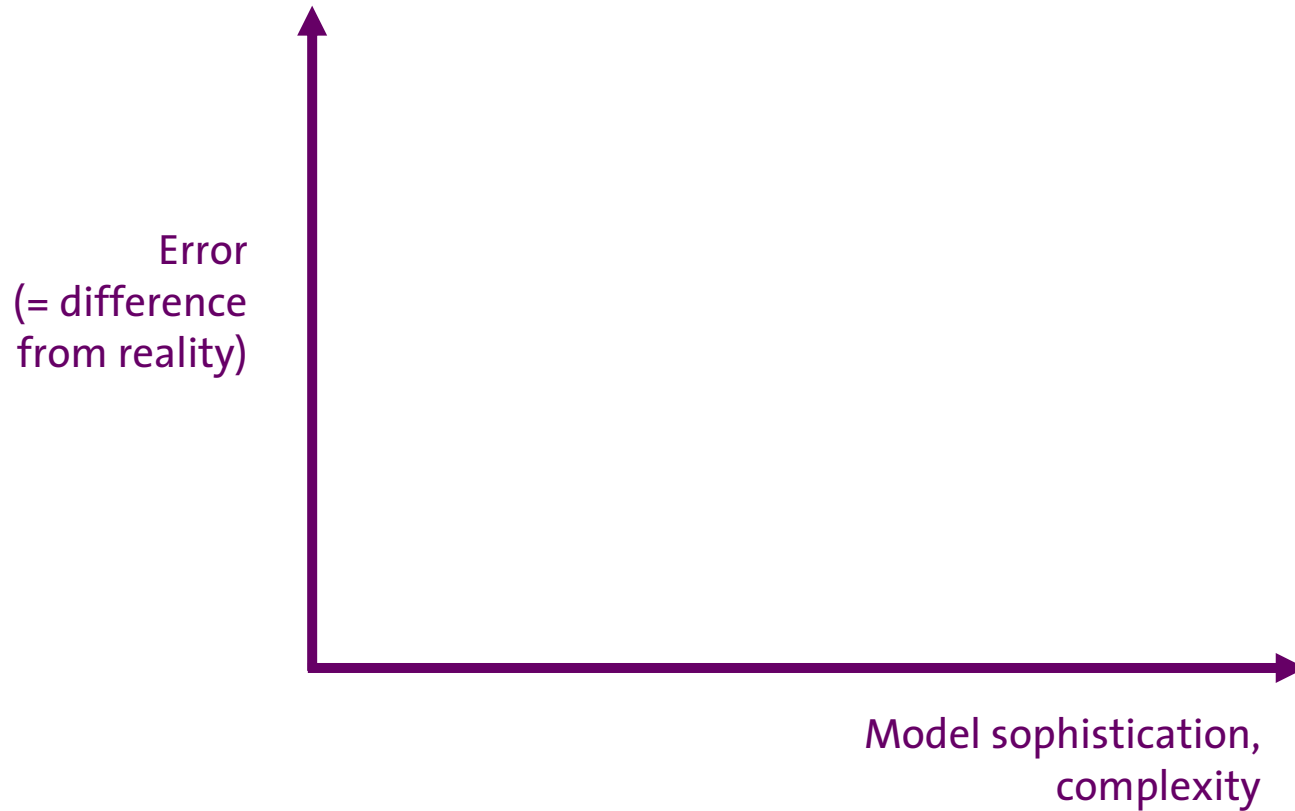


Good reasons for regionalised LCIA

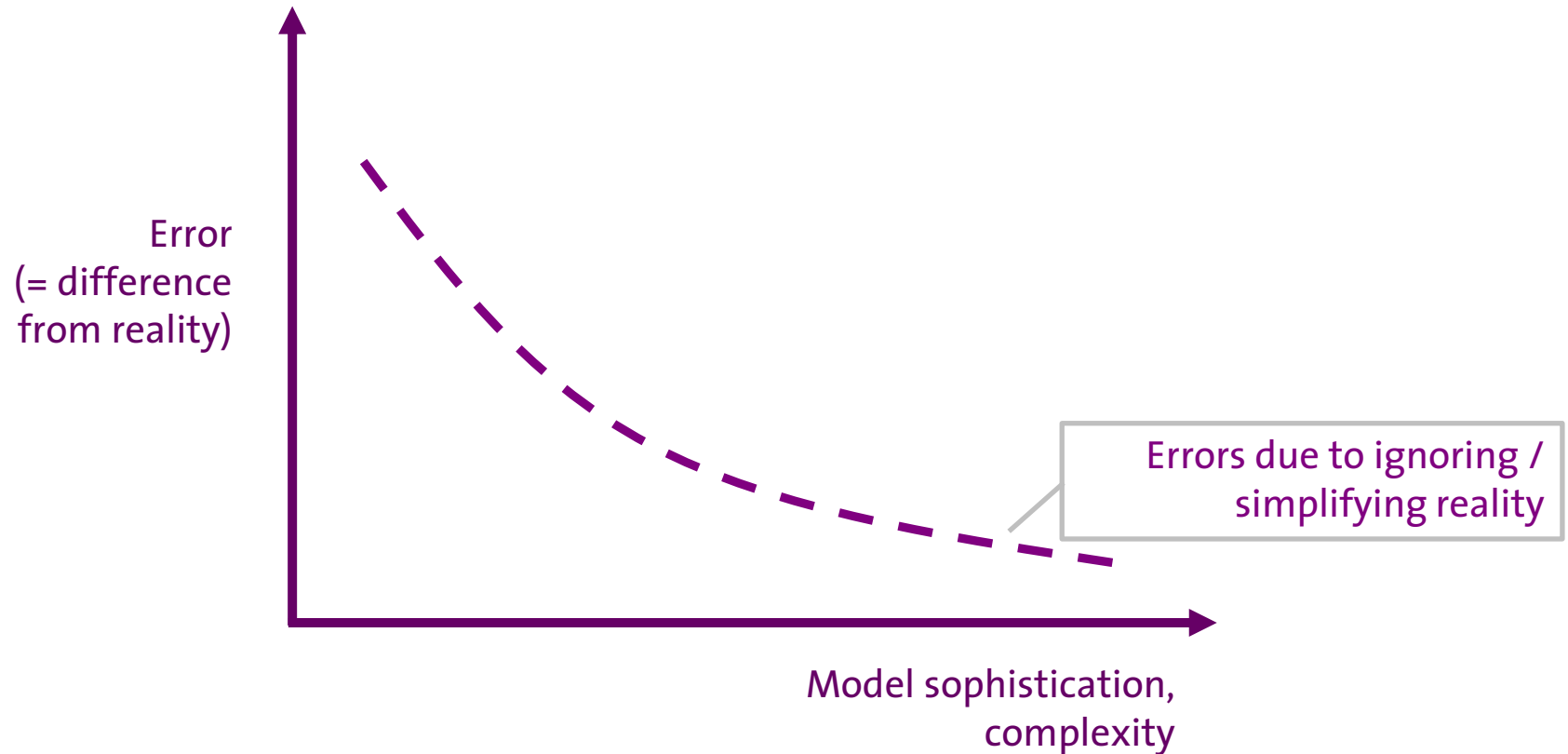
