

A quick speed test for LCA software

Comparing openLCA 1.3.4, 1.4 beta 1, SimaPro 7.3.3 and SimaPro 8.0.0

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1 Test environment

All the calculations were performed on the same computer and at the same day. The computer is a Sony notebook, about three years old, with a German Windows 7 64 bit and with 8 GB RAM.

Basisinformationen über den Computer anzeigen

Windows-Edition

Windows 7 Professional

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Service Pack 1

[Weitere Features mit einer neuen Edition von Windows 7 beziehen](#)



System

Klassifikation:

6,4 Windows-Leistungsinde

SONY

Prozessor:

Intel(R) Core(TM) i7 CPU M 640 @ 2.80GHz 2.79 GHz

Installierter Arbeitsspeicher (RAM):

8,00 GB (7,68 GB verwendbar)

Systemtyp:

64 Bit-Betriebssystem

Stift- und Fingereingabe:

Für diesen Bildschirm ist keine Stift- oder Fingereingabe verfügbar.

[Supportinformationen](#)

For the test, 4 GB (4,096 MB) RAM was allocated for openLCA, in each version, as described here: http://openlca.org/documentation/index.php/Adapt_the_RAM_allocation. All calculations were performed separately, with only the LCA software running as main application. All calculations were performed directly after start of the software to avoid influences from possible caching.

For the SimaPro MU (multi user) versions, the database server is installed on the same computer to avoid potential network bottlenecks.

2 Test procedure

The test procedure is quite simple, I calculated the inventory and results that show main drivers for the results, and contributions and a sankey diagram, for the different software systems, for one specific product, and for the ecoinvent 3 and ecoinvent 2.2 database. In openLCA, this requires building a product system and calculating it, or opening an already created product system. In SimaPro, this requires calculating a network for the product.

The following LCA software systems were compared:

- openLCA 1.3.4 (released December 18, 2013), www.openlca.org/downloads
- openLCA 1.4 beta 1 (released December 28, 2013), www.openlca.org/downloads
- SimaPro 7.3.3 (MU Developer), www.pre-sustainability/simapro
- SimaPro 8.0.1 (MU Developer) with a SimaPro 8.0.0 database server, www.pre-sustainability/simapro

The product is

- dung slab CH for ecoinvent 2.2
- dung slap construction (CH) for ecoinvent 3

For ecoinvent 3, the default allocation system model was selected. Each ecoinvent database contained only unit processes. In SimaPro, the respective unit process library was selected. Finally, it should be noted that in openLCA, the steps of creating a product system (and opening an already

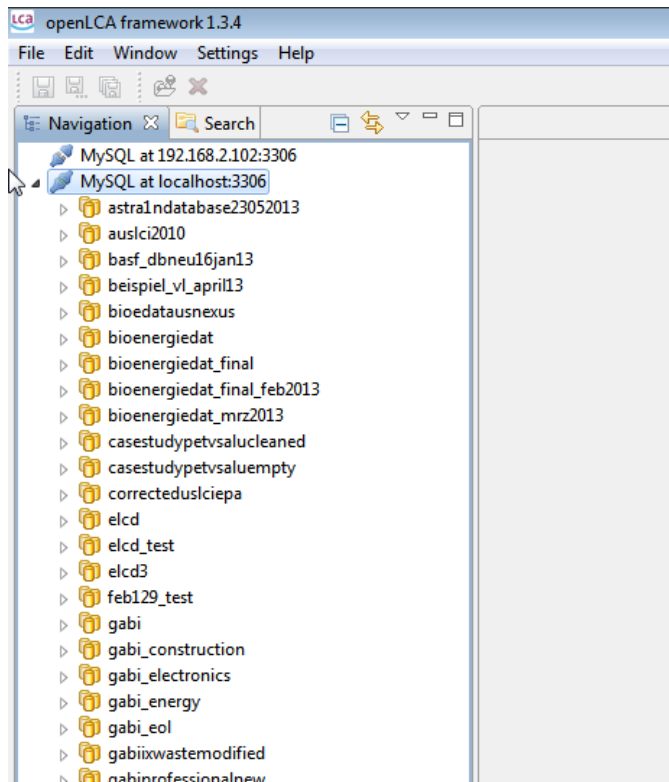
created system) are available individually, while in SimaPro, the network is always calculated 'in one go'.

3 Test details

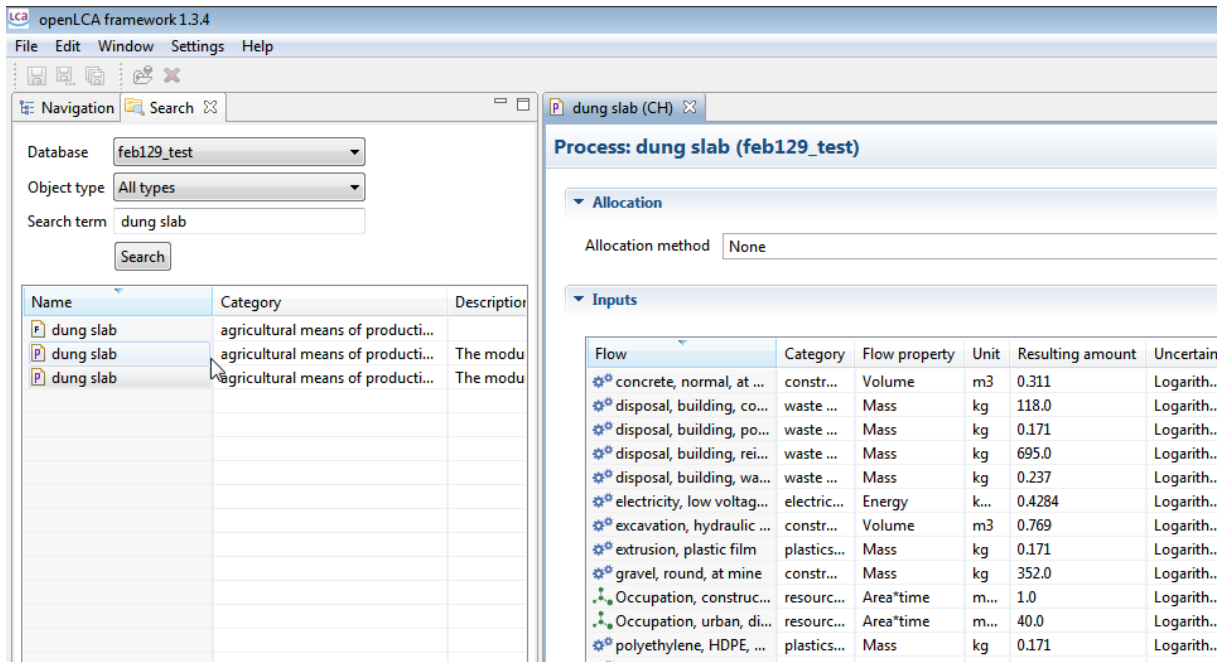
3.1 openLCA 1.3.4

3.1.1 Creating a product system

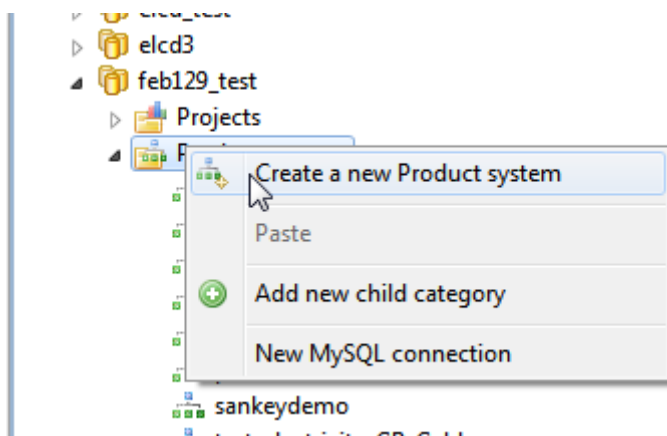
For openLCA 1.3.4, a database is selected, ...



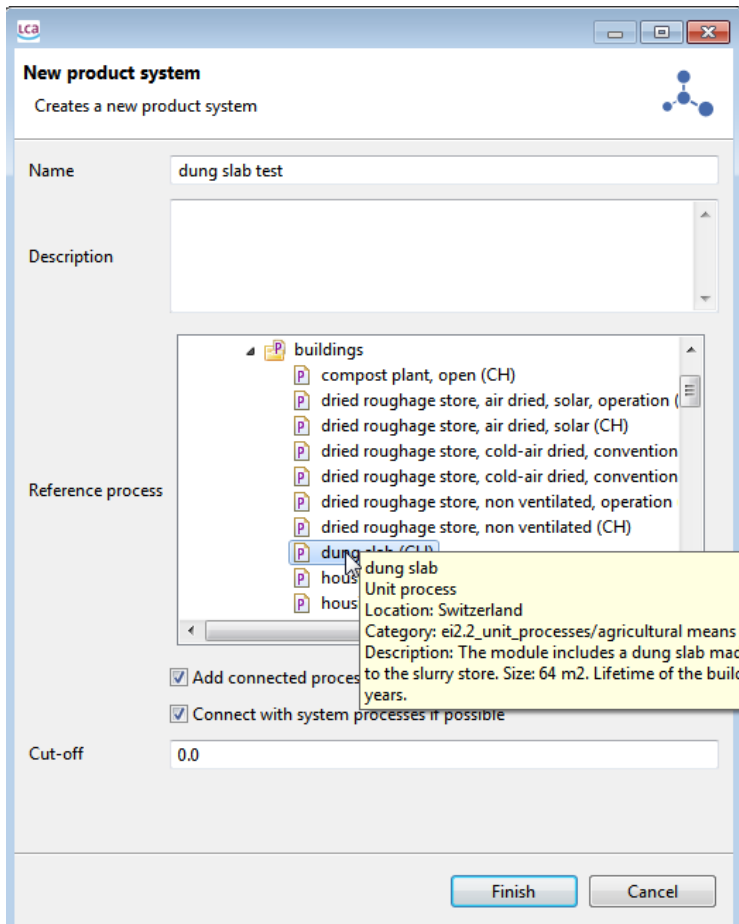
... in the database, the unit process is chosen (here from the search window), it is opened for inspection,



... then, a product system is created, with a right-click on the 'product system' category in the category tree (and in the respective database)



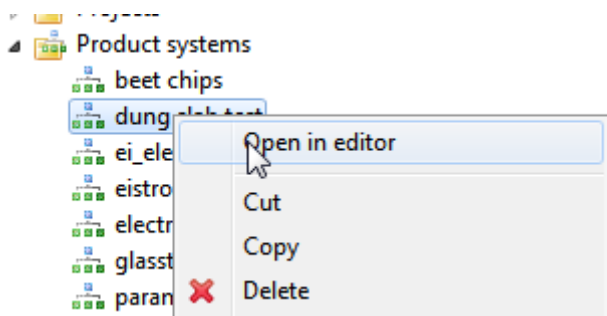
For the product system, the reference process needs to be selected...



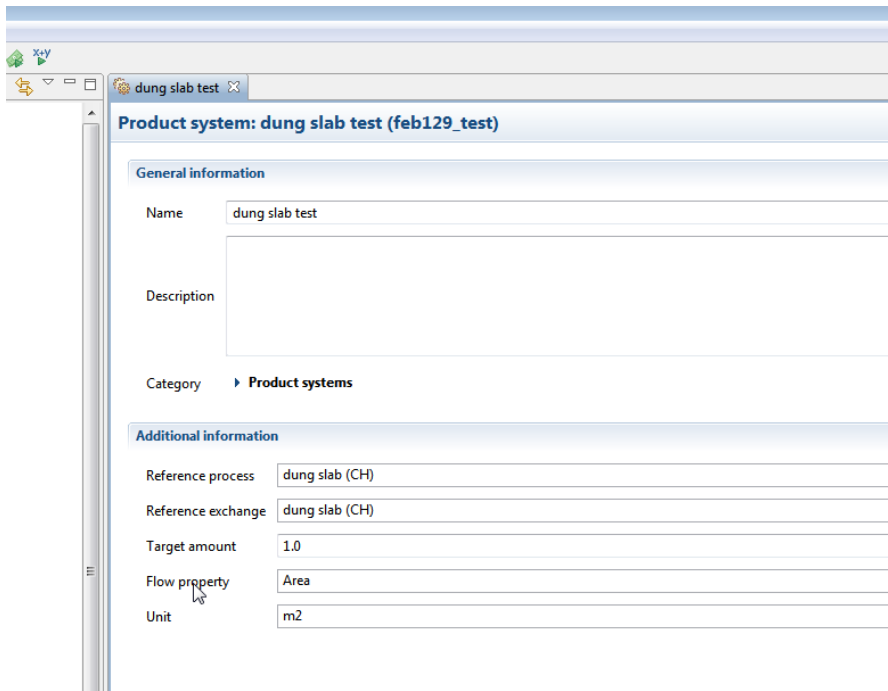
Clicking on finish creates the product system, as a life cycle model of all the connected processes, and opens it also. This takes 19.14s altogether, from clicking on the finish button until the product system is open.

3.1.2 Opening a product system

Opening an already created product system is done with a right-click in the category tree on the product system.



Required time is 12.89s.

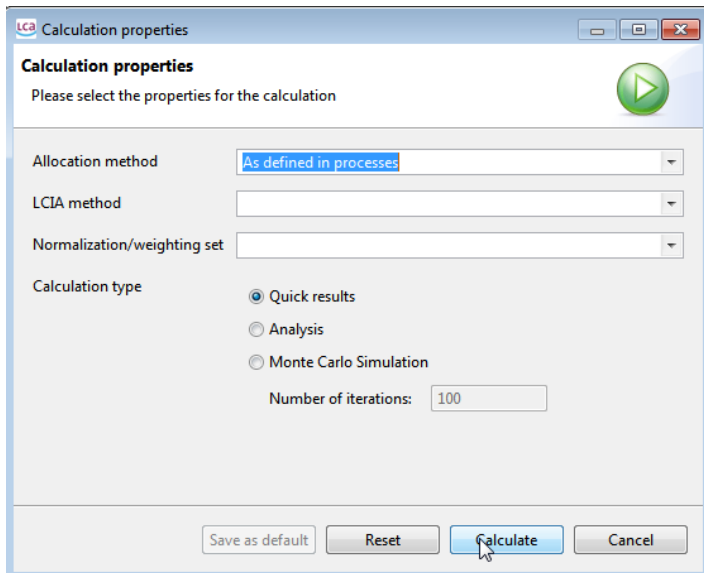


3.1.3 Calculation, ecoinvent 2.2

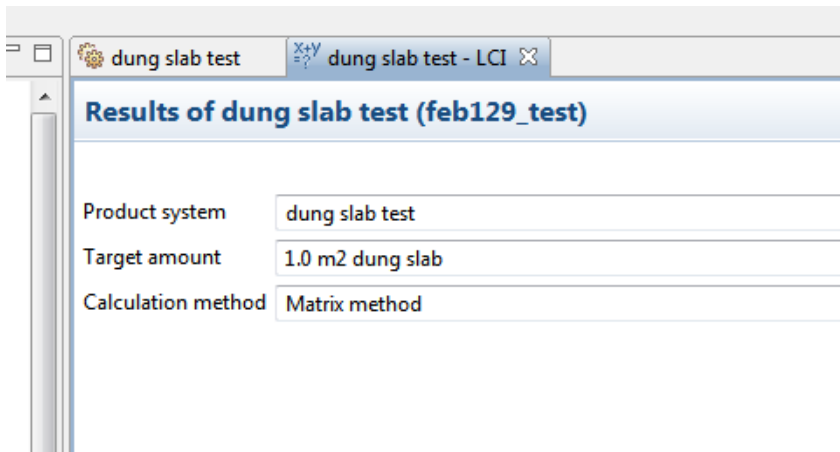
As explained in the introduction, there are two main options available in openLCA for calculating life cycles, a quick calculation and the analysis. Quick calculation only calculates the inventory (and impact assessment category results if an LCIA method is selected). The analysis provides in-depth contribution tables in addition and is comparable to the network calculation in SimaPro. For openLCA, both quick calculation and analysis are conducted.

For openLCA 1.3.4, only the ecoinvent 2.2 database is available.

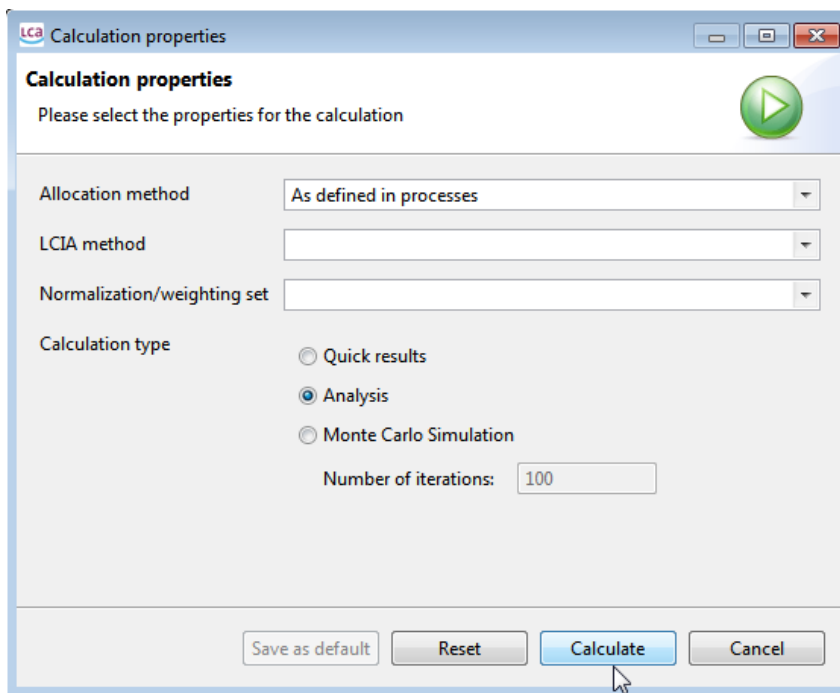
The quick calculation of said product system...