- Fine particles emissions to air



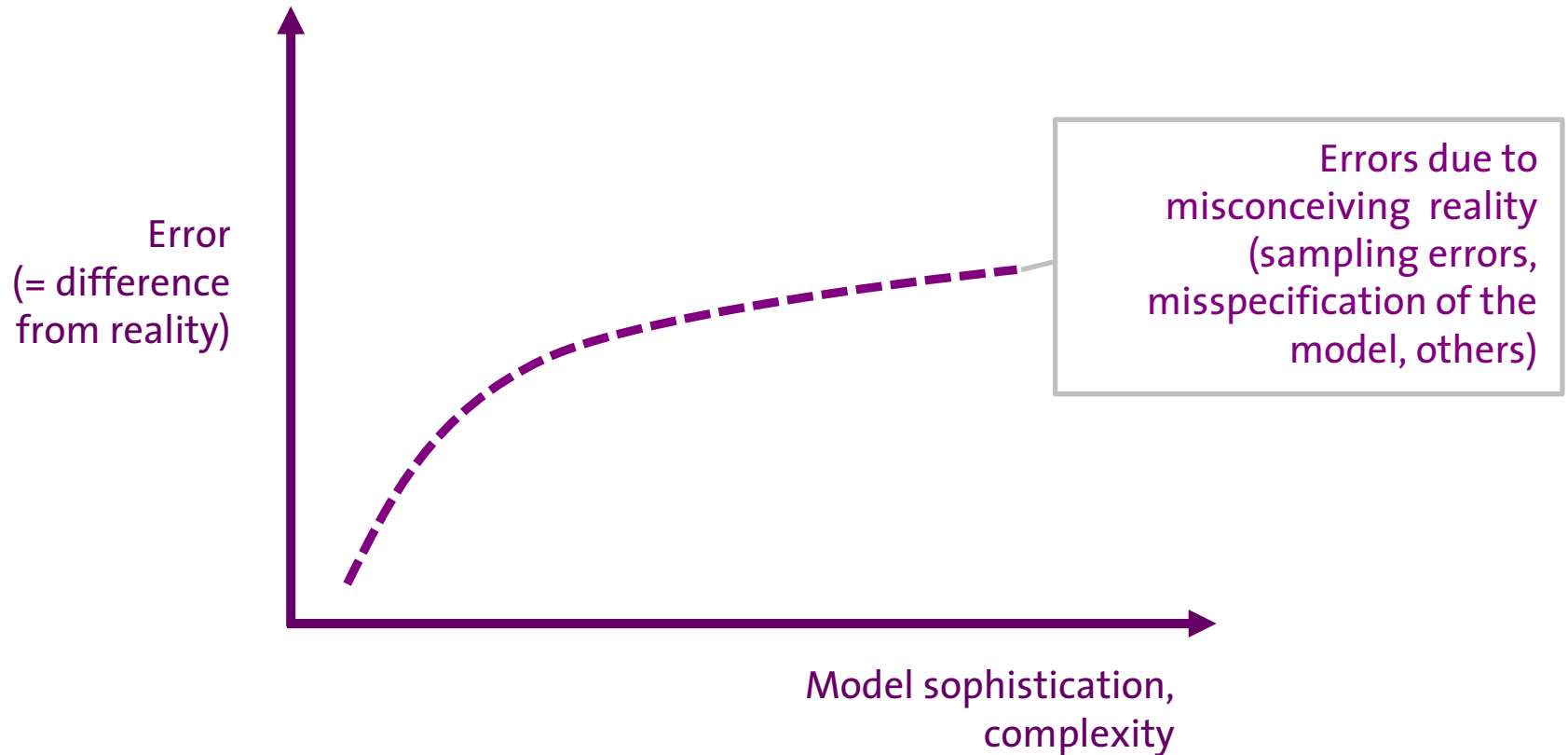
When does regionalised LCIA make sense?