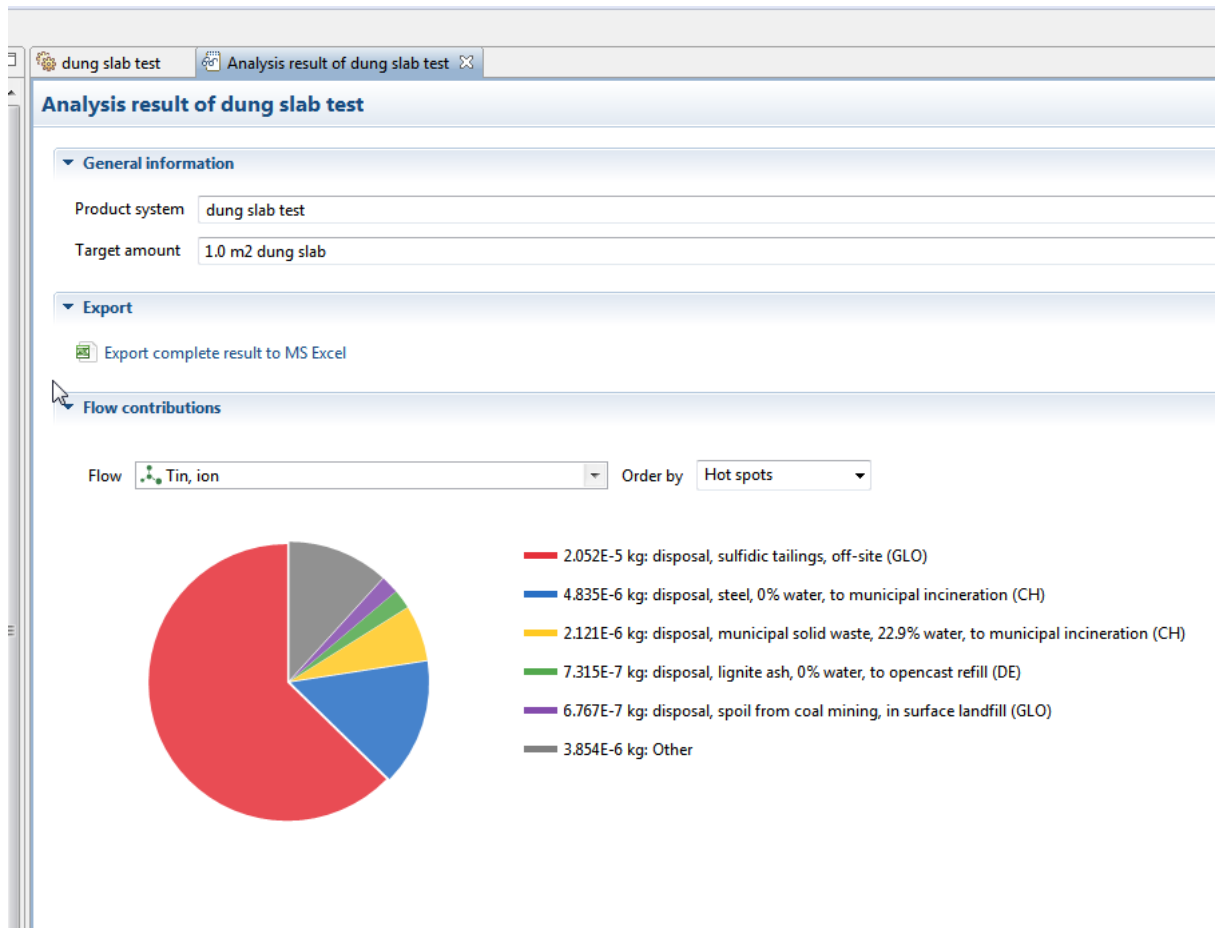


..takes 3.1 seconds..



..while the analysis...





... takes 17.30s.

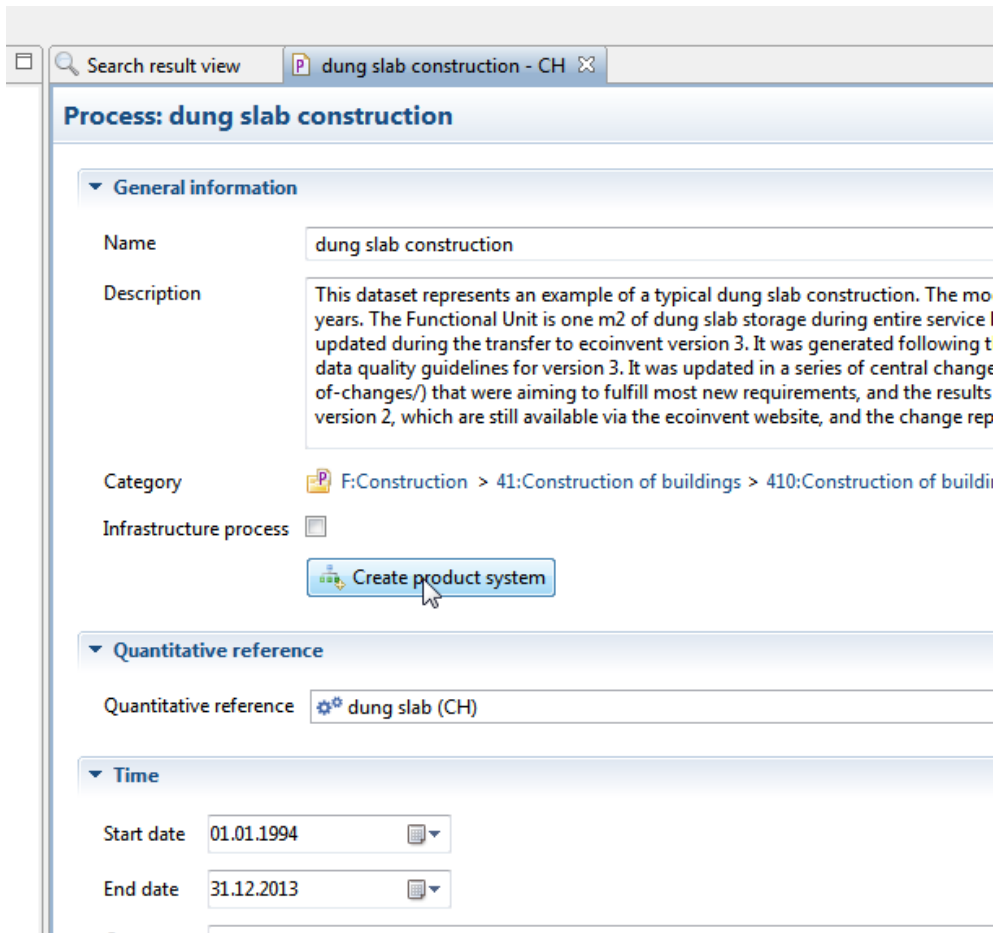
3.2 openLCA 1.4 beta 1

For openLCA 1.4, the tests are performed for ecoinvent 2 and 3 separately.

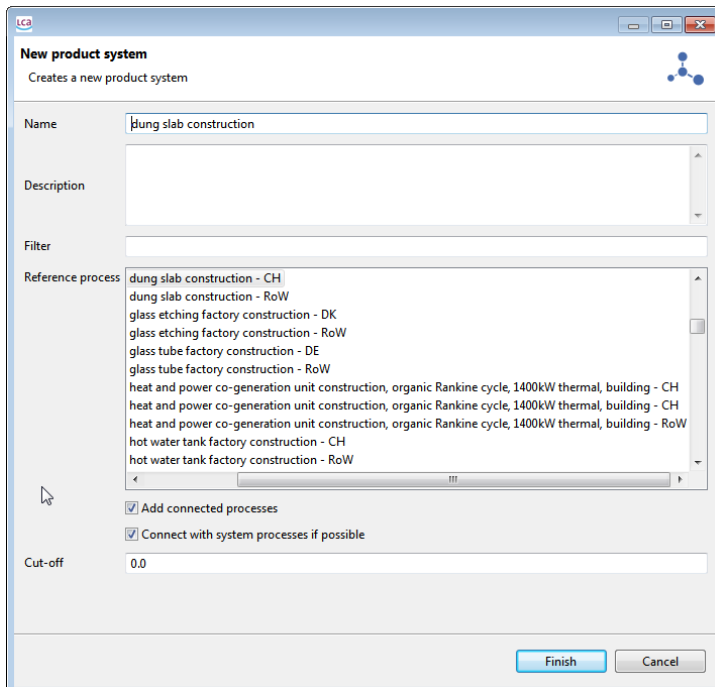
3.2.1 Ecoinvent 3.0.1

3.2.1.1 Creating a product system

In openLCA 1.4 beta 1, a product system can be created directly from the process..