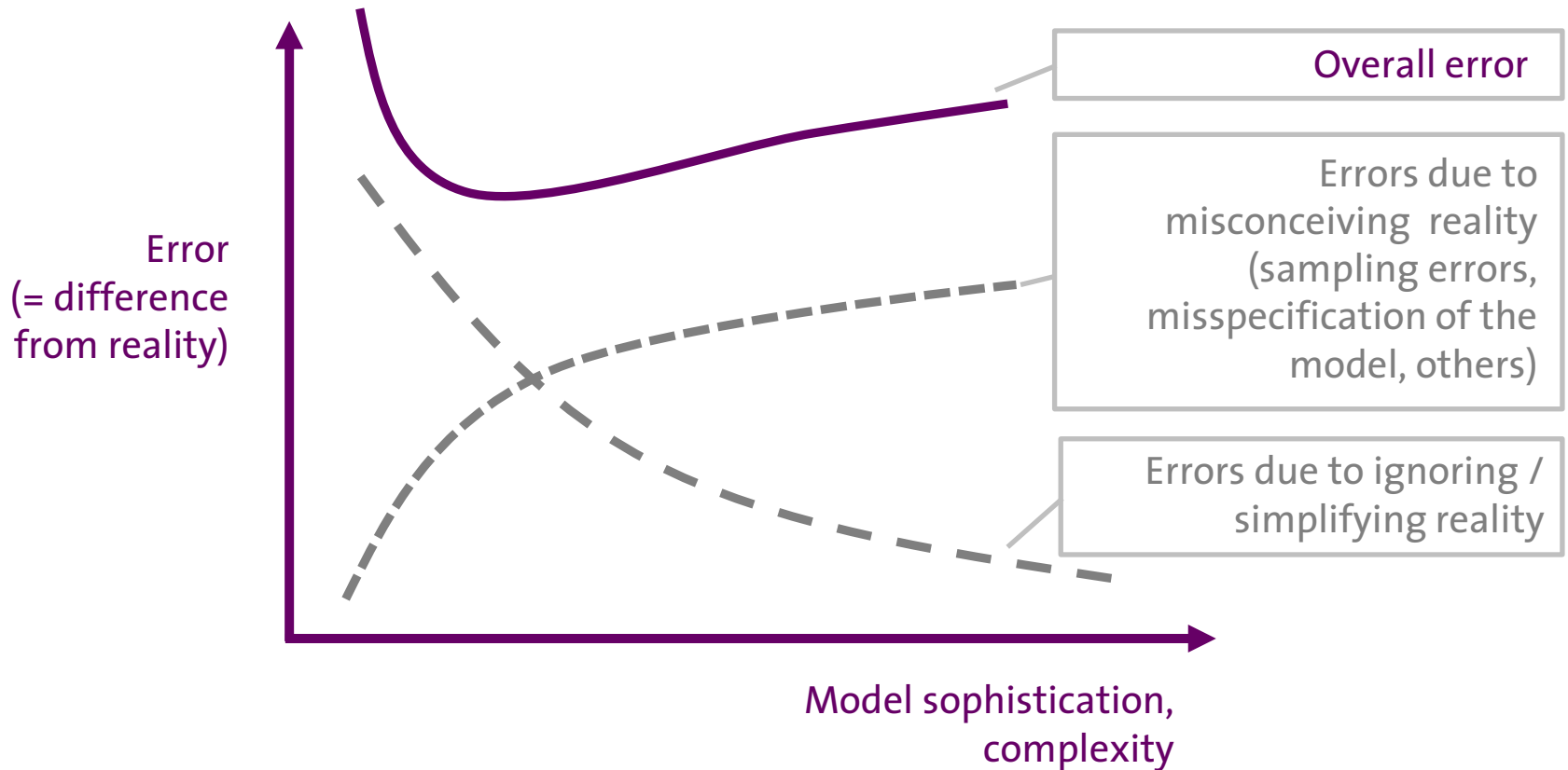
When does regionalised LCIA make sense?



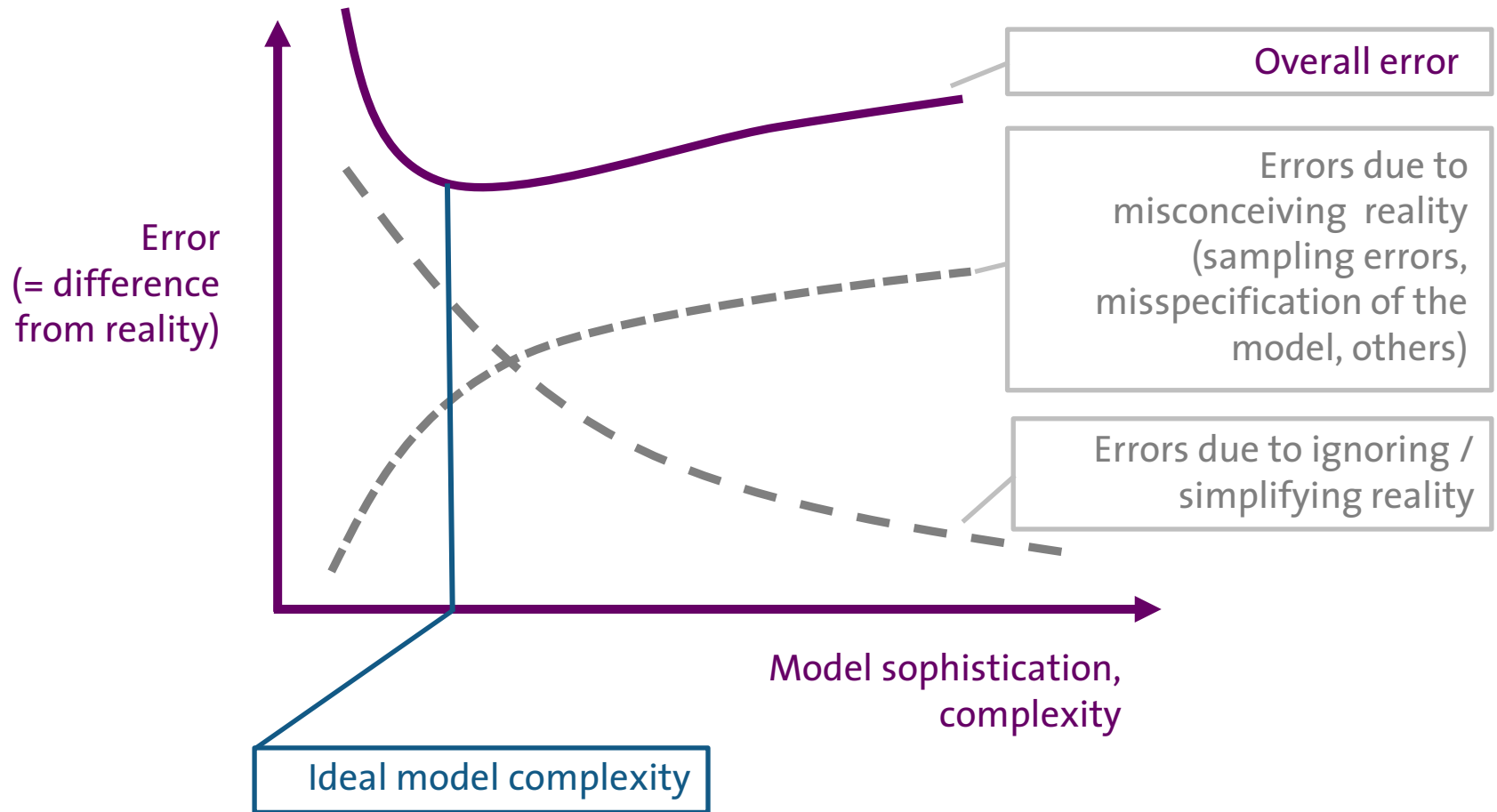
When does regionalised LCIA make sense?