... or as before, with a right-click on the category tree



Creating the product system takes 17.25s

Search result view | dung slab construction - CH | dung slab construction

Product system: dung slab construction

General information

Name: dung slab construction

Description:

Calculate

Reference

Process: dung slab construction

Product: dung slab (CH)

Flow property: Area

Unit: m2

Target amount: 1.0

General information | Parameters | Model graph

Search result view | dung slab construction - CH | dung slab construction

Outline

Filter by name

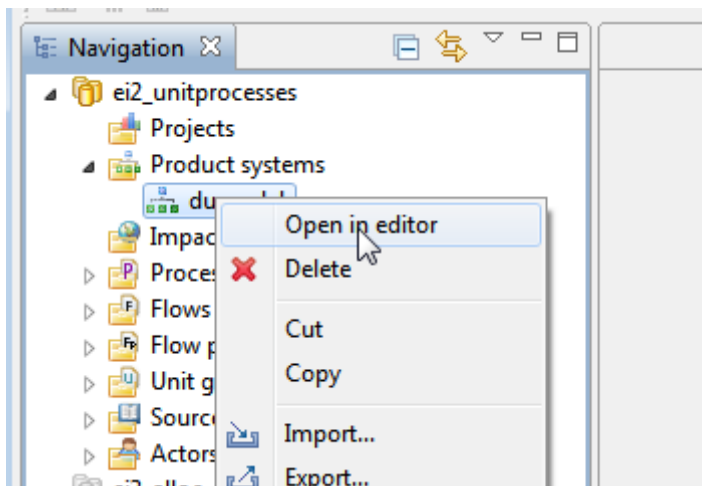
- 1,1-difluoroethane producti
- 1,1-difluoroethane producti
- 1,1-dimethylcyclopentane to
- 1,1-dimethylcyclopentane to
- 1-propanol production - Ro'
- 1-propanol production - REI
- 2,3-dimethylbutan to generi
- 2,3-dimethylbutan to generi
- 2-butanol production by hy
- 2-butanol production by hy
- 2-butanol production by hy
- 2-butanol production by hy
- 2-methyl-2-butanol product
- 2-methyl-2-butanol product
- 2-methylpentane to generic
- 2-methylpentane to generic
- [sulfonyl]urea-compound p
- [sulfonyl]urea-compound p
- [thio]carbamate-compound
- [thio]carbamate-compound
- acetaldehyde oxidation - Ro'
- acetaldehyde oxidation - REI
- acetaldehyde oxidation - REI
- acetaldehyde production - F
- acetaldehyde production - F
- acetamide-anilide-compou

market for wastewater, fr...
 tap water production an...
 market for tap water, at u...
 market for photovoltaic f...
 electricity production, ph...
 heat and power co-gener...
 treatment of biogas, bur...
 electricity production, ph...
 electricity production, ph...
 electricity production, ph...
 electricity production, ph...
 electricity production, ph...
 treatment of biogas, bur...
 electricity production, ph...
 electricity production, ph...

General information | Parameters | Model graph

Properties

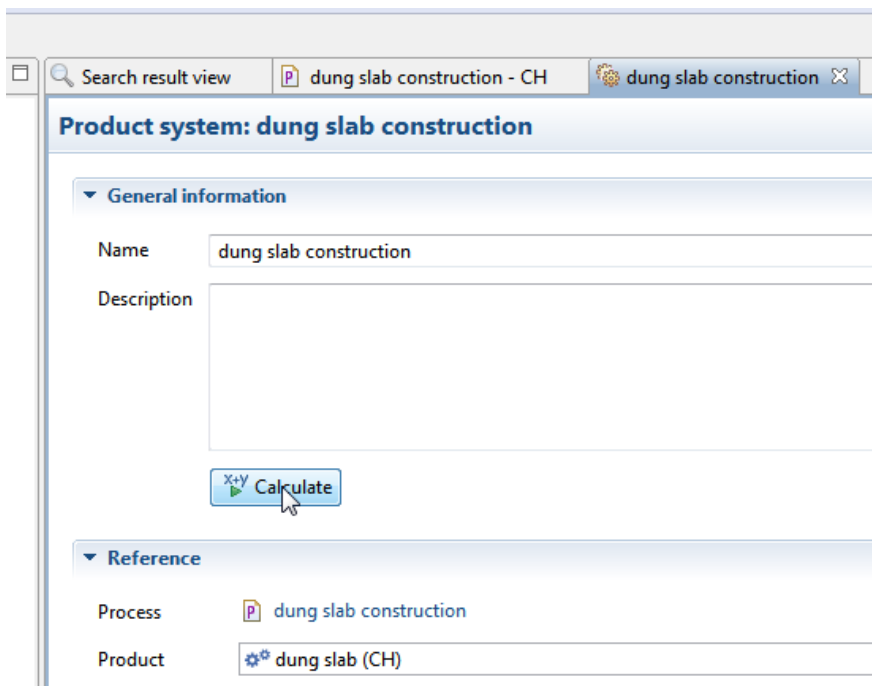
3.2.1.2 Opening a product system

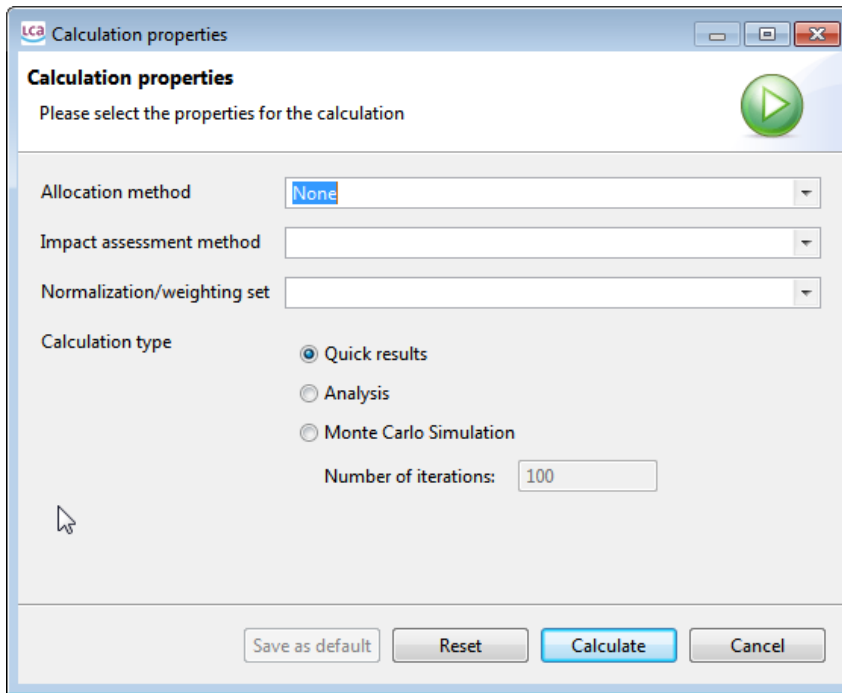


..takes 2.89s

3.2.1.3 Quick calculation

A quick calculation of the product system (only inventory)..





...takes now 18.2 s.

Search result view | dung slab construction - CH | dung slab construction | Quick results

Inventory results

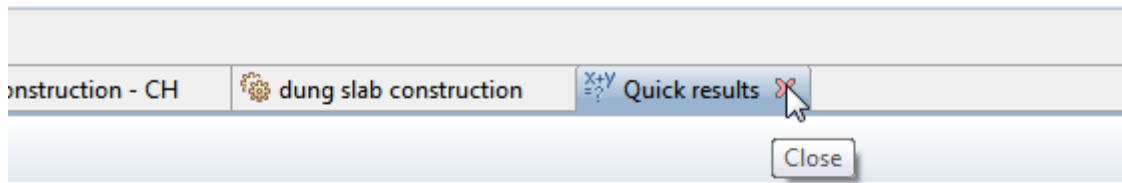
▼ Inputs

Flow	Category	Sub-category	Unit	Amount
Aluminium	resource	in ground	kg	0.07338
Aluminium, 24% in bauxite, 11% in crude ore, in ground	resource	in ground	kg	1.32240E-5
Anhydrite, in ground	resource	in ground	kg	1.66050E-6
Argon-40	resource	in air	kg	0.01428
Barite, 15% in crude ore, in ground	resource	in ground	kg	0.03977
Basalt, in ground	resource	in ground	kg	0.02318
Borax, in ground	resource	in ground	kg	2.04655E-5
Bromine, 0.0023% in water	resource	in water	kg	3.75696E-6

▼ Outputs

Flow	Category	Sub-category	Unit	Amount
1,4-Butanediol	water	surface water	kg	1.70254E-8
1,4-Butanediol	air	high population density	kg	4.25635E-8
1-Pentanol	water	surface water	kg	4.48848E-10
1-Pentanol	air	high population density	kg	1.87018E-10
1-Pentene	water	surface water	kg	3.39188E-10
1-Pentene	air	high population density	kg	7.85525E-10
2,4-D	air	low population density	kg	4.75063E-9
2,4-D	soil	agricultural	kg	8.77214E-7