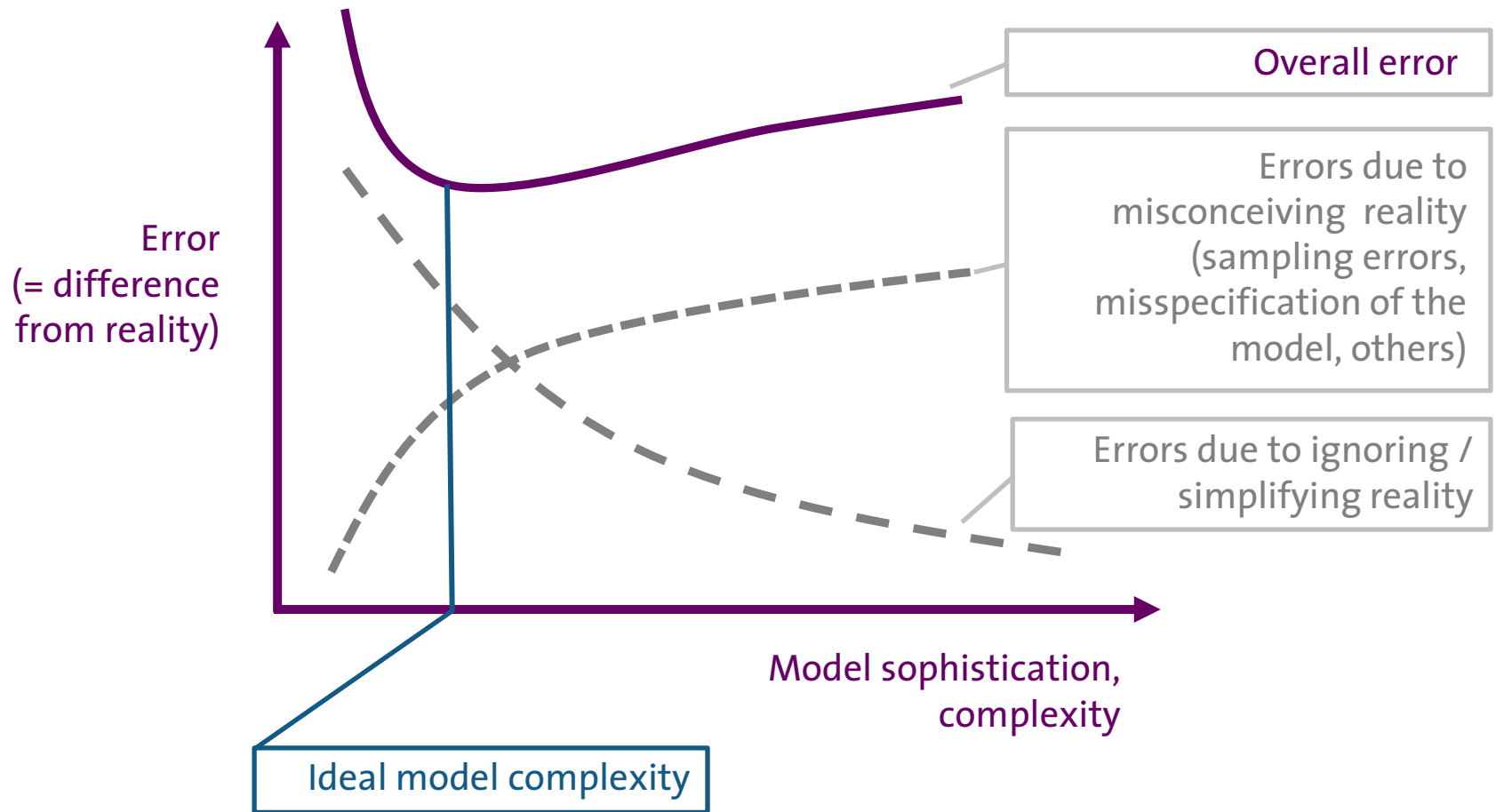
When does regionalised LCIA make sense?



When does regionalised LCIA make sense?



When does regionalised LCIA make sense?



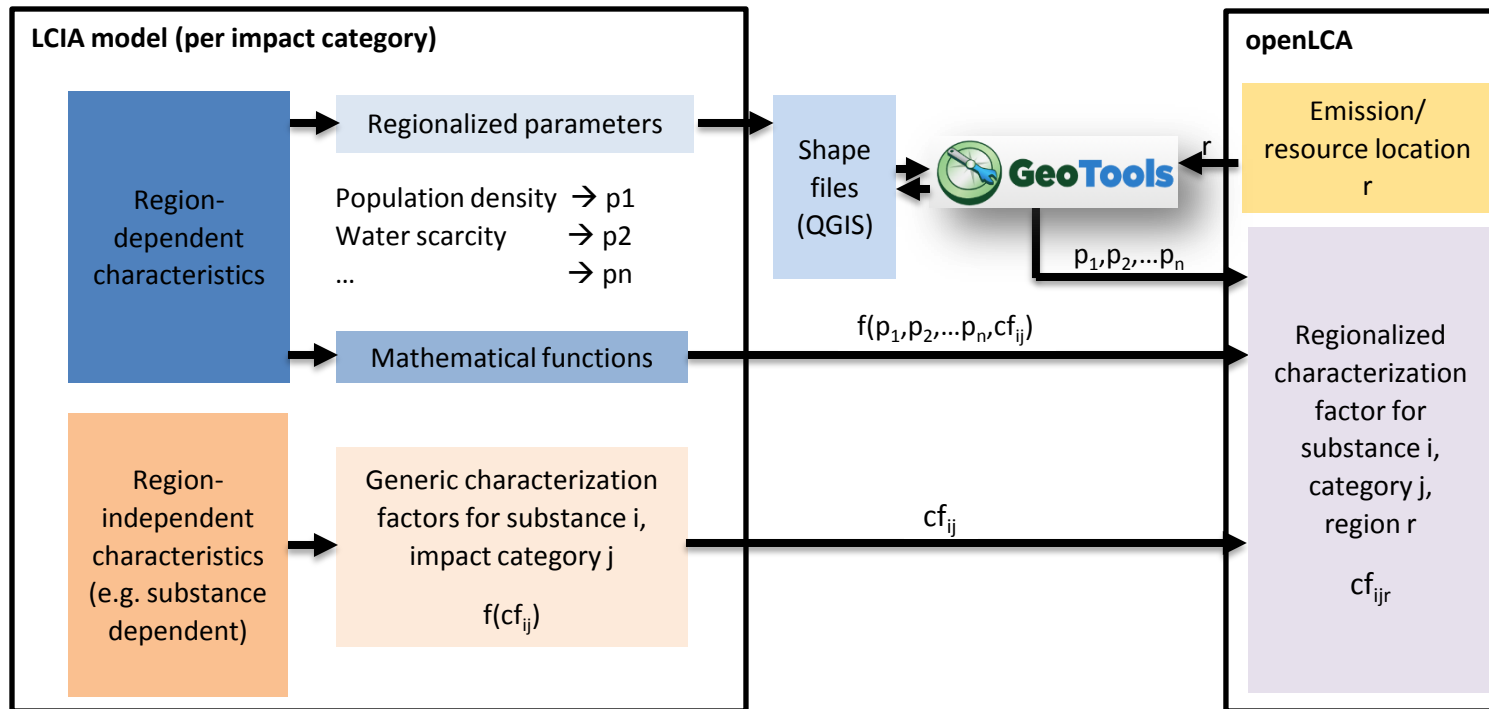
source: SRU, Umweltgutachten 1974, Stuttgart 1974, p. 208; Ciroth, A.: Uncertainties in Life Cycle Assessment, editorial, Int J LCA 2004