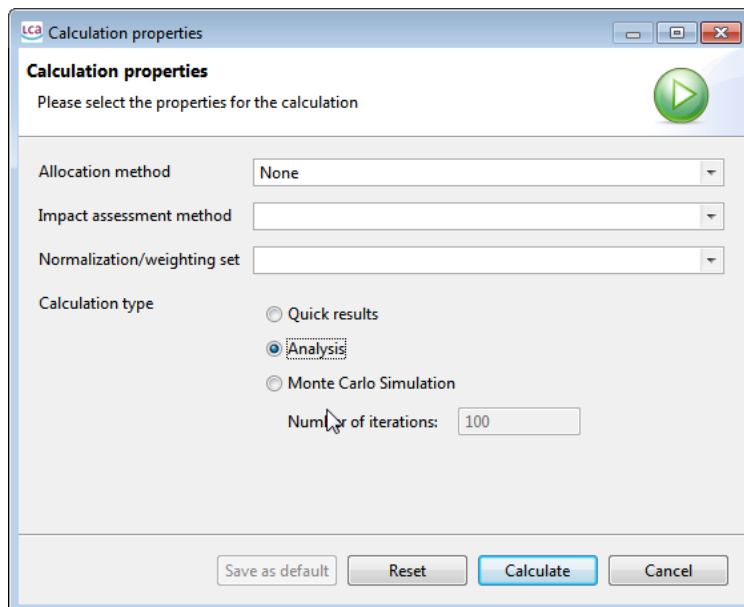
Inventory results

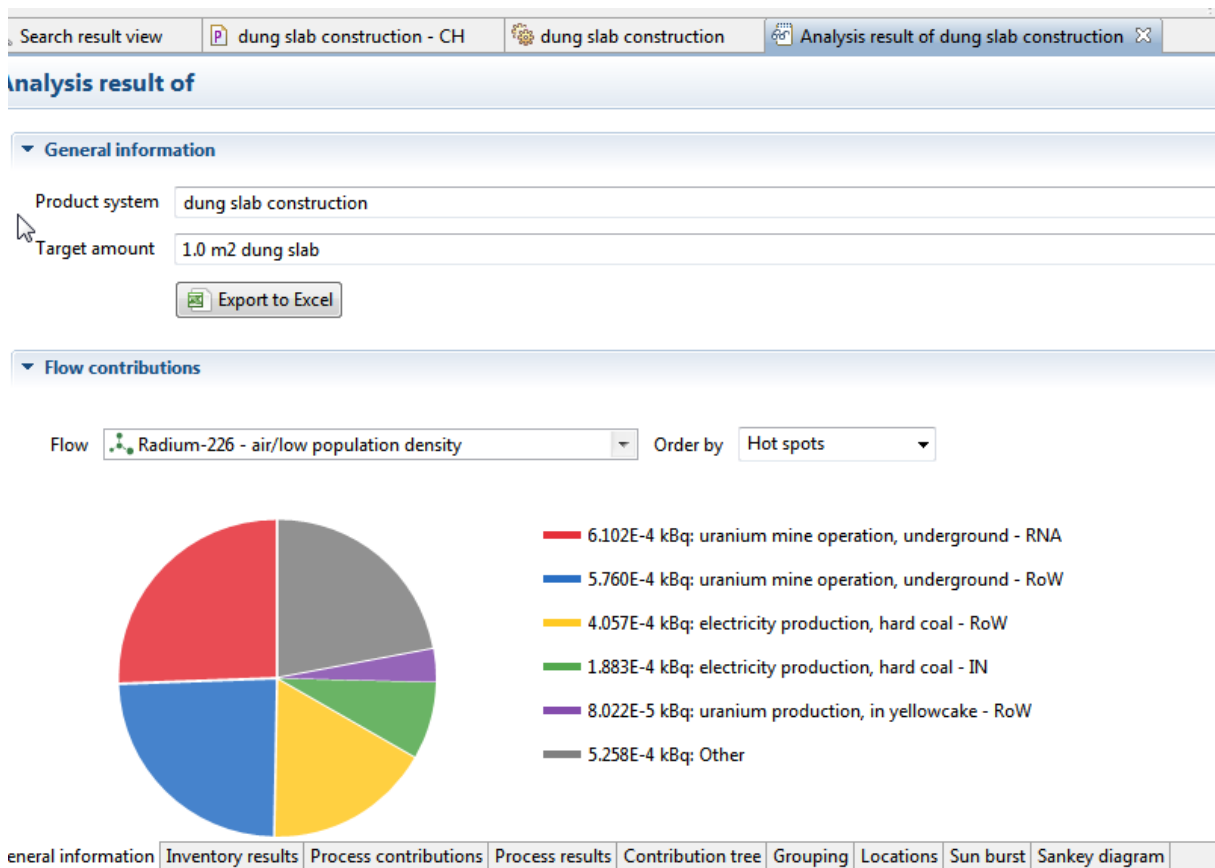


	Category	Sub-category
	resource	in ground
crude ore, in ground	resource	in ground
	resource	in ground
	resource	in air
	resource	in ground
	resource	in ground

3.2.1.4 Analysis

An analysis of the same product system takes 94.48s.

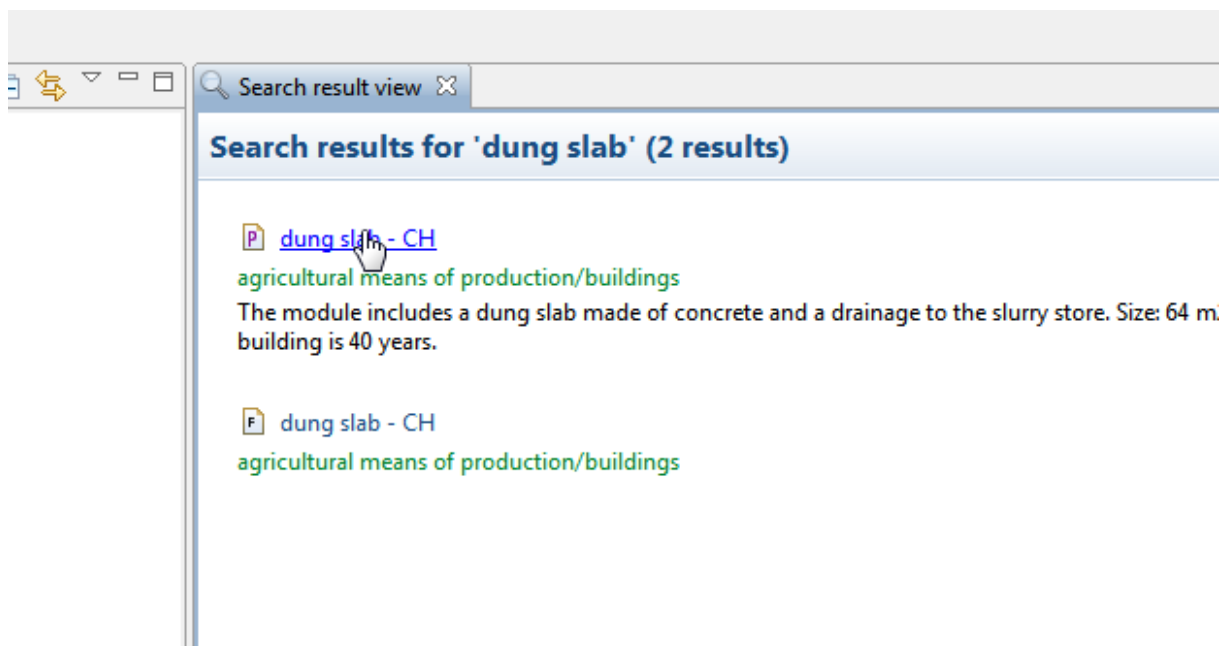




3.2.2 Ecoinvent 2.2

3.2.2.1 Creating a product system

For ecoinvent 2.2, creating the product system...



Search result view P dung slab - CH

Process: dung slab

General information

Name: dung slab

Description: The module includes a dung slab made of concrete and a drainage to the slurry store.

Category: agricultural means of production > buildings

Infrastructure process:

[Create product system](#)

Quantitative reference

Quantitative reference: [dung slab \(CH\)](#)

LCA

New product system

Creates a new product system

Name: dung slab

Description:

Filter:

Reference process:

- dung slab - CH
- housing system with fully-slatted floor, pig, operation - CH
- housing system with fully-slatted floor, pig - CH
- label housing system, pig, operation - CH
- label housing system, pig - CH
- loose housing system, cattle, operation - CH
- loose housing system, cattle - CH
- milking parlour - CH
- shed - CH
- slurry store and processing, operation - CH
- slurry store and processing - CH

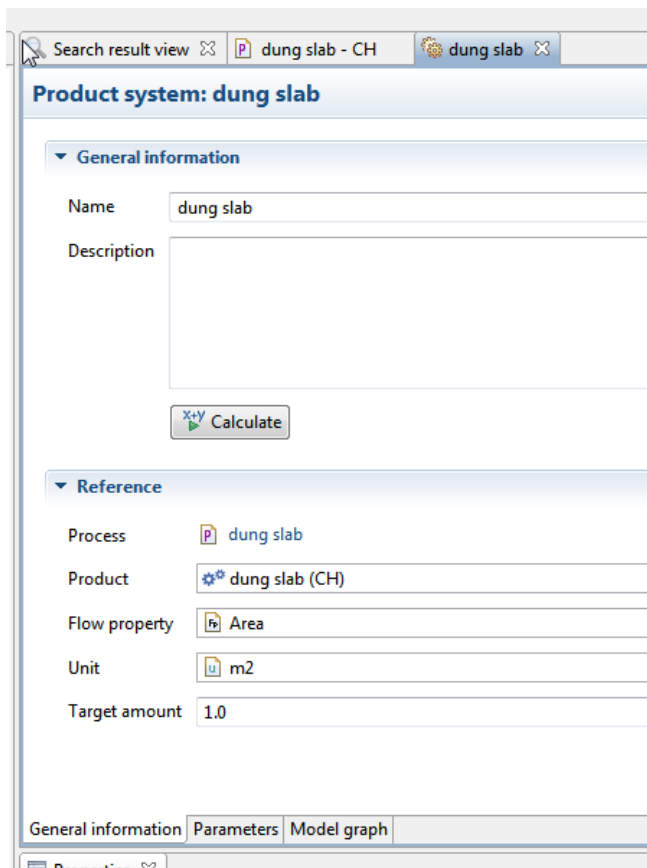
Add connected processes

Connect with system processes if possible

Cut-off: 0.0

[Finish](#) [Cancel](#)

...takes 5.2 s.



3.2.2.2 Quick calculation

A quick calculation is really quick and requires 0.87s only.

Inventory results

Inputs

Flow	Category	Sub-category	Unit	Amount
Aluminium, 24% in bauxite, 11% in crude ore, in ground	resource	in ground	kg	0.03854
Anhydrite, in ground	resource	in ground	kg	1.27919E-6
Barite, 15% in crude ore, in ground	resource	in ground	kg	0.04931
Basalt, in ground	resource	in ground	kg	0.01532
Borax, in ground	resource	in ground	kg	8.49671E-7
Bromine, 0.0023% in water	resource	in water	kg	8.50824E-8
Cadmium, 0.30% in sulfide, Cd 0.18%, Pb, Zn, Ag, In, in ground	resource	in ground	kg	3.50105E-5
Calcium carbonate, in ground	resource	in ground	kg	112.32325

Outputs

Flow	Category	Sub-category	Unit	Amount
1,4-Butanediol	water	river	kg	3.91791E-11
1,4-Butanediol	air	high population density	kg	9.79471E-11
1-Pentanol	water	river	kg	1.47436E-11
1-Pentanol	air	high population density	kg	6.14314E-12
1-Pentene	air	high population density	kg	4.64225E-12
1-Pentene	water	river	kg	1.11414E-11
2,4-D	soil	agricultural	kg	8.29819E-9
2-Aminopropanol	water	river	kg	2.62582E-12

Inventory results

3.2.2.3 Analysis

Also the analysis is quite fast and requires 4.32s.

3.3 SimaPro 7.3.3 MU Developer

For SimaPro 7.3, only ecoinvent 2.2 is used, ecoinvent 3 is not available. The same ecoinvent process is selected as before for openLCA...

Known outputs to technosphere. Products and co-products

Name	Amount	Unit	Quantity	Allocation %
Dung slab/CH/I U	1	m2	Area	100 %

Known outputs to technosphere. Avoided products

Name	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
------	--------	------	--------------	-----------------	-----	---------

Known inputs from nature (resources)

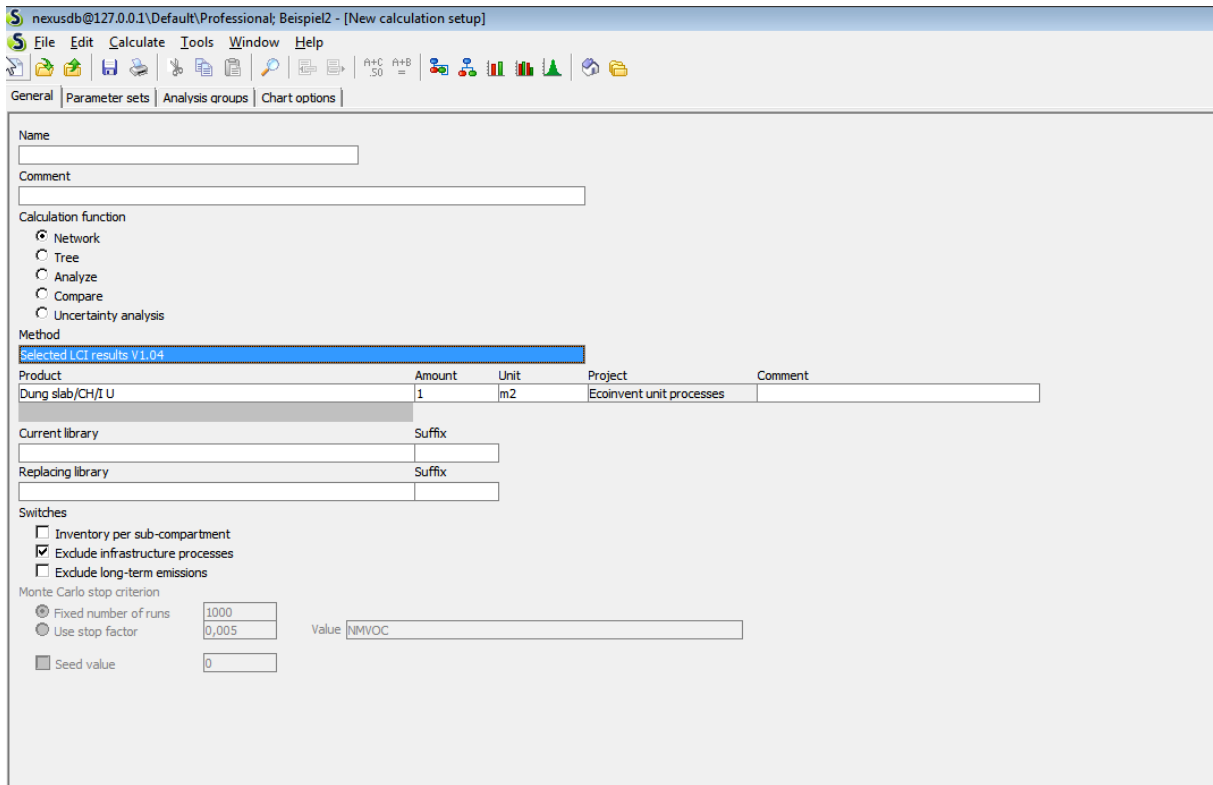
Name	Sub-compartment	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
Occupation, urban, discontinuously built	land	40	m2a	Lognormal	1,5		
Transformation, from pasture and meadow	land	1	m2	Lognormal	2		
Transformation, to urban, discontinuously built	land	1	m2	Lognormal	2		
Occupation, construction site	land	1	m2a	Lognormal	1,5		

Known inputs from technosphere (materials/fuels)

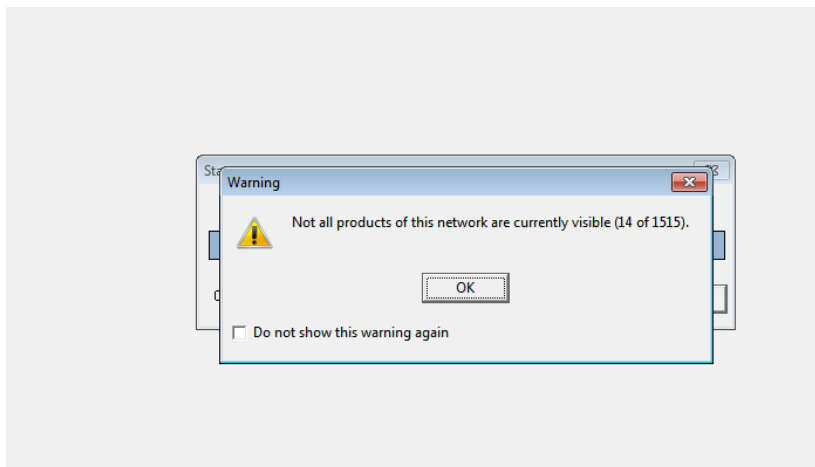
Name	Amount	Unit	Distribution	SD^2 or 2*SDMin
Reinforcing steel, at plant/RER U	10,80000000000000025	kg	Lognormal	1,05
Excavation, hydraulic digger/RER U	0,769	m3	Lognormal	1,05
Poor concrete, at plant/CH U	0,0537	m3	Lognormal	1,05

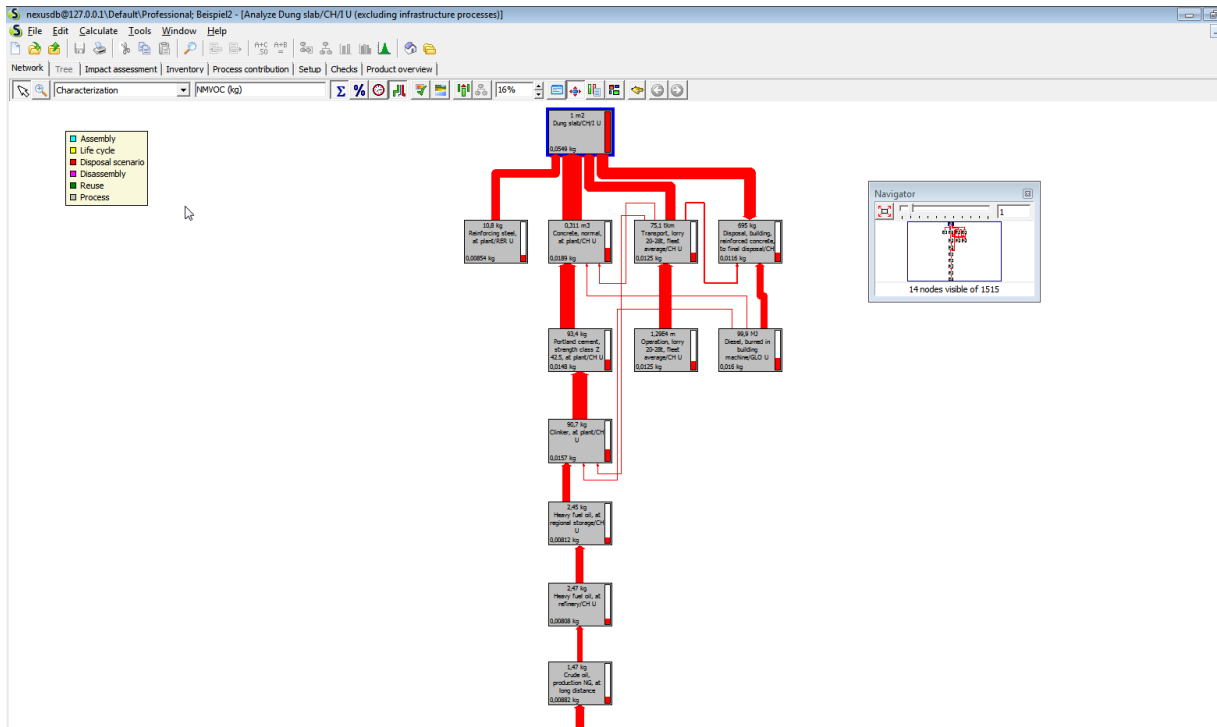
Products

..since it is not possible in SimaPro to have no LCIA method, 'selected LCI results' is taken.