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 efforts for identifying 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

Impact factors

Impact category: Land use

Flow	Category	Flow property	Unit	Factor	Uncertainty
Occupation, arable	resource/land	Area*time	m2*a	$(0.60 * \text{ratio_biom}) / \text{SA_CF}$	lognormal: gmean=1.36 g...
Occupation, construction site	resource/land	Area*time	m2*a	$(0.44 * \text{ratio_biom}) / \text{SA_CF}$	lognormal: gmean=1.00 g...
Occupation, forest, intensive	resource/land	Area*time	m2*a	$(0.04 * \text{ratio_biom}) / \text{SA_CF}$	lognormal: gmean=9.09E-...
Occupation, forest, intensive, clear-c...	resource/land	Area*time	m2*a	$(0.18 * \text{ratio_biom}) / \text{SA_CF}$	lognormal: gmean=0.41 g...

Parameters

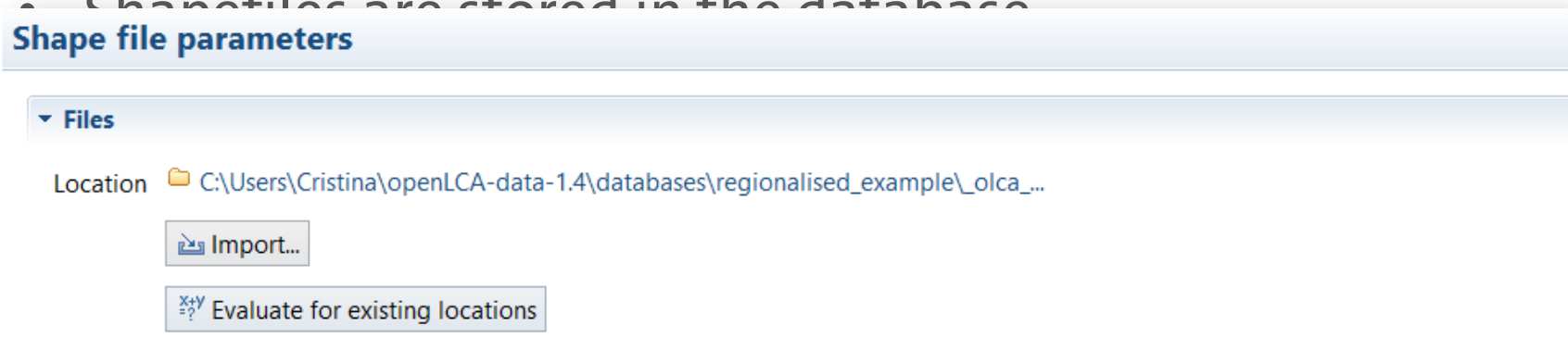
Global parameters

Input parameters

Name	Value	Uncertainty	Description
ratio_biom	1.0	uniform: min=0.21 max=1.97	from shapefile: ecoregions_with_biome_ratio
SA_CF	0.44	none	Settlement Area Characterization Factor
SA_EF	300.0	none	Settlement Area Ecofactor

Shapefiles containing regional characteristics

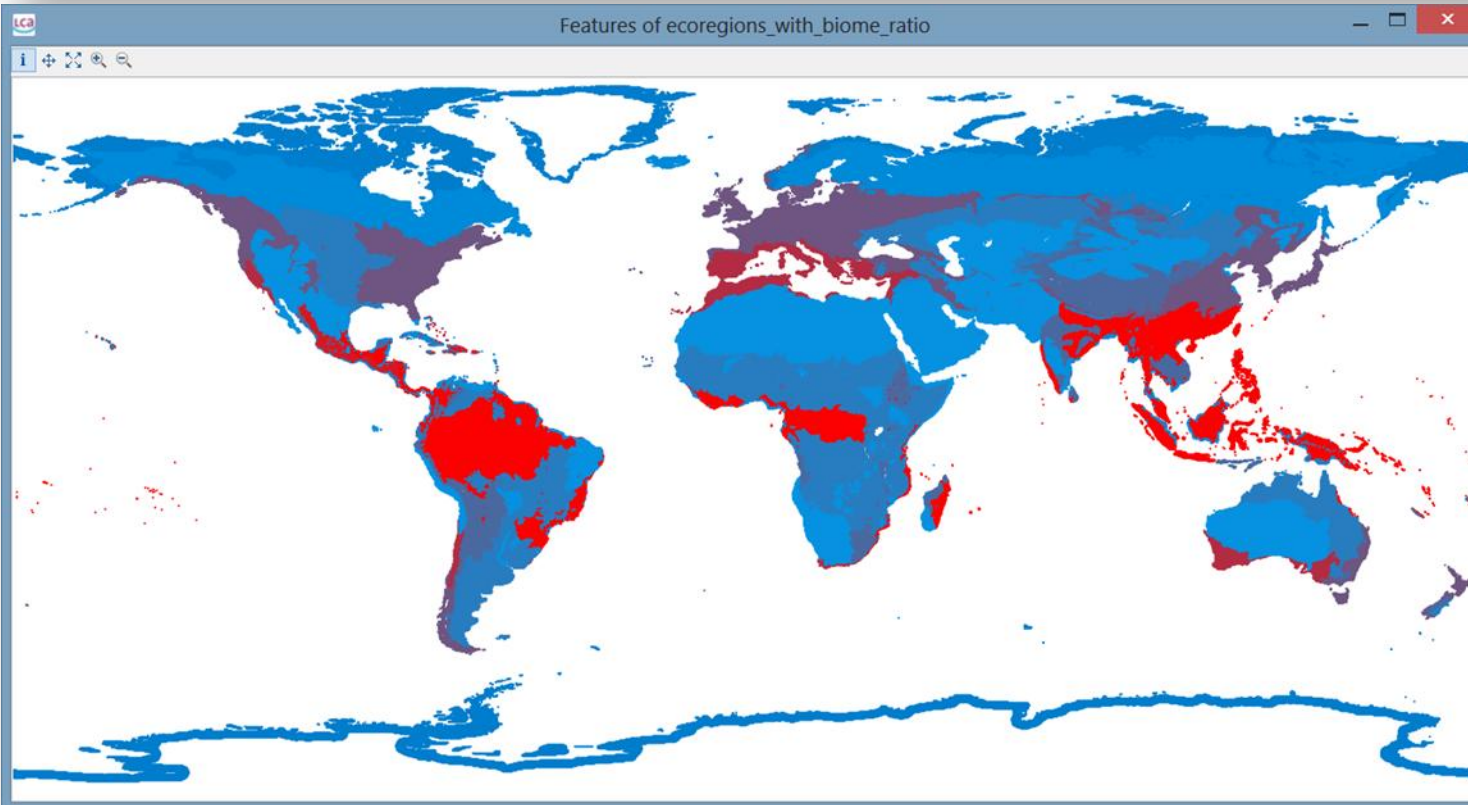
- Regional characteristics affecting the CFs can be defined with parameters:
 - e.g. population density, precipitation variability, etc.
- Data for those characteristics is contained in shapefiles, which can be imported to openLCA
- Parameters are extracted during the shapefile import
- Shapefiles are stored in the database



Shapefiles containing regional characteristics

Parameters of ecoregions_with_biome_ratio

Name	Minimum	Maximum
CLS_CODE	0.0	1144.0
ECO_ID_U	10000.0	17109.0
ECO_NUM	1.0	99.0
ratio_biom	0.20929077	1.96750671



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

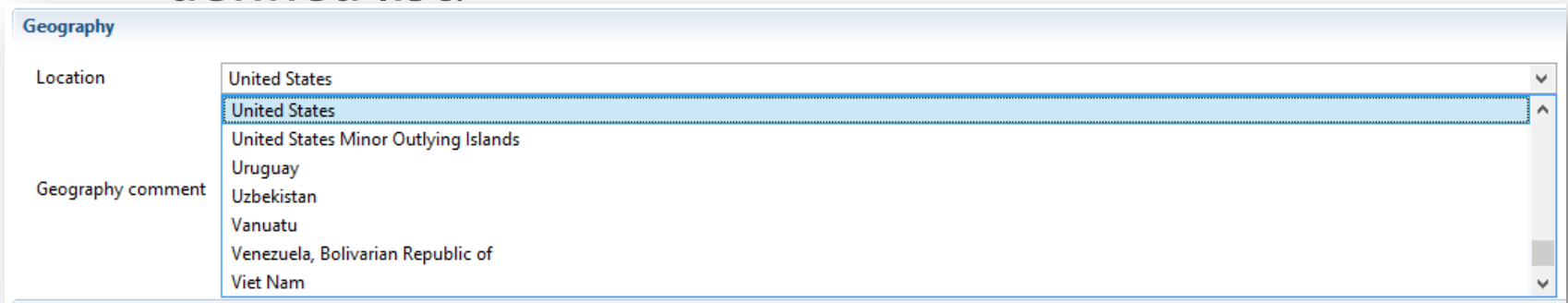
Input parameters					
Name	Value	Uncertainty	Description	External source	
ratio_biom	1.0	none			
Ecofactor	610.0	none			

ecoregions_ratio_biomes

Extension of locations in openLCA (I)

Traditional approach:

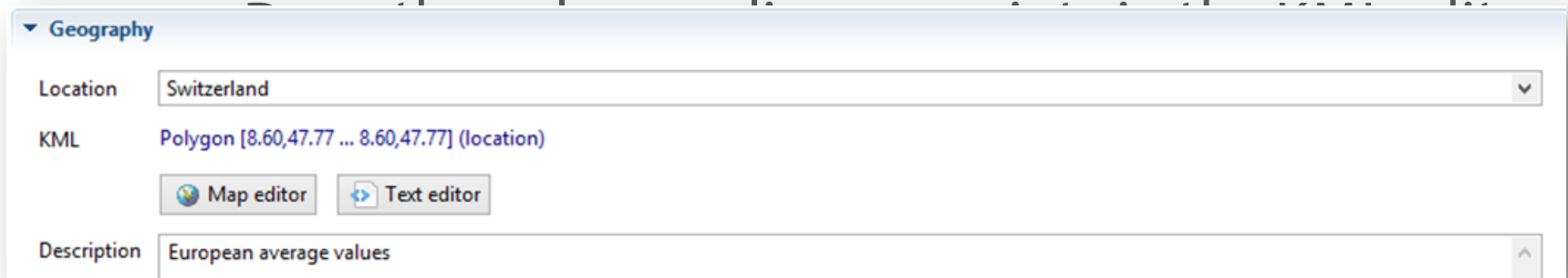
- A list of locations available under File/Preferences/Locations.
- The geographic information of the locations was limited to a pair of latitude, longitude data.
- The processes could only use locations from the pre-defined list.