Time required for calculating the network is 12.55 seconds.





3.4 SimaPro 8.0.0 MU Developer

3.4.1 Ecoinvent 2.2

As explained above, the same process is selected, in the ecoinvent unit process library. A network is calculated.

General | Parameter sets | Analyze groups | Chart options

Name: _____

Comment: _____

Calculation function:
 Network
 Tree
 Analyze
 Compare
 Uncertainty analysis

Method: Selected LCI results V1.04

Product	Amount	Unit	Project	Comment
Dung slab/CH/T U	1	m2	Ecoinvent unit processes	

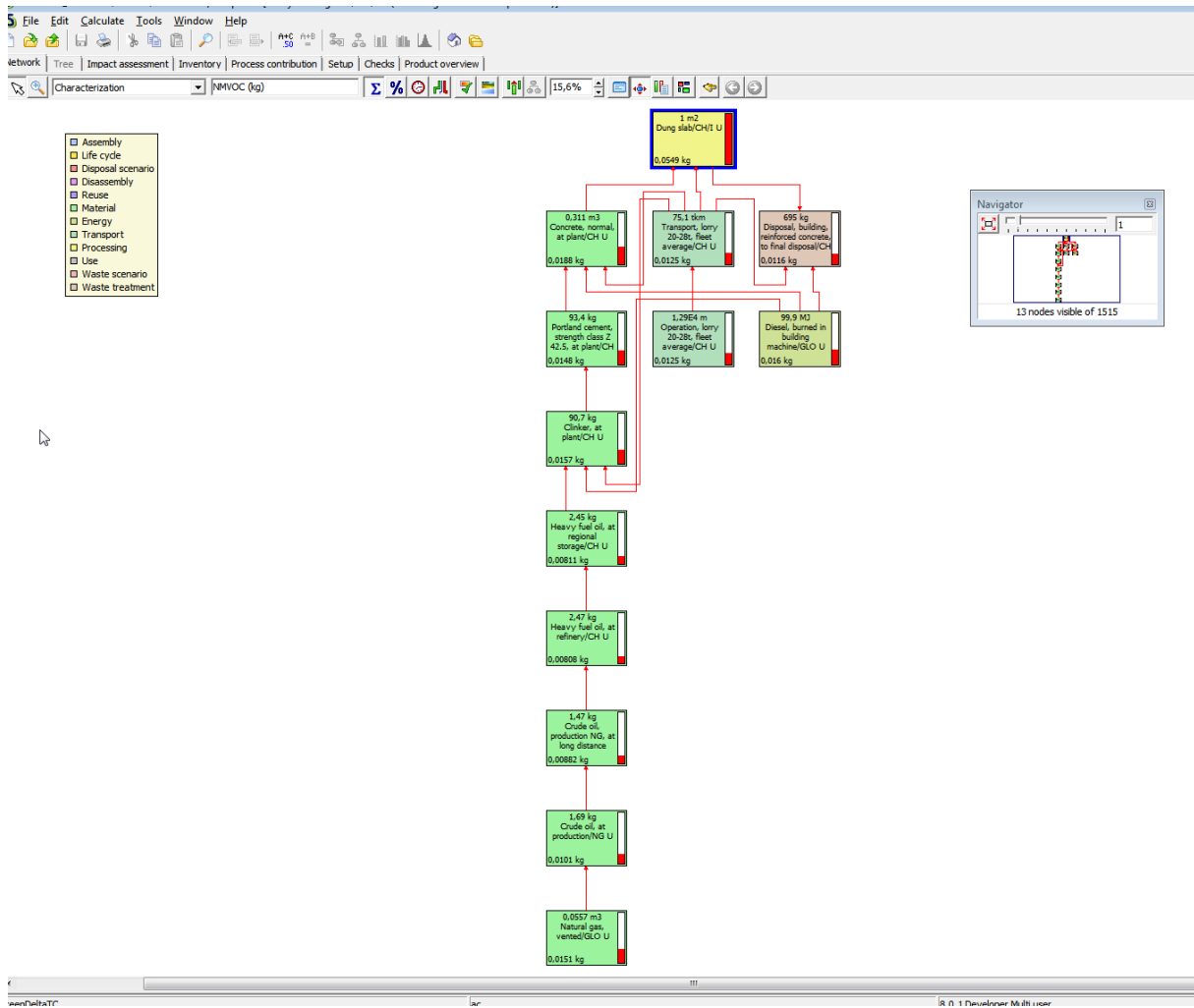
Current library: Suffix: _____

Replacing library: Suffix: _____

Switches:
 Inventory per sub-compartment
 Exclude infrastructure processes
 Exclude long-term emissions

Monte Carlo stop criterion:
 Fixed number of runs: 1000
 Use stop factor: 0,005 Value: [Characterized result (@IMVOC)]
 Seed value: 0

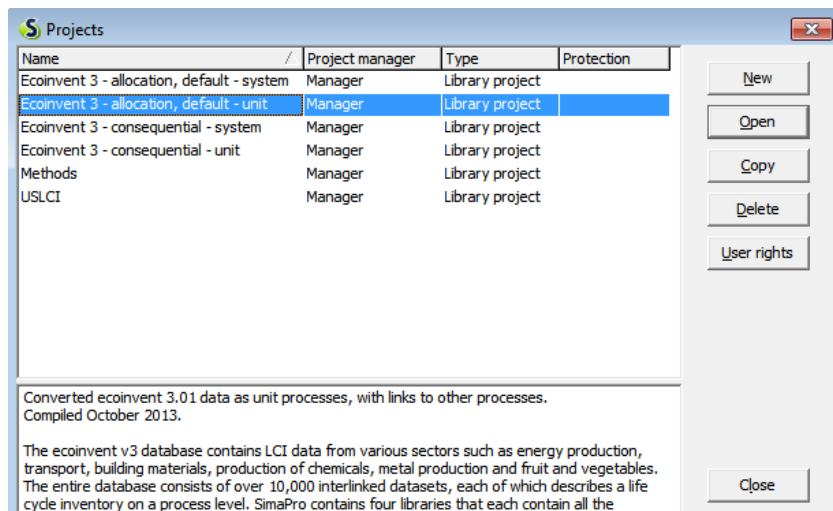
GreenDeltaTC | ac | 8.0.1 Developer Multi user



Required time is 11.8s

3.4.2 Ecoinvent 3.0.1

For ecoinvent 3, the calculation is performed using the ecoinvent unit process default allocation library;



the “dung slab” process is selected again..

Name	Type	Category	Project
Dung slab {CH} construction Alloc Def, S	Processing	Agricultural\Transform... \Infrastructure	Ecoinvent 3 - allocat
Dung slab {CH} construction Alloc Def, U	Processing	Agricultural\Transform... \Infrastructure	Ecoinvent 3 - alloca
Dung slab {CH} construction Conseq, S	Processing	Agricultural\Transform... \Infrastructure	Ecoinvent 3 - conse
Dung slab {CH} construction Conseq, U	Processing	Agricultural\Transform... \Infrastructure	Ecoinvent 3 - conse

Edit processing process: 'Dung slab {CH} | construction | Alloc Def, U'

Documentation | Input/output | Parameters | System description

Products

Known outputs to technosphere. Products and co-products

Name	Amount	Unit	Quantity	Allocation %	Category
Dung slab {CH} construction Alloc Def, U	1,0	m2	Area	100 %	Agricultural\... \Infractu...
(Insert line here)					

Known outputs to technosphere. Avoided products

Name	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
(Insert line here)						

Inputs

Known inputs from nature (resources)

Name	Sub-compartment	Amount	Unit	Distribution	SD^2 or 2*SDMin	Max	Comment
Transformation, from pasture and meadow	land	1	m2	Lognormal	2,0459		(1,2,4,1,1,na) Modelled, based on "Agricultural Buildings" - pdf-document on the dedicated talk page of ecoinvent (www.ecoinvent.org/talk-pages)
Transformation, to urban, discontinuously built	land	1	m2	Lognormal	2,0459		(1,2,4,1,1,na) Modelled, based on "Agricultural Buildings" - pdf-document on the dedicated talk page of ecoinvent (www.ecoinvent.org/talk-pages)
Occupation, urban, discontinuously built	land	40	m2a	Lognormal	1,5506		(1,2,4,1,1,na) Modelled, based on "Agricultural Buildings" - pdf-document on the dedicated talk page of ecoinvent (www.ecoinvent.org/talk-pages)
Occupation, construction site	land	1	m2a	Lognormal	1,5506		(1,2,4,1,1,na) Modelled, based on "Agricultural Buildings" - pdf-document on the dedicated talk page of ecoinvent (www.ecoinvent.org/talk-pages)
(Insert line here)							

..and a network is calculated without inventory...