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”.



Extension of locations: KML editor (text)

KML Editor

Map Text

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <kml xmlns="http://earth.google.com/kml/2.1">
3   <Folder>
4     <name>OpenLayers export</name>
5     <description>Exported on Tue Oct 07 2014 20:37:00 GMT+0200</description>
6     <Placemark>
7       <name>OpenLayers_Feature_Vector_35130</name>
8       <description>No description available</description>
9       <MultiGeometry>
10        <Polygon>
11          <outerBoundaryIs>
12            <LinearRing>
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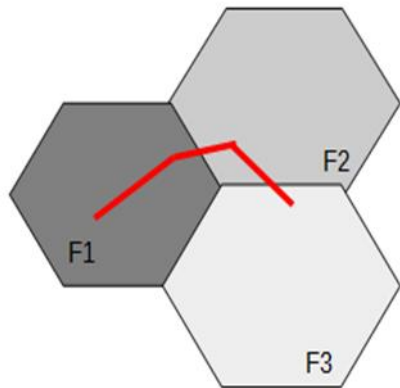
Update location Clear

Calculation framework

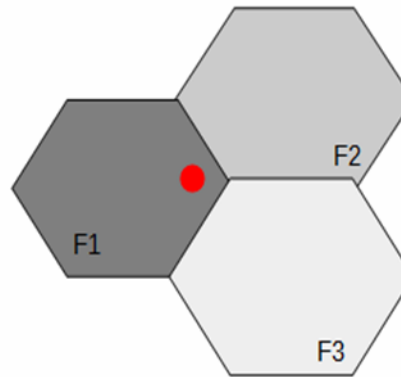
Linking of process locations and LCIA methods spatial units

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

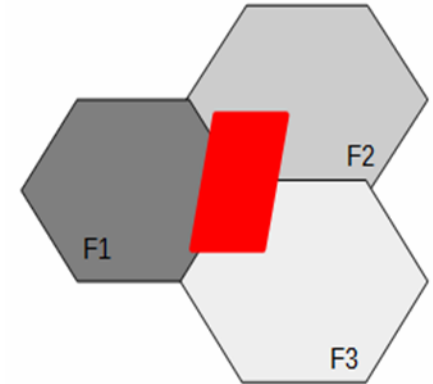
→ A weighted mean calculated for each regional parameter



$$(p(F1)*L(F1) + p(F2)*L(F2) \dots) / L$$



$$p(F1)$$



$$(p(F1)*A(F1) + p(F2)*A(F2) \dots) / A$$

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)

$$RR = CR * GR$$

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

Please select the properties for the calculation

Allocation method: None

Impact assessment method: ecological scarcity 2013 (per country and biome)

Normalization and weighting set:

Calculation type:

- Quick results
- Analysis
- Regionalized LCIA
- Monte Carlo Simulation

Number of iterations: 100

Save as default | Reset | Calculate | Cancel

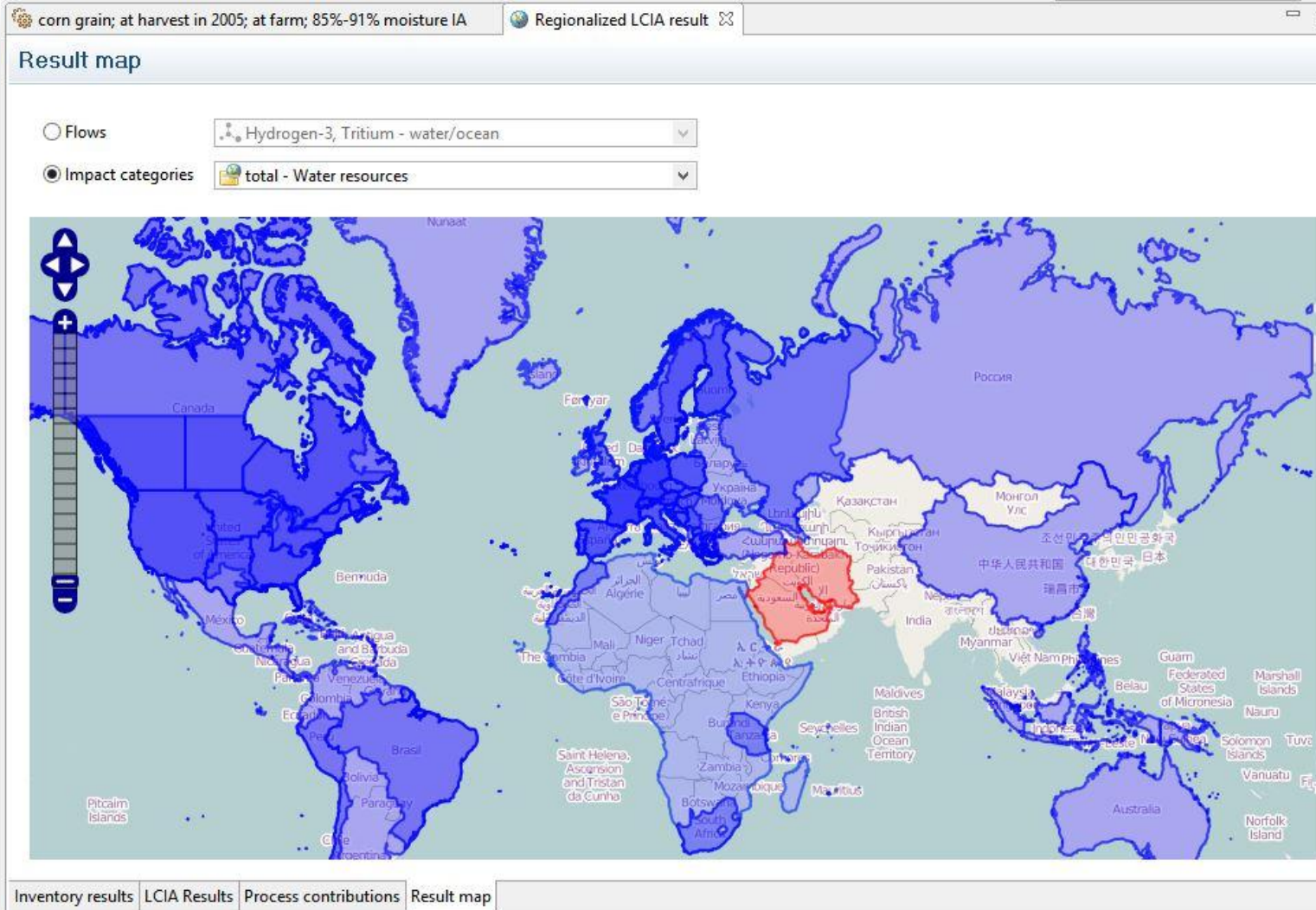
Regionalised LCIA: Calculation procedure

- 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:

The screenshot displays a software interface with two main sections. The top section, titled 'Shape file parameters', includes a 'Files' dropdown menu, a 'Location' field with a folder icon and the path 'C:\Users\Cristina\openLCA-data-1.4\databases\regionalised_example\olca_...', an 'Import...' button, and a checked checkbox labeled 'Evaluate for existing locations'. The bottom section, titled 'Parameters of ecofactors_renamed', contains a table with columns for 'Name', 'Minimum', and 'Maximum'.

Name	Minimum	Maximum
f_x Critical F	0.004	1646.6
f_x Current F	0.0	761.0
f_x Ecofactor	0.0	2.0E7
f_x Normalizat	2.614	2.614

Regionalised LCIA: Results (I)



Regionalised LCIA: Results (II)

Locations

- Flows Manganese - air/low population density
- Impact categories total - Water resources

Result contributions

Location	Process	Amount	Unit
Latin America and the Caribbean		1.79256E-9	kg
	copper, primary, at refinery	1.79256E-9	kg
	copper concentrate, at beneficiation	3.21146E-10	kg
	hard coal, at mine	3.21146E-10	kg
	hard coal, at regional storage	3.21146E-10	kg
Europe		4.06805E-10	kg
Global		2.99522E-10	kg
Indonesia		2.83524E-10	kg
Germany		7.65524E-11	kg
Poland		5.91038E-11	kg
Spain		2.05723E-11	kg
	lignite, burned in power plant	2.05723E-11	kg
	natural gas, burned in power plant	2.05723E-11	kg
	electricity, production mix ES	2.05723E-11	kg
	hard coal, burned in power plant	2.03072E-11	kg
	electricity, natural gas, at power plant	2.03072E-11	kg

Environmental Product Declarations



Environmental labeling according to ISO

	Type I Environmental labeling	Type II Self-declared environmental claims	Type III Environmental declarations
<i>Information</i>	Qualitative	Qualitative / quantitative	Quantitative
<i>Range</i>	Special products	All products and services	All products and services
<i>Quality check</i>	Verification of eco-labeling body	None	Third-party certification
<i>Receiver</i>	Consumers	Consumers/ professional purchasers	Professional purchasers

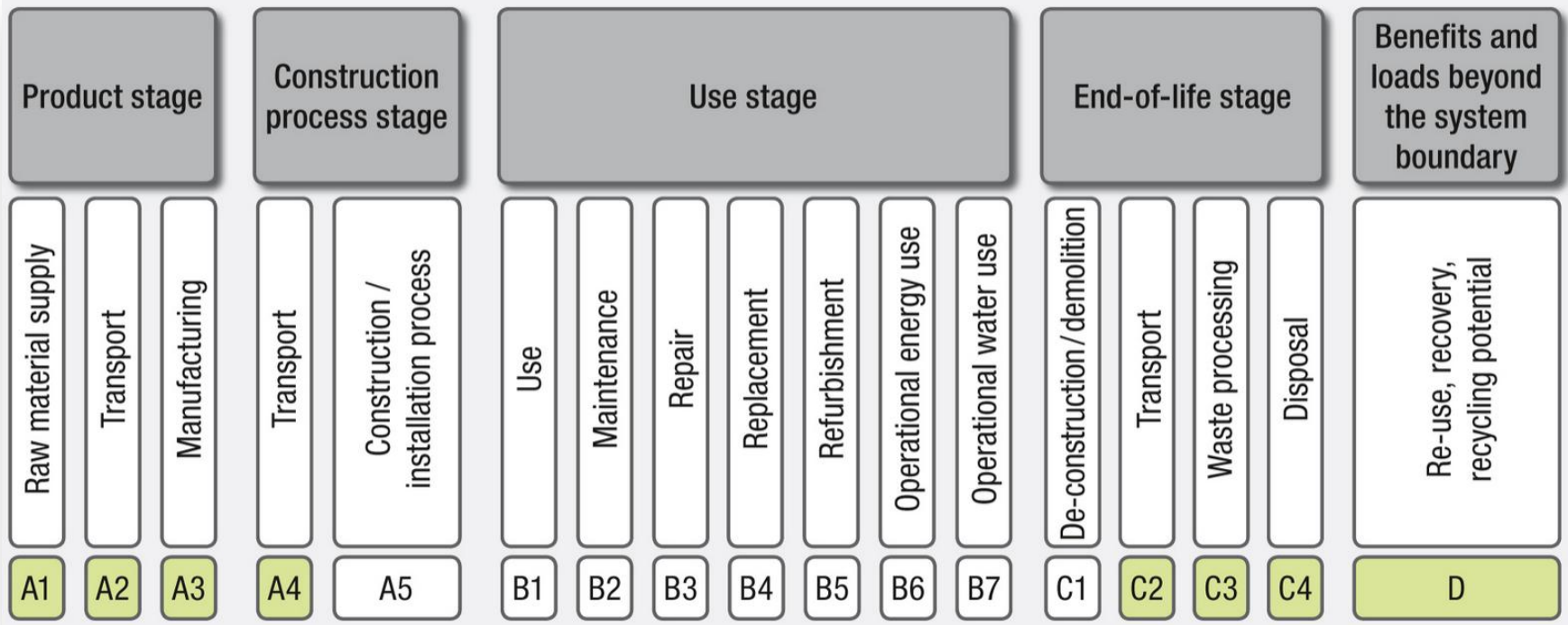
http://www.dantes.info/Tools&Methods/Environmentalinformation/othertools_label.html

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:



GreenDelta
sustainability consulting + software



Thank you!

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