New calculation setup

General | Parameter sets | Analysis groups | Chart options

Name

Comment

Calculation function

Network
 Tree
 Analyze
 Compare
 Uncertainty analysis

Method

Product	Amount	Unit	Project	Comment
Dung slab {CH} construction Alloc Def, U	1	m2	Ecoinvent 3 - allocation, defau	

Current library Suffix

Replacing library Suffix

Switches

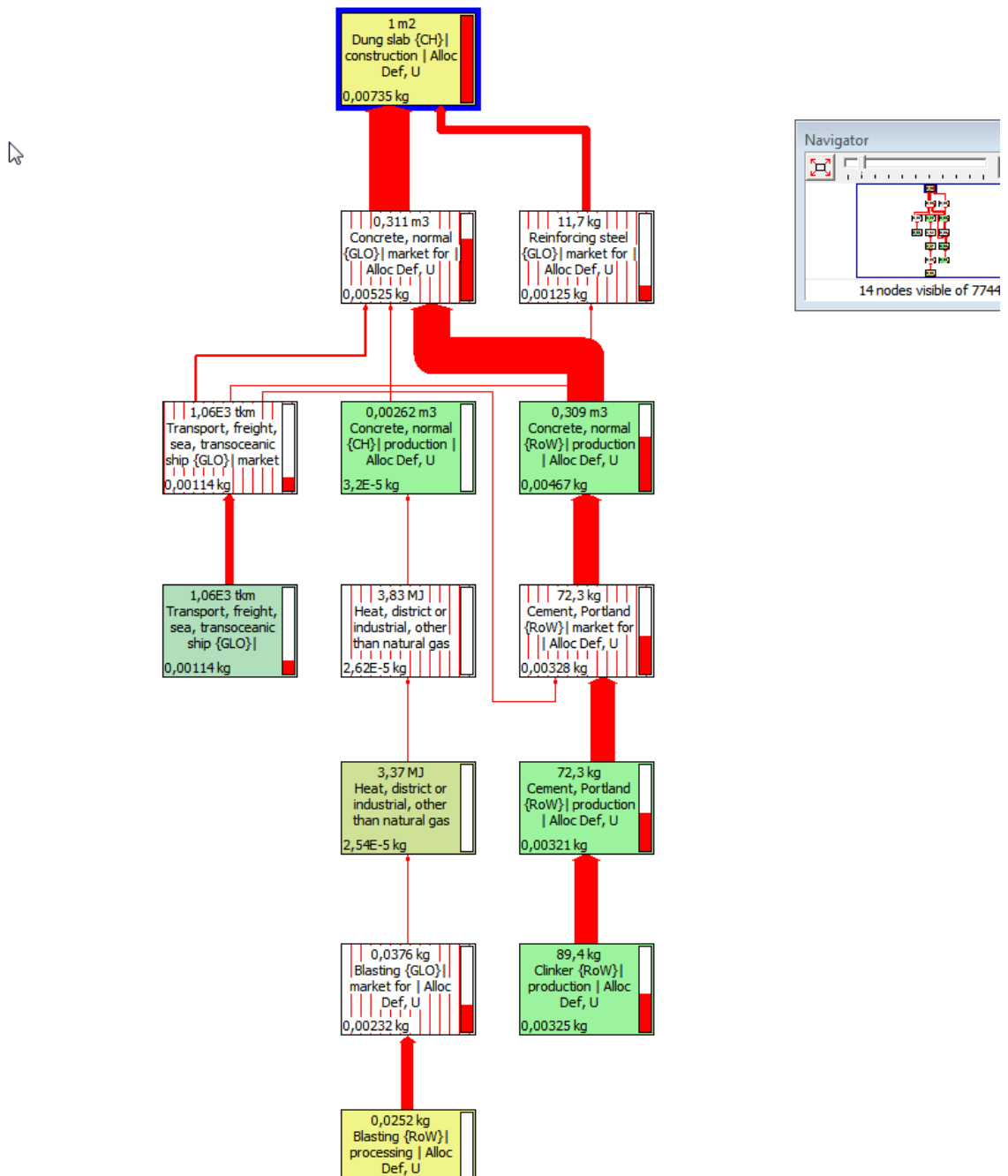
Inventory per sub-compartment
 Exclude infrastructure processes
 Exclude long-term emissions

Monte Carlo stop criterion

Fixed number of runs 1000
 Use stop factor 0,005 Value Inventory result (Raw/(unspecified)/Biomass)
 Seed value 0

Help Calculate Close

..which takes 101.27s



4 Test summary

4.1 Required time

The table below summarises the required seconds for each of the steps described above.

duration [seconds]	ecoinvent	openLCA 1.3.4	openLCA 1.4 beta 1	SimaPro 7.3.3	SimaPro 8.0.0
1 Creating a product system	2.2	19.14	5.20		
	3.0.1		17.25		
2 Opening an existing product system	2.2	12.89	2.89		
	3.0.1		3.52		
3 Calculating a product system, quick calculation	2.2	3.10	0.87		
	3.0.1		18.2		
4 Calculating a product system, analysis	2.2	17.30	4.32	12.55	11.80
	3.0.1		94.48		101.27

The results show that

- performance has drastically improved for the openLCA 1.4 version (compare 1, creating a product system for ecoinvent 2, which is now almost 4 times faster ($19.14/5.2=3.67$))
- ecoinvent 3 puts rather high demands on the software, the (basically) same product now is linked to 7.500 processes, and creating its product system takes more than three times longer than in ecoinvent 2 (for action 1, $17.25/5.2=3.36$); calculating the analysis takes even 8.5 to 20 times longer (SimaPro, openLCA)
- for SimaPro, actions 1, 2, and 3 are not available separately but are always performed 'in one go' when calculating a network
- the SimaPro network calculation, which is more or less comparable to the openLCA analysis (although in openLCA, some additional charts are prepared, but both in the analysis and in the network calculation, in depth contribution analyses and a sankey diagram is presented), needs about the same time as the analysis in openLCA; openLCA is even a bit faster, but only by about 7% (action 4, $101.27/94.48$), and the product system needs to be opened in openLCA first which takes some (3.5) additional seconds.

4.2 Calculated figures

The calculated inventory figures are almost fully identical for one database system (ecoinvent version) across the different LCA software systems, the largest difference was obtained for Krypton, resource in air, in ecoinvent 3, with a ratio of 1.02 for the openLCA analysis value vs the SimaPro value. The screenshot below shows some examples. Some flows have changed between ecoinvent 2 and 3, and also some categories do not match between ecoinvent and the SimaPro implementation; for example, the ecoinvent category 'water/ surface water' does not correspond to the SimaPro categories 'river' and 'ocean' together but only to river.

dung slab construction CH							quick / analysis	SP/openLCA quick calculation
olca1.4	ei3	analysis	cc6a1abb- Carbon dioxide, resource	in air	kg	1,802608		
olca1.4	ei3	analysis	4602b501- Krypton, in air resource	in air	kg	7,39E-07		
olca1.4	ei3	analysis	ce88a9b6- Silicon	water	ground water, long-term	kg	0,698927	
olca1.4	ei3	analysis	c407952d- Uranium-238	water	ocean	kBq	0,000141	
olca1.4	ei3	analysis	1653bf60- Potassium, ion	water	surface water	kg	0,003332	
olca1.4	ei3	analysis	37d35fd0- Sulfate	water	surface water	kg	0,028806	
olca1.4	ei2	analysis	cc6a1abb- Carbon dioxide, resource	in air	kg	0,980385		
olca1.4	ei2	analysis	ce88a9b6- Silicon	water	ground water, long-term	kg	0,358592	
olca1.4	ei2	analysis	c407952d- Uranium-238	water	ocean	kBq	0,000381	
olca1.4	ei2	quick calculation	cc6a1abb- Carbon dioxide, resource	in air	kg	0,980385		1
olca1.4	ei2	quick calculation	ce88a9b6- Silicon	water	ground water, long-term	kg	0,358592	1
olca1.4	ei2	quick calculation	c407952d- Uranium-238	water	ocean	kBq	0,000381	1
olca1.4	ei3	quick calculation	cc6a1abb- Carbon dioxide, resource	in air	kg	1,821229		1,010329827
olca1.4	ei3	quick calculation	4602b501- Krypton, in air resource	in air	kg	7,56E-07		1,022807325
olca1.4	ei3	quick calculation	ce88a9b6- Silicon	water	ground water, long-term	kg	0,705703	1,009693896
olca1.4	ei3	quick calculation	c407952d- Uranium-238	water	ocean	kBq	0,000142	1,006652062
olca1.4	ei3	quick calculation	1653bf60- Potassium, ion	water	surface water	kg	0,003344	1,00363688
olca1.4	ei3	quick calculation	37d35fd0- Sulfate	water	surface water	kg	0,029221	1,01437916
SP8.0.0	ei3	analysis	Carbon dioxide, in air	Roh	kg	1,821229		1
SP8.0.0	ei3	analysis	Krypton	Roh	kg	7,56E-07		1
SP8.0.0	ei3	analysis	Silicon	Wasser	groundwater, long-term	kg	7,06E-01	1
SP8.0.0	ei3	analysis	Uranium-238	Wasser	ocean	kBq	0,000142	1
SP8.0.0	ei3	analysis	Potassium	Wasser	river	kg	0,003344	
SP8.0.0	ei3	analysis	Potassium	Wasser	ocean	kg	0,000361	
SP8.0.0	ei3	analysis	Potassium	Wasser	ocean + river	kg	0,003706	1,108077 ? River ->
SP8.0.0	ei3	analysis	Sulfate	Wasser	ocean	kg	0,001971	
SP8.0.0	ei3	analysis	Sulfate	Wasser	river	kg	0,029221	
SP8.0.0	ei3	analysis	Sulfate	Wasser	ocean + river	kg	0,031192	1,067453 ? River ->
SP8.0.1	ei2	analysis	Carbon dioxide, Raw	in air	kg	0,980385		1
SP8.0.1	ei2	analysis	Silicon	Water	groundwater, long-term	kg	0,358592	1
SP8.0.1	ei2	analysis	Uranium-238	Water	ocean	kBq	0,000381	1